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HANDOUTS

PUBLIC FINANCE

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It is a useful tool for studying the subject, but it does not guarantee preparation that is as exhaustive and complete for passing the exam as the material recommended by the University.

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Public Finance

Comprehensive Guide for the Exam

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Disclaimer: the Public Finance exams are rather similar to Microeconomics (Economics Module 1) in types of questions asked but are multiple choice. Remember to revise the old exercise book and pay attention to all graph building. Political economy graphs are *not* included in this repository, but all intuition to build them is here.

Special Thanks to Rishabh Rupani <3.

Introduction

Public economics is study of the government's role in the economy. Governments intervene through policy mandates in the economy constantly and they do so to protect national interests. However, in the study of this course, we focus on the following:

- **When** should a government intervene in the economy?
- **What** are the interventions governments can make and their effects?
- **Why** do governments intervene the way they do?

Governments usually intervene to prevent or correct **market failures** or to address **redistribution issues**. The former are primarily generated by externalities, imperfect competition reaching criticality, asymmetry of information (moral hazard, adverse selection and similar) or individual failures (moral or material). Measles outbreaks and vaccine mandates are an example of **government policy intended to limit an externality**.

Even in case of perfectly functioning markets, outcomes might be too unequal to maintain social peace, hence the **government intervenes to impose redistribution policies**. This has to be modulated because immediate redistribution benefits might be hampered by reduction of incentives to work, capital flight and similar (*equity-efficiency trade-offs*). For instance, for years there has been an increase in inequality with the stagnation of income growth for the bottom 50% of the population. This is largely mitigated by taxation (Piketty et al., check slides).

Interventions tend to have two types of effects:

- **Direct effects** are immediately measurable and assume nobody changes behavior the moment a specific policy is implemented (easy to compute, less useful for in-depth economic analysis).
- **Indirect effects** are those *unintended effects* that spring by the change in behavior of people following a policy implementation.

For example, if you tax foreigners that make patents in your country, you might find that such patentholders just emigrate abroad or relocate to multinational corporations to protect the profitability of their patents. CBO scores are a real-life example of economic analysis-based scoring systems for public budget policy proposals.

Governments do what they do in accordance with **public economy principles**, affecting all society through even narrow policies. There is also the vested interest in reducing the amounts of **government failures to act in society's benefit**. In general, as students we distinguish between:

- **Normative Public Economics**, which focuses on how things should be.
- **Positive Public Economics** which focuses on how things are through analysis.

We focus on the latter as it has clear empirical and practical results. The former is for the economist to explore in accordance with their own morality.

Recent Trends

Some terminology first, straight out of Macro101:

- If government's revenues exceed the budget, there is a **surplus**, otherwise there is a **deficit**.
- Each dollar of a deficit adds up to the **government's debt**.
- The debt is financed through **borrowing from nationals or foreigners** (individuals and institutions).

In general, the following trends have been reported in the OECD countries:

- Advanced economies have **very large governments** compared to less developed ones (up to 50% of GDP).
- Government sizes **stabilized starting in the 1980s** in the OECD.
- **Welfare states** are the main drivers of government expansion in public affairs.
- Countries tend to spend more than their revenues, **especially in times of crisis**.

Regulatory agencies are at the current forefront of governmental efforts to control and influence economic actors, and discussions are being held on the role of big data and big tech corporations.

Theoretical Tools

These are the tools necessary to understand the dynamics of economic decision making: they are narrow and fairly useful for consumption behavior, less so in more complex social settings.

Utility and Indifference

A utility function is a **function that translates consumption into utility**, an arbitrary concept key to optimization:

$$U = u(\text{Bundle of Goods with Quantities})$$

The locus where all bundles of goods that give the same utility to the same individual is known as **indifference curve** and is indicated as:

$$\overline{U} = u(\text{Bundle of Goods with Quantities})$$

And it holds that:

- Consumers prefer **higher indifference curves**, consuming more is better than consuming less.
- Indifference curves with *goods* are always **downward sloping**.

The additional utility after consuming an additional unit of a good is known as **Marginal Utility**, and it's found by taking the first partial derivative of the utility function with respect to the good we're calculating the MU on:

$$u(x_1, x_2) = (x_1 \cdot x_2)^{0.5} \Rightarrow \frac{\partial u(x_1, x_2)}{\partial x_1} = 0.5 \cdot x_2 \cdot (x_1 \cdot x_2)^{-0.5} = \frac{\sqrt{x_2}}{2\sqrt{x_1}}$$

Correlated with marginal utility, the **Marginal Rate of Substitution** is the absolute value of the slope of the indifference curve at any given point, which is equal to the ratio between the MU of goods 1 and 2:

$$U(x_1, x_2) = (x_1 \cdot x_2)^{0.5} \Rightarrow MRS_{1,2} = \frac{x_2}{x_1}$$

Constrained Utility Optimization

Consider the budget constraint as the locus where a **consumer can consume their entire income** on a basket of two goods:

$$p_1 x_1 + p_2 x_2 = y \Rightarrow x_2 = y - \frac{p_1}{p_2} x_1$$

Hence the **slope is the ratio of the two goods prices**. By this, when trying to find the **bundle of goods that maximizes, the utility curve representing this bundle is tangent on the budget constraint in a point such that**:

$$MRS_{1,2} = \frac{p_1}{p_2} = \frac{MU_1}{MU_2}$$

Demonstration: consider the following constrained optimization problem:

$$\max_{x_1, x_2} u(x_1, x_2) \text{ subject to } p_1 x_1 + p_2 x_2 = y$$

Utilize the **Lagrangian optimization method**:

$$\mathcal{L} = u(x_1, x_2) - \lambda(p_1 x_1 + p_2 x_2 - y) \Rightarrow \text{taking FOCs} \Rightarrow$$

$$\begin{cases} \frac{\partial \mathcal{L}}{\partial \lambda} = p_1 x_1 - p_2 x_2 + y = 0 \\ \frac{\partial \mathcal{L}}{\partial x_1} = MU_1 - \lambda p_1 = 0 \\ \frac{\partial \mathcal{L}}{\partial x_2} = MU_2 - \lambda p_2 = 0 \end{cases} \Rightarrow \begin{cases} y = p_1 x_1 + p_2 x_2 \\ \lambda = \frac{MU_1}{p_1} \\ \lambda = \frac{MU_2}{p_2} \end{cases} \Rightarrow \begin{cases} y = p_1 x_1 + p_2 x_2 \\ \frac{MU_1}{MU_2} = \frac{p_1}{p_2} \end{cases}$$

$$\Rightarrow \begin{cases} y = p_1 x_1 + p_2 x_2 \\ MRS_{1,2} = \frac{p_1}{p_2} \end{cases} \quad \text{Q.E.D}$$

Income and Substitution Effects

Post-optimization, two demand functions are generated such that $x_n(p_n, Y)$. How does x_n change with Y and p_n? Those are the so-called:

- **Income effects**, or the effects on the consumption of a given good after a shock to the budget constraint.
- **Substitution effects**, or the effects on the consumption of a good after a shock to its price (for now exogenously assumed).

Those effects vary depending on the good of which one wants to test the effects of:

- **Normal goods** demand responds positively to an expansion in income and negatively to an increase in price.

- **Inferior goods** demand responds negatively to an expansion in income and negatively to an increase in price (unless they are Giffen goods, then an increase in price will be so intensely trumped by the income effect that the consumption of the good will increase).

Mind that those effects are not monodimensional, rather they usually occur in tandem especially after shocks to the prices, which cause **pivots in the budget constraint** (substitution, then income effects).

Aggregate Demand and Elasticity

Each individual has a demand for each good and across all individuals $D(q)$ is the **aggregate demand of the good** such that:

$$v(Q) - p \cdot Q \Rightarrow \text{FOC} \Rightarrow v'(Q) = p \Rightarrow Q = D(p)$$

Where $v(Q)$ is the utility function tied to the consumption of Q. The **surplus obtained by the consumer** is measured as the area below the demand curve and above the horizontal price line: if the first unit consumed produces utility $v(0) = D^{-1}(0)$, hence surplus is $v'(Q) - p = 0$ due to $v'(Q) = p$.

To measure the % change in demand caused by a 1% change in the price of a good we use **elasticity**, which is especially useful as unitless:

$$\varepsilon_D = \frac{\Delta\%Q_D}{\Delta\%p_D} = \frac{\partial D}{\partial p} \cdot \frac{p}{D}$$

Elasticity is a function of price; hence it changes along the demand curve. Moreover, the following applies:

- Elasticity is typically **negative** as consumption falls as price rises.
- Elasticity is typically not constant.
- A vertical demand curve mandates **perfect inelasticity**, or a good that will be consumed at the same rate no matter the price ($\varepsilon_D = 0$).
- A horizontal demand curve mandates **perfect elasticity**, or a good that will be consumed at different rates given the same price ($\varepsilon_D = -\infty$).
- The effect of **one good's prices on another good's demand** is the *cross-price elasticity*, typically nonzero.

Producers and Supply Side

Producers utilize technology to produce goods starting from factors like labor and capital and their narrowest goal is to **maximize profits**:

$$\max_Q [p \cdot Q - c(Q)] \Rightarrow \text{FOC} \Rightarrow c'(Q) = p$$

With $c(Q)$ being a **convex and increasing cost function**. It is hence defined the supply curve $Q = S(p)$, quantity supplied by producers at a given price. Elasticity of supply is given by:

$$\varepsilon_S = \frac{\Delta\%Q_S}{\Delta\%p_S} = \frac{\partial S(p)}{\partial p} \cdot \frac{p}{S(p)}$$

And the **producers' surplus** is the area above the supply function and below the horizontal price line.

Market Equilibrium and Welfare

Market equilibrium is achieved once **supply and demand are matched**:

$$D(p^*) = S(p^*)$$

And if $p > p^*$ there will be **excess demand and the price will have to come down to maintain equilibrium**. The opposite is true for $p < p^*$ (excess supply). At equilibrium, welfare for both consumers and producers is maximized and the sum of the two yields **total economic surplus** (**First Theorem of Welfare Economics** – A perfectly competitive market where supply matches demand maximizes economic surplus or is *efficient*). At equilibrium there is **Paretian efficiency**, or impossibility given the current technology to improve one's welfare without taking away another's: this is a very weak assumption and governments can act to establish it by fixing market failures.

However, this is not necessarily a "good outcome" because there may be rampant inequality in a pareto efficient equilibrium. This, in theory, is mitigated by **redistributing all initial endowments and letting markets operate freely** (**Second Theorem of Welfare Economics**), which is impossible in real life because not all endowments are observable. This means that a government will have to distort the economy through action to reduce inequality at the cost of efficiency (*Equity/Efficiency Dilemma*).

Economists analyze distributional effects by **using Social Welfare Functions** (SWFs), which are functions that combine the utility functions of all individuals in an overall social utility function. There are two main views of social welfare and both have their own SWF:

- **Utilitarian SWFs** are such that $SWF = \sum_{i=1}^{n} U_i$ and all utilities are given **equal weight**. If marginal utility is decreasing with income, then a **redistribution from rich to poor will occur** (transferring a dollar from a rich person to a poor person reduces the former's utility less than the increase in utility for the latter).
- **Rawlsian SWFs** are such that $SWF = min(U_1, \dots, U_n)$, which mandates that **social welfare is maximized when the worst-off person's utility is maximized** in society. This strongly emphasizes the redistributive aspect from top to bottom.
- **Commodity egalitarianism**, which mandates a society ensure a basic set of needs is met at any given time.
- **Equality of Opportunity** seeks to compensate individuals for the lack of opportunity they suffer as effect of their intrinsic or uncontrollable background to ensure equal access to success.

In general, here we assume that governments intervene in economies to **fix or mitigate market failures** and to **enforce redistribution in society**.

Empirical Tools

Identification Problem

The aim of empirical public finance is to measure the effects of a shock or policy. Hence, the main objective is to **distinguish between causality and correlation**, the two are often confused

and in statistics this is known as **identification problem**: how do we know that movements between two correlated variables are caused by one or the other?

Specifically, we could have the following given two variables X and Y:

- X causes Y.
- Y causes X (inverse causality).
- Some third (confounding) factors influence both.
- X and Y are correlated but this is random (spurious correlation).

Researchers typically estimate the following:

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + u_i$$

And have to make sure that $E[u_i|x_1, x_2] = 0$, otherwise the beta coefficients will be mixing the causal effects with the effects of confounders. Indeed, if that assumption is violated, then **omitted variable bias** (OVB) will be found in the estimation:

$$E[\tilde{\beta}] = \beta_1 + \beta_2 \frac{Cov(x_1, x_2)}{Var(x_1)}$$

The Rise of Experiments

In order to resolve the identification problem, economists began relying on experiments. However, since economics is a social science and it's impossible to conduct experiments like a physicist would, **natural experiments have been implemented to estimate the causal effects of shocks and policies**. Randomized control trials, or RCTs are the simplest type of natural experiments, and they are structured in the following way:

- A group is **randomly split into two groups**, one treated, one control.
- Randomization prevents that confounders blunt the effectiveness of the econometric analysis.
- They have become exceedingly popular in the past 30 years.

For instance, UBI studies have been conducted using RCTs to show the generalized effects of applying basic incomes on broad populations. However, sometimes RCTs are not always viable or ethically doable. Moreover, if true randomization is violated, then confounders can get in the way of properly isolating a policy's effect: to recreate randomization we use other **quasi-experimental methods**.

Instrumental Variables

IVs solve endogeneity problems with specific regressors by **estimating the endogenous regressor with another variable that is considered both exogenous and uncorrelated with the main regressand if not through the endogenous regressor**. This allows for the identification of the causal effect of the endogenous variable on the regressand.

They are estimated through the *2-Steps Least Squares* (2SLS) method. In practice:

- Run a regression of the endogenous regressor on the IV and the other controls and gather the predicted values.

- Run the regression of the main regressand on the other regressors using the predicted values of the endogenous regressor found in the previous step.

An example of a very good IV is the Vietnam War draft lottery linked to draft eligibility to estimate if a person actually served in the military: random numbers were assigned to people on a date of birth basis; lower numbers were called for the draft. Draft eligibility (our IV) was a good predictor of service in the military (our endogenous regressor).

Regression Discontinuity Design

RDDs exploit jumps in the probability of treatment assigned to some *running variable*. The main interest is in estimating the model:

$$Y_i = \alpha + \beta g(X_i) + \delta D_i + \varepsilon_i$$

Of which the primary quantity of interest is the **local average treatment effect** (LATE), which is δ in this case, as $X_i \rightarrow c$, cutoff point. There are two types of RDD:

- **Sharp RDDs** are deterministic in the treatment assignment at cutoff point.
- **Fuzzy RDDs** are not deterministic but the probability of treatment jumps at cutoff point.

The latter requires more work, as the cutoff point is not deterministically separating treatment and control. If treatment assignment is not deterministic, only the probability of belonging to a treatment discontinuously increases. By this, we need an IV that is based solely on the cutoff, hence it's **exogenous**, and that influences the outcome only through the treatment, making it a valid instrument.

RDD can have multiple limitations:

- Firstly, the only thing that is supposed to make the outcome change abruptly at cutoff is the treatment. This is **a rather strong assumption and has to be defended**.
- There is no bulletproof guarantee that control and treatment group are comparable (tests must be balanced on observables).
- Sometimes there is **endogenous bunching at cutoff**.
- LATE is identified *only at cutoff* (for instance, in Women and Local Public Finance by Casarico et al., 2022, we know the changes that occur when a woman is elected mayor in a **close election**, and what happens in, say, a conservative town when a woman becomes mayor can only be extrapolated).

Difference-in-Differences

DiD designs are very popular because they **allow to estimate changes after a shock is introduced in a system or market** by splitting the sample in control and treatment and assessing if an assumed **parallel trend** is broken by the introduction of said shock. Consider the estimator:

$$DiD = \left(Y^{T,After} - Y^{C,After}\right) - \left(Y^{T,Before} - Y^{C,Before}\right)$$

Which not only calculates the difference between two periods in a treated group but compares it to changes in a similar but uncorrelated one to root out confounders. The core assumption about DiD is that the treatment and control groups must **parallelly move before the shock** and

must be comparable while **not having any spillover effects between the two**. A generic DiD is estimated via:

$$Y_{it} = \alpha + \beta D_{it} + \delta_i + \delta_t + \varepsilon_{it}$$

Where D_{it} is the binary variable of belonging or not to the treated group, all other regressors are supposed to be fixed (*two-way fixed DiD setup*). Noteworthily, **we cannot test parallel trends post-shock**, but we can test parallelism before the shock (which is the thing that should hold to make the causal estimation reasonably solid).

Limitations of Experiments

Well-designed identification strategies are not immune to specific weaknesses that come from data quality and replicability of observations.

Statistical power can be low even in well-constructed models: there could be low probability of detecting successfully an effect and small sample sizes or weak shocks can increase the probability of finding false-positives or negatives. This is the reason why researchers report minimum detectable effects and sample sizes.

Attrition can become dangerous if tied to treatments: participants dropping out of a study in non-stochastic ways can generate biases in the estimation. Lee bounds are very useful in this.

Models might lack external validity if they are built on very narrow datasets, leading to results that are not generalizable in other samples or not easily scalable. RDDs often limit themselves to LATEs and not ATEs for instance. Evaluating direct effects while treating the rest of the economy as fixed often leads to an incomplete **partial equilibrium**, while estimating **general equilibria** requires an in-depth analysis of spillovers and interactions between effects.

Randomization can raise **ethics concerns** by either exposure to harmful things or reduction of access to basic needs (vaccines are tested through RCTs against other vaccines because leaving people unprotected is deemed deeply unethical). Right now, there is an increased prominence in administrative data, big data, machine learning and AI, which can raise **privacy concerns**.

Externalities

Externalities arise when an action of an economic agent **influences another agent outside the market mechanism**: if a steel foundry pollutes a river where people swim, it is imposing a *negative* externality. They are a core case of **market failure** (1st Welfare Theorem is violated – market economy doesn't give maximum welfare if left unchecked) and there are many kinds of externalities.

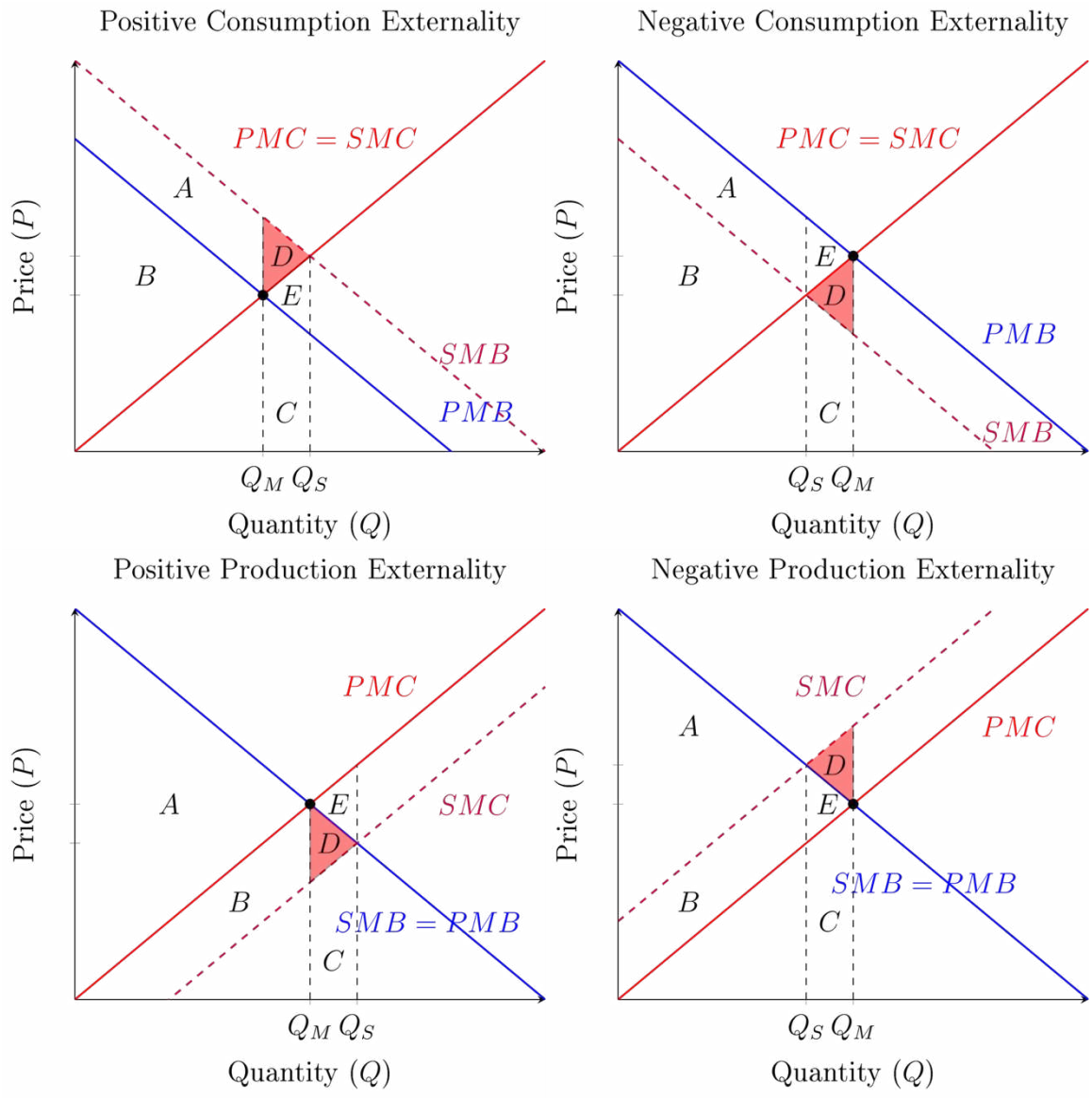
Types of Externalities

Production externalities arise when firms produce in such a way that modify aggregate welfare outside market structure.

Negative Production Externalities see a firm **reduces wellbeing of others through production**. Specifically, there is a *marginal damage associated with production*, which is the **spread between the Social Marginal Cost** (SMC) and the **Private Marginal Cost** (PMC). This type of

externality imposes a **deadweight loss** (DWL) on society due to the lost opportunity for trade due to the externality.

Negative Consumption Externalities see consumers **reduce aggregate welfare through their consumption**, the dynamic is the same as under a production externality, but with **Private and Social Marginal Benefits**, instead of SMCs and PMCs. *Positive Consumption and Production Externalities* occur when agents **increase aggregate welfare** through consumption or production (i.e., they "underproduce/underconsume").



In a nutshell, **the first theorem breaks down in all externality cases** due to the influence of economic agents on each other's private property. There are remedies however, both involving or not involving a centralized authority like the government.

Remedies to Externalities

Ronald Coase responds to externalities by **reintegrating them within the market system** through his theorem:

- Well-defined property rights and costless bargaining lead to **efficient negotiations between parties** that will lead to an ultimately efficient outcome.
- It matters not who holds the property rights on something, **but only that something is owned by someone**, in determining the efficient quantity for a good that produces externalities.

For instance, if swimmers own a river that is being polluted, the polluting firm can be **charged the marginal damage for ruining a property**. If the river is owned by the firms, then they can eliminate the externality altogether by preventing people from swimming in the river or **charge the MD for cleanup**. This is the *libertarian way of eliminating externality effects*. In practice, this is a very flawed way of seeing the problem, and it usually works only on a very small scale:

- **Bargaining is not costless** especially for large numbers of agents having conflicting grievances and power levels.
- **Assigning property rights is hard and costly**, especially with many agents involved.

For the small-scale nature of the Coasian solutions, there is often the need for a **governing authority to step in and represent the grievances of many agents uniformly**. This leads the way for *public sector solutions* to the externalities problem:

- **Quantity regulations on goods** see governments limit the use of externality-producing things (CFCs were banned due to the ozone layer damage in the 1990s).
- **Pigouvian Taxation or Subsidization** to restore a more efficient equilibrium can also be applied (carbon taxes).

Both can be strengthened via the introduction of **tradable permits** that can also be traded. If Pigouvian Alterations are decoupled from tradable permits, then an interesting dilemma materializes:

- If a government sells permits directly to firms, **then it's effectively imposing a Pigouvian Tax/Subsidy**. If the permits are offered for free, then the effect is that of a tax + initial transfer to the agents.
- In case of **uncertain marginal costs for reducing an externality**, taxes are not as effective as permits, (which I something that happens when the SMB is very steep).

Case Studies

A key case on the subject of externalities is **Acid Rain Regulation** like the 1970 Clean Air Act, setting standards on various polluting substances. In the 1990s the system was amended to allow for emissions trading as well. The effects of acid rains were evaluated with the aid of adherence to the regulation.

The core issue was that **areas with more particulates and pollutants may fundamentally differ from other areas**, hence the adherence to regulation became a natural treatment/control sampler. The approach used by Chay and Greenstone was a DiD event study:

- Regulation adherence was found to not particularly decrease their concentration of particulate post-regulation, but regulation shirking ones reduced their concentration.
- The same effects were found in infant mortality rates, with regulation shirking regions reducing infant mortality rates, showing positive effects in applying the regulation on acid rains.

CO2 emissions contextualized to Climate Change are also a very compelling and complex case study due to four key reasons:

- Emissions affect the **entire world** even if not all countries emit the same amounts per-capita, and the overall effects are concentrated to already impoverished regions. Environmental disruption generates massive costs and adjustments to disruption is also exceedingly costly in terms of human life and money.
- Economically, global warming is a classic externality, but the marginal damage of, say, CO2 emissions is very hard to track and **contingent on how much individuals' value consumption in the here and now** (if people are very impatient, they will literally prefer societal collapse).
- CO2 emissions pose an extreme existential risk to humanity, possibly leading to civilization-ending effects. Decarbonization can be done but doing it **without tanking the economy in the short and medium term is crucial** for the solutions to be viable.
- Cooperation is key to socialize costs and benefits of decarbonization and avoid free riding on the efforts of third parties. Kyoto and Paris agreements are examples of this approach.

The latter is especially tricky, as developed countries are the fastest to approach decarbonization, whilst having been the **primary beneficiaries of cheap fossil electricity**, while developing countries right now cannot just leapfrog one stage of economic development to satisfy quotas. Carbon taxes are inherently regressive and very unpopular both internally and externally, which requires in-country and international redistribution efforts: people and developing countries have to have their incentives matched to fully commit to decarbonization.

Public Goods

Public goods are defined as **non-rivalrous and non-excludable**, i.e., nobody can stop someone from enjoying that good either by excluding them via legal means, nor by denying the opportunity of consuming the good via adversarial consumption. Sunlight is a pure public good.

Optimal Provision of Private and Public Goods

In private-goods only scenario, two goods with two prices can be considered, with one good having $p_y = 1$ (numéraire). Two individuals interested in the two goods are likely to get **different amounts of goods at the same market price**. Consider the MRS formula to get the optimality condition for the goods' consumption:

$$MRS_{x,y} = \frac{MU_x}{MU_y} \Rightarrow MRS_{x,y}^{\text{Agent 1}} = MRS_{x,y}^{\text{Agent 2}} = \frac{p_x}{p_y} = p_x$$

And in equilibrium (if markets are efficient and open):

$$MRS_{x,y} = MC_x$$

Public goods are provisioned via the **Samuelson Rule**, which states that *social welfare is maximized when the marginal cost is equal to the sum of all MRS* in the economy, not to the individual MRSs. Indeed, consider good z as a public good:

$$\text{MRS}_{z,y}^{\text{Agent 1}} + \text{MRS}_{z,y}^{\text{Agent 2}} = \text{MC}_z$$

Private Underprovision of Goods

Private sector agents tend to **underprovide public goods for the market** due to the fact that when an investment has private cost but public benefit, then selfish individuals will be incentivized to underinvest. This creates a **free-rider problem**. Conceptually, a private provision of a public good leads to a **positive production externality being introduced in the market**, which is exactly why they are undersupplied.

Consider the same two individuals with the same utility and two goods, one public one private. The contribution towards the public good is defined as:

$$Z = Z_1 + Z_2$$

And the utility of a single individual is defined as:

$$U_i = 2\,log(X_i) + log(Z_1 + Z_2)$$

With a budget equal to $X_i + Z_i = 100$ or some other number. Taking the FOCs of the utility function yields the **Best Response Functions** that, when matched, yield the **Nash Equilibrium** or the utility-maximizing choice given the other agent's action. Given that budget we see that:

- Under the strategic equilibrium there will be underprovision of the public good.
- Under socially optimal provisions the provision will match the required maximum social utility.

Indeed, taking the best response functions:

$$F_i = \left(100 - 2Z_j\right)/3 \Rightarrow Z_i + Z_j = \left(200 - 2\left(Z_i + Z_j\right)\right)/3 \Rightarrow Z = 200/5 = 40$$

And comparing them to the socially optimum equilibrium:

$$MRS^i = MC = 1 = \frac{200 - F}{2F}$$

Which implies that $3F = 200 \Rightarrow F = 66.67$ at optimum, which proves the previous claim of underproduction. In general, the private sector is not rooted out by free riding: if private agents can solve the problem of non-excludability, then they can produce the most efficient quantity of a specific good. Sometimes free riding can be fixed via **charging fees proportional to the individuals' valuation of the public good**.

Empirical Evidence of Free-Riding

Consider the case of Business Improvement Districts in NYC. They are legal entities that provide services and funds to local businesses, and they avoid the free-riding problem via **fees on nonpaying members** as long as 60% of members do contribute. They are exceedingly successful and largely due to legal underpinnings allowing members to charge fees to encourage payment to the BID: non-excludability was cast away to charge through taxes all consumers.

There is also experimental evidence of free riding by the studies of Marwell and Ames and Isaac, McCue and Plott. If you give a group of people a fixed budget to assign towards private goods and common goods, **the more a game is repeated, the more the choice of the public good** (which improves everyone's utility symmetrically but less than the individual marginal utility of the

private good) **becomes rarer among participants**. By this, people shouldn't really cooperate much in reality.

Indeed, if people are assumed to be rational, then they will be completely selfish, but in reality, people tend to be **altruistic**, they tend to **value social capital** and also care for their own **warm glow** to help society. This should explain partially why private actors provide public goods and cooperate.

Public Provision of Public Goods

Government can provide public goods as well and can **potentially solve the problem of noncontributors**, although in an imperfect way. Consider a government forcing each individual to provide 5 of a public good, so the previous total contribution becomes:

$$F = F_1 + F_2 + 10$$

And utility becomes:

$$U = 2\,log(X_i) + log(F_1 + F_2 + 10)$$

With a budget of $X_i + F_i = 95$. The final result is such that $F = 30$, which means that **by forcing contribution, the government crowds out the individual private contributions** (reduction in private contribution due to an increased state provision). Indeed, if we replace the utility function with:

$$U = 2\,log(X_i) + log(F_1' + F_2')$$

With $F_i' = F_i + 5$ and budget $X_i + F_i' = 100$ the result will be the same. The government can provide the public good at the **socially efficient price**, but if private actors are crowded out of the market, then prices will begin to rise again. In reality, **public interventions are very distortionary** also due to their tendency to influence future economic scenarios.

Empirical Evidence of Crowd-Outs and Charity Motivations

Take the example of charities. People tend to donate for a variety of reasons spanning from wanting their name on buildings or programs (**warm glows**) or sheer humanitarian altruism. Such effects are not captured in conventional economic models.

Charity is also a public goods provision from the private sector, although it's usually encouraged by the government (donations are usually tax deductible). When governments intervene with charitable grants there is a **crowd-out effect**: Andreoni and Payne in 2003 found that for every 1000$ increase in a government grant to charity, private contributions fell by an additional 250$. This means that **if grassroots fundraising is a primary source of funds for a charity, government grants could actually bankrupt it**.

Crumpler and Grossman (2008) ran an experiment to test whether or not individuals donated out of pure altruism. They discovered that they didn't: if people were assured that a charity of their choosing would receive 10USD and that they could donate more money up to 10USD, but that would reduce the initial donation by the same amount, not everyone chose not to donate (most rational choice), rather **many donated relatively small contributions**. This proves that people tend to **donate also for their personal utility** or other socially mandated reasons.

Falk (2007) discovered that **reciprocity is a major driver of charity**: people were more incentivized to donate large sums to developing countries if they received more postcards with children's drawings on them.

Dellavigna, List and Malmenadier (2012) focused on **social pressure**: people that were approached with no warning by charity solicitors were the most incline to donate and donated larger sums. Warnings to other houses that a solicitor was coming had less success and people that were given the opportunity to opt-out of charity refused the most and gave the least. By this, in door-to-door fundraising lower utility of potential donors and **social pressure can still help with extracting the money**.

On the topic of social pressure, policymakers experimented with **social prices**, or the social consequences of shirking a public function imposed on individuals. Indeed, people that were informed that their neighbors would know whether they voted or not were more successfully shamed into voting in local elections (Gerber, Green and Larimer, 2008). Social Pricing has been proven **more effective than Pigouvian Taxation in cases of excessively hard enforcement** (shaming someone for littering is far more effective than simply fining them). Social "Subsidization" is also effective, people that were encouraged to drive green vehicles added to their own welfare by having driving be more pleasurable.

Cost-Benefit Analysis

At the heart of economics, we wish to know **how much beneficial a given measure is with respect to its initial cost**. C-B analysis is core in public economics when deciding when to undertake public goods projects. It's not a simple task, especially because it can be difficult to translate theoretical concepts into real numbers and factors, requires value judgement and credible policy evaluation. **Benefits are future, costs are all in the present**.

Building a highway, for instance, is a very costly endeavor in the first years but it may pay off if it connects resource rich areas with transformation hubs. Is it worth it to build? How much productivity can be extracted from tolls, higher wages and such?

Current Cost Measurements

There are a few ways of calculating costs for an ongoing project:

- **Cash-Flow Accounting** is based solely on how much the government pays for inputs and calculates the benefits solely by adding up the income from the revenues generated by the project once it's operational.
- **Opportunity Cost** is based on the social marginal cost of any resource as its value in its next-best use.

Economic costs are the costs associated with the resource consumption and transformation for a project to be done, which means that in the case of a perfectly competitive labor market the social economic cost will also correspond to the value of the wages of the workers employed on the project (CF Approach). If markets are inefficient however, the social marginal cost is the next best wage if a worker is employed somewhere else. In practice, costs have to be evaluated at the **present discounted value (PDV)**:

$$\sum_{t=1}^{T} \frac{CF}{(1+r)^t} = \frac{CF}{r} \text{ if } t \to \infty$$

Long-Run Social Discounting and Benefits

The **social discount rate** is the appropriate rate with which discount all future cash flows. The main reason for discounting cash flows is that **one dollar today is worth more than one dollar tomorrow** because delaying current consumption denies current (and certain) utility. Moreover, in the context of public economics, **one dollar spent today towards a very long-term cost is more than one dollar spent to address the same issue by future generations**. We will use only the rate r that embodies both effects succinctly.

In practice, consider the case in which in 100 years we could all go extinct due to climate change:

- At a 50% probability, we all go extinct or very poor, so there is no discount.
- At a 50% probability, we grow at a CB mandated $r = 3\%$ yearly for 100 years.

Therefore, the amount of money we'll get in the first place is 1$ now being worth 1$ in 100 years, in the second case, that same dollar is worth approximately $19.22. Conversely, in the second case, 1$ in 100 years at rate $r = 3$ will be worth 0.052$, which allows us to say that:

$$(1-\bar{r})^{-100} = 0.5 + 0.5 \cdot 0.052 = 0.552 \Rightarrow \bar{r} = 6\% \text{ Implied Discount Rate}$$

According to Weitzman, we should **use low discounting for distant futures in which there is a possibility of growth stopping altogether**.

Turning to benefits, in a perfect market, individuals **freely optimize the blend of labor and leisure they prefer** to accommodate their consumption tastes. In reality **there are hourly limitations** and **leisure hours are not all the same** (i.e., commuting sucks). By this, markets are not always the best information mechanisms to understand the value of time for individuals.

Another way to understand such value of time is to **utilize contingent valuation** or ask individuals to value options they are not choosing or do not have the opportunity to choose in the here and now. This is the **only feasible way of gathering information if there is no market price for reference** (i.e., "should we leave space uncolonized?"). However, there are four main issues with contingent valuation:

- People can **lie and overexaggerate their willingness to pay** for things they are not actually paying for.
- People often **assign different values for individual and combined problems**.
- Asking issues in an order **changes the value assigned to each**.
- Asking about different location sites or variances in the scope often **does not change the answers** (*embedding effects*).

Rationally, the best way of addressing multiple problems is to **allocate a single budget to all causes simultaneously**. By this, the government is the best-positioned agent to tackle issues and asking people one by one to rank or rate WTPs for certain issues is completely useless.

Another way of estimating value is through **revealed preferences in the market** (letting people's actions show their WTPs): if a group of people agree on a price for a good, then it's probably worth as much. It's by far the favorite way of estimating value among economists. For instance, a house near productive areas might cost x more than one farther away, with x being the **cost of avoiding long commutes**.

Valuing Human Life

Cost-benefit analysis becomes very itchy when it comes to valuing human life, and it's the crux of economics being called a **dismal science**. Virtually, all expenditures and savings can save or sacrifice lives: it's common practice to place dollar values on **statistical lives**, not real ones.

For example, when a GM line of cars was due for recall in 1993, costing $1bn and potentially saving 32 lives, the company settled to pay $50mn to support education programs against drunk driving and to buy 200'000 children's seats for cars. Seats alone likely saved more than 50 children, **implying that GM saved more lives at a lower cost than with a recall**. How do we value the saved lives? Three approaches:

- **Lifetime wages**, or the PDV of all potential wages an individual could have earned in their active life.
- **Contingent valuation**, "how much is your life worth in $".
- **Revealed preferences**: estimation of the WTP of paying for an item that quantifiably reduces mortality.

Another way of doing this is **estimating compensation differentials**, such as additional or reduced wages to engage with more or less dangerous living conditions. In practice, consider paying a soldier $10k to go to Iraq in peacetime with an additional 0.1% chance of dying:

$$\text{Value of a Life} = \frac{\text{USD}10'000}{0.001} = \text{USD}10mn$$

However, this is very unreliable, as it relies on the same unrealistic **perfect market conditions**:

- People have to be **perfectly rational and not induced to take excessive risks through need**.
- There is **perfect and symmetrical information**.
- Quantifies the value of the life of the **marginal person willing to take such risk**, not average preferences.
- In general, **prices are unreliable as value indicators for something**, enslaved people also had prices.

Consider the example of **raising the speed limit on a highway**: in 1987, speed limits in 21 US states were increased by 10mph. Fatality rates increased by 35% and speeds increased by 3.5%: every lost life carried a saving of 125'000 hours in lost time, or **$1.54mn per fatality** at most.

Modern Cost-Benefit Analysis

We find a number of issues with cost-benefit analysis, namely:

- **Counting Mistakes**, like counting secondary benefits, counting labor as a benefit and not a cost, and double-counting benefits.

- **Distributional Concerns**, or the lack of uniform accrual of costs and benefits across all individuals obtaining access to public services.
- **Uncertainty**, which dictates that costs and benefits themselves, are uncertain.

The more modern way of conducting cost-benefit analysis is through **Marginal Value of Public Funds**, which is a "*bang-for-buck*" approach:

$$MVPF_j = \frac{\sum WTP_i^j}{G_j} = \frac{WTP^j}{\text{Net Cost}}$$

Representing the amount of welfare that can be delivered to policy beneficiaries per dollar spent by the government.

Political Economy

Political economy is the study of **the reasons of government intervention** in a positive way (why doing what it's being done). In principle, governments are beholden to the will of the people they rule over: in democracy that accountability is direct, in autocracy pragmatism and fear of revolution creates an indirect accountability system.

Democracy can be **direct** through referenda or **voter initiatives** to bring a proposition into law through signatures, but in general people **delegate their democratic lawmaking to representatives** gathered in a parliamentary system.

Voting

Majority voting is used to aggregate individual preference into a social decision: options are put to a vote and the option receiving the majority wins. **It does produce a consistent aggregation if preferences are restricted to take a specific form**, like voting for public school funding to be either *high, medium or low*. Consider the following abstract social choice problem:

Society can make $n = 1, \dots, N$ possible choices and individuals can have $j = 1, \dots, J$ possible preferences. **The social decision has to aggregate individual preferences into a social preference over N that satisfies the following**:

- Pareto Dominance: if for all individuals a choice is better than the other, then the social choice will be better as well ($\forall j \in J,\ a <_j b \Rightarrow a <_S b$)
- Transitivity: $a <_S b \wedge b <_S c \Rightarrow a <_S c$
- Independence of irrelevant alternatives: the social choices depend solely on individual ranking of the two main alternatives, and not on other irrelevant ones.

This is problematic, as **no social decision uniformly converts individual preferences into a consistent aggregate** without restricting the preferences or imposing a dictatorship (*Arrow's Impossibility Theorem*). A way of solving this is through the **Median Voter Theorem**, which is based on choosing as the *Condorcet Winner* (the outcome the wins in majority voting) the preference of the voter that peaks at the median of all peaks. The proof is the following:

Let $a_1 < \dots < a_{\text{median}} < \dots < a_j$ being the median voter's peak and suppose that voting happens in between a_{median} and some a^* with $a_{\text{median}} < a^*$. By this, a_{median} wins because all individuals have decreasing preferences for a beyond a_{median}. The same is true symmetrically if $a_{\text{median}} > a^*$.

This is a hugely influential result in political economy, but it has some assumptions it has to abide by:

- The theorem **breaks down in the case of multidimensional voting**: representatives are rarely elected by single-issue voters and individuals might locate themselves in multiple points of a political spectrum.
- **Only two candidates are allowed** or the theorem breaks.
- Politicians must be interested with a single-minded voter-maximization strategy (**No Ideology**).
- **Everyone affected by the policy must vote**, but in reality, political apathy is rampant.
- **Money has no effect** on the outcome of an election, but in reality, extremism can help maximize fundraising even if less voter-maximizing.
- **Every actor has perfect information** on the issue and on the voters' preferences.

The theorem is strong in theory but effectively not applicable to real life: a lot of literature tries to *test the median voter theorem* by estimating the spread between expected votes on a specific position and the actual votes. Results are mixed: AER shows that having, say, daughters influence the position of people to vote more liberally in reproductive rights elections: *ideology matters a lot as well*, Washington's findings show that politicians build on their own experience above their voter-appeasing strategies.

Evidence from the US Senate show that opposing-party senators elected for the same state **vote in radically different ways in the senate** which violates the median voter theorem as they should approximately represent the same percentage of people. In the US House of Representatives, the results are the same in the case of close elections where candidates from different parties have been voted in by approximately the same amount of people.

This doesn't invalidate the theorem tout court, as evidence also shows empirical evidence of **ideological convergence between election rounds**: candidates move towards the positions of those opponents that failed narrowly the first round.

Finally, the median voter theorem cares not about efficiency: unless the **median marginal benefit is equal to the mean marginal benefit**, the choices made under it will be suboptimal. Lobbying can either solve or exacerbate this feature: people with a high willingness to pay for or to block a social choice can influence public officials by leveraging their wealth to campaign for their desired outcome (and they will be successful if the opposition can't or won't oppose them). Another (very old) solution is to restrict or empower voters on the basis of their wealth: Sweden had votes proportional to taxes paid before 1900s, but today this is seen as an attempt to bring about a **plutocracy**

Government Failure

According to **public choice theory**, a government might not act to maximize the wellbeing of citizens, leading to **government failure** if this action turns into chronic unwillingness or impossibility. In dictatorships and bureaucracies, there is the presence of **self-serving individuals or institutions** that extract rents from the provision of the services they offer. By this, many believe that the role of the government should be heavily minimized to avoid overreach (*Leviathan Theory*): this is very prevalent in the political landscape of countries like the US. This also fuels the debate between **private and public provision of goods**:

- The private sector might have an edge in efficiency and innovation, but the public sector makes sense for natural monopolies on energy and water.
- Private competition can create wasteful or predatory practices if the good being sold is not well understood by the public like healthcare.
- Emergency situations can be ameliorated via public provision.
- Nonprofit alternatives can be a middle ground in some areas like education by fusing innovation and limited rent-seeking.

According to Acemoglu-Robinson, **inclusive governments** (those that extend public and economic rights broadly to all citizens) grow faster than **extractive governments** hijacked by self-serving elites (look at South and North Korea). Moreover, Acemoglu-Johnson-Robinson (2001) wherever colonization was additive to actual settlement of Europeans, economic outcomes were much better than simple extractive colonization (i.e., Australia vs Nigeria).

State and Local Government

In all states on Earth, the central government has to **delegate some functions to local autonomies** to shed the bureaucratic burden: this creates the problem of *fiscal federalism*, which arises when funds are raised by both a central and local authority and both have different or overlapping needs for funding. In the US, the system is quite decentralized (but has had a recent centralizing trend), with 33% of revenues being collected at the state and local level. However, in the US, the federal government handles most of the spending. Other countries, like France, are more centralized and redistribute more aggressively among local autonomies.

The core way local governments raise revenues is through **property taxation**: historically, real estate was easy to track, tangible and immobile, making it easy to tax even in older times where incomes were much more difficult to track. Today income is easily tracked alongside spending, making it simpler to raise sales and earnings levies.

The Tiebout Model

Charles Tiebout postulated that the core difference between the provisions of public and private goods, and the one that *creates inefficiency in the former* is the **structural lack of shopping and competition**. However, if we account for *local government provision of public goods*, competition is restored because **people can just move from an area to another** and "*vote with their feet*". By this, a threat of exit (and hence of losing tax revenue) generates the incentives to provide goods efficiently.

Formally, the Tiebout model can be exemplified by taking two cities each holding $2N$ individuals that hold the same income Y and differ only on their preferences for public goods: N people derive utility by consuming said public good $U_X(C, G)$ (and therefore are *willing to pay for it*) and the others do not $U_Z(C)$. If people are allowed to relocate, then the following equilibrium will occur:

- In each town, if $\boldsymbol{G}$ **is decided by the median voter**, and equally financed through the people's incomes, a town with a public-goods-loving majority will enact some utility maximizing spending on the public good, otherwise it will pay nothing.
- The result is that people will **automatically relocate to the town that best matches their willingness to pay** until there is no more need for relocation.

This can be neatly split into the two **Tiebout Theorems**:

1. At equilibrium, individuals automatically sort themselves out: if there is a public-goods-loving person in the wrong town, then there is their counterpart in the other, **and the two will just switch places**.
2. In each town **the local level of public goods provision is efficient**, as in one town nobody pays for the public good and in the other people maximize $U(Y - G/N, G)$ given their budget of $Y = G/N + C$.

The main message of this simplistic model is that local competition between townships or states reflect the need for public goods to be **appreciated by the underlying population** and to be **efficiently provided** with no waste. The Tiebout model is also *very libertarian* as it denies the redistribution roles of taxation but rather focuses on the common individual choice to pay for a public good (*benefit principle of taxation*) and emphasizes the personal choices to relocate and the competitive framework of local governments' rivalry.

It also has problems, as it requires very stringent assumptions to actually work:

- Individuals must face **no costs of relocation** and have **perfect information** on each town they consider.
- There must be **enough choices** so that people seamlessly relocate in their favorite one.
- There must be **no externalities** between towns to avoid under-provision.
- Local governments must charge **equal taxes to all people** or people need to be **exactly uniform** in terms of income, owned property or spending.

Evidence on Tiebout Sorting

Under Tiebout Sorting two effects should be observable: **more choice of townships should lead to more similarities across townships than when there are fewer choices** (this fact is well-established) and **the more sorting there is, the more efficient the public good provision should be**.

Hoxby (2000) compared cities on the basis of school districts:

- There are cities with *few districts*, allowing for less choice.
- There are other cities with a finer division of districts, allowing for more choice.

The key findings are that **cities with few districts tend to have less sorting across neighborhoods**, which is well-established, and **cities with more districts have higher test scores**, which is controversial.

Another way of testing the sorting is by **house price capitalization** or consolidating all costs and benefits of living in a house, including the local public goods accessible to the inhabitants. In general, the higher property taxes are with respect to public goods, the lower the house price will be. Schonholzer (2023) showed through an RDD that at the boundary between Piedmont and Oakland (one wealthy the other less so) there is a significant jump in house prices and higher redistribution of Asian residents from Oakland to Piedmont. The Cellini-Ferreira-Rothstein (2010) found in the context of votes for higher school founding in CA that **the municipal bonds for education had a positive effect on house values**, leading to underinvestment in education.

Tiebout Consequences and Redistributional Issues

A key insight from the model is that **poorer people will flock where public services are well provisioned**, while the others will prefer not paying for redistribution, ultimately leading to the breakdown of the system at the local level. By this, it's best to leave this function to **higher levels of government**: locally there must be a direct relationship between taxes and benefits for the population (*tax-benefit linkage*).

Currently there is a very significant inequality in the ability of local governments to fund and in the extent, they can fund public spending. Redistribution is usually carried out directly by the central government through taxes and spending, or it can be done **indirectly through intergovernmental grants**. Assuming that the choice of both private and public spending is on a median voter basis, we can establish the optimal grant level to allow for this preference to happen.

There are three main forms of grants:

- **Matching Grants** which tie the amount of the grant to the local spending already in place. It increases public goods provision via income and substitution effects (budget line shifts outward).
- **Block Grants** are lump sums not tied to any mandate, causing a simple budget line shift (only income effect kicks in).
- **Conditional Block Grants** are fixed amounts, but with a mandate to spend it on specific goods, shifting the budget line but giving a clear corner solution if spending on the public good is low enough.

Crowd-out is still theoretically a relevant issue: enacting a block grant allows the local government to cut taxes by the amount previously needed to fund the public good, **leading people to redirect that spending towards private consumption**. This is due to the fact that **money is fungible** and we don't care *where it comes from*, rather we care only about the total resources for the purposes of establishing allocation across private and public goods.

Hines and Thaler found however that this tended not to happen (crowd-out due to federal funding close to zero), leading Arthur Okun to state that **the money sticks where it lands**, instead of replacing state spending (*Flypaper Effect*). Recent studies confirm this finding *in the short-term*, with significant evidence of crowd-out long-term.

Redistribution in Action

Consider the case of **school finance equalization**, laws that ensure equal financing of all schools in a given state's communities. Many US states impose it to avoid crass disparity as schools would be financed only through local property taxes. However, there are side effects that the courts imposing it don't really consider too much.

SFE imposes an **implicit tax on government tax revenues**: for each extra dollar of taxation imposed by the local authorities, a percentage is taken away to fund other communities' schools, which **blunts local spending** by the amount centrally redistributed. In 1971, California was forced to enact SFE due to a SCOCA ruling that disparities above a certain threshold were unconstitutional. The way it was implemented worked by:

- Forcing wealthy residents to give all tax revenues above a threshold to a common schooling pool for poorer communities.
- Local governments lost all incentives to increase taxes.
- Property taxes failed in funding schools efficiently.

Another instance of such interventions having adverse effects was the CA Proposition 13 that **capped at 1% of cash value the property taxes on real estate** due to growing discontent for the fiscal pressures on homeowners: schools were funded through SFE and the taxes failed to be capitalized into prices. Moreover, statutory home price increases were capped at 2% yearly against the 4%-5% average pre-reform. The result was a higher net worth for retirees on fixed incomes (as their house was their primary asset), but anyone willing to buy a house had to contend with **enormous capitalizations of property taxes**, creating a lock-in effect. Meanwhile, the centrally organized K-12 school system was integrated at the state level in the 70s but was not generously funded at all.

Education

Education is widely funded by governments, **albeit it being a private good** with overwhelmingly private returns and simple excludability: this is because a long and complete cycle of education is universally regarded as a useful type of consumption that *improves the opportunity outlook of people* in the long run. Many families would likely not be able to afford it, incurring a massive and unavoidable opportunity cost in forgone development to the entire economy.

Mandatory primary schooling is strongly associated with an increase to modern levels of literacy and higher education attendance. On top of that, there are a few economic reasons why education is considered a smart investment into private good provision by governments:

- **Education exerts a set of positive externalities** onto the economy, especially in civic engagement, crime containment and increased TFP.
- **Subsidized education allows consumers to properly optimize their intertemporal consumption** given the realistic scenario of constrained credit markets.
- **Providing education prevents avoidable individual failures** due to the familial or individual short-sightedness on the topic.

In general, we can safely say that, even with education being a private good, its provision is most efficient at the social level through a centralized mediator of collective needs.

Empirical Evidence on Education

Estimating correlations between education and whatever effect one wishes is limited as in such topics there are *potentially limitless confounders*, generating abundant omitted variable biases. For instance, to estimate the effects of completing high school on incarceration probabilities, Lochner and Moretti (2004) utilize **changes in state-level compulsory attendance laws as an instrumental variable** to sort out the endogeneity problem. The results show that *completing high school leads to a probability of incarceration reduction* of 0.76% for white kids and 3.4% for black kids. The same IV method led to the discovery of similarly positive effects of education on the likelihood of voting (Moretti, 2003).

An RDD model was estimated to evaluate the effects of **credit market limitations** on the choice of attending college. In a perfect market, if the present discounted value of education is higher

than its costs, a loan should be automatically granted. However, in a situation where **the state guarantees such loan** upon the completion of a test with a specific score (like in Chile), Solis (2017) found that **the loan availability generated a significant jump of the probability of the marginal student of enrolling in university**.

Carrell-Sacerdote (2017) found that providing high school students with Dartmouth grad level application prep **yielded a significant increase in women's likelihood of enrolling in college** but had a more negligible impact on men. Moreover, giving cash to families directly without mandate or guidance **has been found to not have any significant effect**, indicating that mere economic incentives are not enough to prevent individual failures.

Improving education quality is also linked to better results for adults, however most gains depend on the modality of application of such improvements:

- By using the Tennessee Project STAR that divided randomly pupils into small and regular-sized classes as an RCT, Krueger and Whitmore (2001) found that **test scores improved for the small classes**.
- Chetty (2011) found similar effects in college enrollment and adult earnings.

Charter Schools are more controversial. In principle, they are private schools that can self-regulate much more than public schools, allowing for the analysis of the *role of competition in education provision*. Many charter schools are so oversubscribed that **rely on lotteries to assign spots**, allowing for a neat RCT design to analyze their effects. In general, *urban charter schools* boosted achievement in students, while *non-urban ones* reduced it, as found in a study by Angrist in Massachussets.

Preschool attendance is also an important issue: the US doesn't offer it for free and most families rely on friends and family for daycare (crass private underprovision of the good). Again, admissions lotteries are still in place and the estimated positive effects of going to preschool include higher college attendance and graduation rates and lower rates of incarceration (Gray-Lobe, 2021).

On average, highly educated people earn more than their counterparts. There are two explanations for this phenomenon:

- If **education increases personal productivity**, then workers can require a higher wage to work in a specific and higher-paying job.
- If **education does not increase personal productivity in any significant way**, then it can act as a *signal* to employers that a worker is somewhat better than another one (*rat race scenario*).

Again, estimating effects is very tricky because *confounders bias every simplistic regression model*: we again rely on natural experiments to carry out our analyses. For instance, Bleemer and Mehta (2022), by running an RDD model on people that, on the basis of their GPA, were or were not able to **graduate as Econ Majors from UC Santa Cruz**. The increased likelihood of graduation with a high GPA corresponded to a *massive nigh 50% earnings premium*.

Government Provision of Education

Private schools have relatively inelastic supply, with a fixed student body at the top institutions, and historically **government-led action increased the supply and therefore the attendance**.

Public institutions in the US currently host the majority of higher-ed students and their expansion started after WW2 and Korean War through the GI Bill.

However, right now students are being saddled with **ever-increasing student loans** due to the reduction of state-level funding to universities. At the same time there has been an increase in **private equity acquired for-profit schools**, that advertise very aggressively and saddle students with a lot of debt. These are signs of *blatant market failure* due to enormous informational asymmetry and personal failure caused by reduced purchasing power.

This is a social welfare problem, as access to education has a very positive role in **intergenerational mobility**. As Chetty found in 2020:

- **Access to education is very variable in the US**, with Ivy League schools having overwhelmingly very wealthy students.
- **Only a fraction of poorer kids drops out from top schools** and those who did transferred to top state schools.
- **Good colleges show very similar outcomes between poor and wealthy students**, indicating that universities are tickets to opportunity.
- **There are large discrepancies between students that enter college in a lower position with respect to those who graduate and reach a higher position**, indicating social mobility.

Social Insurance

As safeguards against adverse events, many countries mandate or offer **insurance policies to citizens** so that they may receive a premium or service funded by taxpayer money. Examples of social insurance are health, disability or unemployment insurance. Since the 20th century, state-provided insurance has been on the rise to support and provide services within welfare states.

Insurance Basics

Considering an increasing and concave utility function $U(c)$, and the probability of an adverse event happening q, the **expected utility for the individual** is going to be:

$$EU(c) = (1-q)U^{NA}(c) + qU^{A}(c)$$

Where $U^{A}(c)$ and $U^{NA}(c)$ are the **utilities resulting from the adverse effect happening or not happening** respectively. An *actuarily fair insurance* is the insurance that sets the **premium equal to the insurer's expected payout**. By this, we can imagine a fictional scenario where a worker earns a wage w and has some probability q of falling ill. If they fall ill, they will have to pay their doctor d for treatment. The worker can choose to insure themselves, paying p as a premium and receiving b as payout in case they get sick. The premium is always paid. The worker will then maximize:

$$EU = (1-q)U(w-p) + qU(w-p-d+b)$$

The insurance company will have expected profits such that $E\pi = p - qb$: if the insurance is actuarily fair, then **the insurer will have to charge the premium equal to the expected payout** and make **zero profits**:

$$E\pi = p - qb = 0 \Rightarrow b = \frac{p}{q}$$

By this, taking the FOC of the expected utility to maximize it:

$$\frac{\partial EU}{\partial p} = -(1-q)\frac{\partial U(w-p)}{\partial p} + q\left(-1+\frac{1}{q}\right)\frac{\partial U(w-p-d+p/q)}{\partial p} = 0 \Rightarrow \frac{\partial U(w-p)}{\partial p} = \frac{\partial U(w-p-d+p/q)}{\partial p} \Rightarrow w-p = w-p-d+p/q \Rightarrow \boxed{p^* = dq}$$

Which implies that the worker consumes in both states of the world $C^* = w - dq$. Intuitively, **the concavity of the utility function mandates that it's always desirable to reduce consumption in the high-income states to increase it in the low-income states**.

Individuals need not to choose only actuarily fair insurances: if they are *risk averse*, they might buy insurance that is *actuarily unfair*: **the more the aversion, the more unfair of an insurance will an individual be willing to consume**.

Information Asymmetry and Government Provision of Insurance

Information asymmetry in markets causes market failure due to two main phenomena: **adverse selection and moral hazard**. If information was perfectly symmetric, in a market for health insurance where consumers are either sickly or healthy, will lead to the companies charging an actuarily fair insurance such that the payout is $b_i = p_i/q_i$ and premium is $p_i = q_i d$. There will be inequality in premia and in welfare, **but the market will be efficient**.

However, if companies cannot observe the consumers' characteristics, then **sickly people will have the incentive to appear healthy** and **obtain a discounted insurance plan with the same payout in case of illness**. Companies can impose prices based on *average risk*, under a **pooling equilibrium**, which is a good deal for the sickly and a mediocre one for the healthy, or offer a *cheap and expensive contract* with partial and total coverage respectively (**Separating Equilibrium**), which means that the healthy will be underinsured.

The act of pretending to be healthy while sick is **adverse selection**: the insured knows more about themselves than the insurer and therefore tricks the system: more sickly people relied far more on Obamacare than healthy ones. One way to fix this is to make insurance **mandatory** and have low-risk people subsidize the high-risk ones through redistribution. There are also other reasons for imposing mandatory health insurance:

- **Healthcare is considered a basic right** in most of the world.
- **Society might want to cover for high-risk people** as their status might not be tied to any fault of their own (i.e., people with autoimmune diseases).
- **Lack of insurance can generate negative externalities**, like people that refuse or cannot vaccinate compromising herd immunity.
- **Public healthcare is persistently less costly on the administrative side**.
- **Government might want to atone for personal failure or credit limitations**.

Moral Hazard is the other form of information-asymmetry-driven behavior, this time based on people choosing to be less risk aware because they are insured: this problem exists for both private and public insurance and creates the **consumption smoothing-moral hazard trade-off**. It's very rare in health insurance, but other forms of insurance are known to incentivize this behavior if monitoring is too imperfect (i.e., auto insurance or unemployment insurance).

In general, there is no way of fully removing information asymmetry in the real world. By this, socialized insurance will:

- Have as its **major benefit the amount of consumption smoothing transferred to consumers**.
- Have as its **major cost the moral hazard of insuring adverse events**.

Which means that socialized insurance must *ration its coverage to stay as efficient as possible*.

Retirement and Social Security

What is Social Security

Retirement is necessary due to the fact that **workers become more and more unproductive the older they get** until they stop working or die: if there is no public provision of retirement, people will **choose to save throughout their working life** to then maintain some standard of living during retirement (*Life-Cycle Model Prediction*). That being said, it's highly unrealistic for people to just save a lot on an uncertain income for uncertain returns expecting uncertain preferences to stay constant over decades. Here's where pensions get publicly provided by the state.

OECD countries implement substantial government funded retirement and individuals pay contributions through payroll taxes to fund **social security schemes** in exchange for a pension of their own upon retirement at a specific age. In the US, FICA taxes are levied on workers' earnings and people can start receiving their social security checks after 10 years of contributions and after the age of 62.

Social Security in Practice

Social Security checks are **annuity payments** that last until the recipient dies: the amount is a progressive function of the recipient's **average earnings over the person's 35 highest paying years**; in the US this is the Average Indexed Monthly Earnings. Once benefits start, they are **indexed to inflation** once per year: higher earners live longer and therefore will receive higher annuities for longer as a result of their earnings and long life.

Benefits are paid out either on a **Full Benefits Age** (FBA) basis, when a recipient gets the full retirement benefits, or at the **Early Entitlement Age**, when the recipient accepts a discount on the benefit to retire early (in the US this is $8 \cdot y \,\%$ less in annual benefits for every year before FBA starting at 62 years old). Pensioners in the US can work and still receive SS: they are put through an earnings test if they are below FBA and they have to return **half the benefits they get for every dollar above $20k that they earn**, with benefits returned if the worker falls short of $20k yearly. Family members like children of deceased workers and the spouses of claimants are **entitled to at least a portion of the dead worker's pension** conditional on their income.

Pension systems can either be:

- **Unfounded, or Pay-As-You-Go** (PAYG) so that the benefits extracted from the workers are immediately transferred to the retirees (current benefits equal the current contributions).
- **Funded through Sovereign Wealth Funds** where workers deposit their contributions and they take away the *sum of such contributions and the correlated capital gains*. Private pensions like 401k are funded.

In the former, consider a generation t made up of N_t individuals that earns w_t and pays taxes equal to $\tau N_t w_t$ and that will receive pension benefits equal to $\tau N_{t+1} w_{t+1}$ from generation $t+1$:

$$\frac{B_t}{T_t} = \left(\frac{N_{t+1}}{N_t}\right) \cdot \left(\frac{w_{t+1}}{w_t}\right) = (1+n)(1+g)$$

Meaning that the **implicit return on the taxes levied to pay for social security is the sum of the population growth n and real wage growth per-worker g**.

A funded system, instead, works by entitling everyone to a fund where taxes are collected and pension benefits will be:

$$\text{Benefits} = \text{Taxes} \cdot (1+r)$$

The PAYG system relies on a growing population and a growing economy to be properly sustainable: it is always desirable when $n+g>r$ (Diamond, 1965), which describes an economy that is **dynamically inefficient**, with PAYG representing a **Pareto-Improving Measure**. Note that risk-adjusted r should be lower than r, but still higher than $n+g$. Funded systems on the other hand provide higher returns because they don't deliver free lunches to the first generationers.

Studies on the Italian pension system after the reforms of 1992 that **reduced benefits for public sector workers more than the private's** show that only a third of the reduction was recuperated via increased private savings, suggesting the presence of a *partial crowd-out effect of public pensions on social security*. This is indeed the primary reason for government to intervene in this field: there is the persistent trend of **people failing to save enough for retirement** (personal failure).

Social Security and Retirement

If a worker chooses to retire a year later than initially planned, they will **pay more in payroll taxes**, **receive a year less of benefits** and **set a higher SS benefits level** through the actuarial adjustment: the adjustment is **fair if those effects cancel each out in PDV**.

This behavior might be influenced by:

- **Early retirement policies**.
- **Actuarily unfair benefits adjustments for those retiring after EEA**, which creates an effective tax on working.
- **Social norms impacting the retirement benefits**, with some government finding evidence of the existence of a **Normal Retirement Age (NRA)**.

Indeed, there is a massive spike of *retirement hazard at EEA* the less fair the adjustment is, with many others directly retiring at FBA.

Insurance and Workers' Compensation

Institutional Features

From a US perspective, workers are eligible to **three main forms of social security beyond retirement benefits**:

- Unemployment Insurance (UI) is federally mandated and state-run. Payroll taxes are used to fund benefits for unemployed workers laid off by companies.
- Disability insurance (DI) is a federal program in which payroll taxes are used to pay benefits to workers that remained impaired beyond the capacity to work.
- Workers' Compensation (WC) is state-mandated and obligatory for all firms to compensate workers for on-the-job injuries. It's directly provided by private insurers.

They have varying levels of duration and difficulties of verification: none offer a 100% average wage replacement rate upon verification, and the federal nature of the US makes it that there is significant statutory variation from state-to-state.

Unemployment Insurance

Basics

It's a very large and expensive program, averaging $50bn of yearly expenditure with an $800bn peak in 2021 at the height of COVID: it has **significant importance as a macroeconomic stabilizer**, as it is triggered by unintentional and non-disciplinary job loss. Clearly it helps in times of need to smooth consumption and avoid poverty, but it may reduce the job-seeking efforts of the unemployed recipients in a classic case of **moral hazard**.

Each state being entitled to have any type of restrictions on UI makes it very effective as a "*laboratory*" for empirical work. It is financed through payroll taxes that **are not internalized in the employee's salary** and is partially experience-rated on firms, meaning that payroll taxes are higher the more a company has layoffs, but in practice, industries with very few layoffs subsidize the ones with the more.

Eligibility requirements usually include:

- Minimum employment requirements over at least the previous year.
- Unemployment must be unvoluntary and non-disciplinary.
- Individuals must take part in active labor market policies and seek for jobs.

The latter two are respectively very easy and very hard to check: even among the eligibles, **only half end up getting any benefits**. Said benefits do not cover the entirety of the previous worker's wage and usually range between 35% to 55% replacement rate. In general, benefits can be collected for up to 6 months, with extensions for periods of ordinary or exceptional recessions. EU countries tend to be more generous for longer.

In principle, insurance should cover 100% of the costs, but due to market inefficiencies and asymmetric information that cannot happen as that would **eliminate all incentives to seek labor**; therefore, the replacement rate must be less than 100%. The more people value insurance, the higher the replacement rate will be.

Empirical Evidence

Empirical work focuses on the trade-off between insurance value and efficiency cost, utilizing quasi-experimental designs to estimate the effects of UI:

- Meyer (1990) found that **unemployment benefits had a 0.4-0.6 elasticity with respect to unemployment duration** (10% rise in UI leads to 4%-6% rise in unemployment duration) using a DiD design.

- Card, Chatty and Weber (2007) found that in Austria a worker can get up to 30 weeks of benefits when employed for more than 36 months in the last 5 years, against the usual 20 weeks. Using an RDD analysis they found that UBs elasticity is **closer to 0.3**.
- During the COVID Pandemic Ganong (2021) found that indeed **the increase in UBs caused an increase in moral hazard**, but that increase is **largely economically insignificant and overshadowed by the positive effects insurance had in helping the job losers**.

DiD strategies were employed to see if UI had meaningful effects on consumption smoothing Gruber (1997) finds that in absence of insurance, **the unemployed' consumption would fall by 22%** (of course it doesn't tank to 0 because people *self-insure* via familial safety nets). When UI is withdrawn, there are meaningful negative effects on consumption. Another issue is **permanent job downgrades** due to the exasperate job-seeking that takes place upon receiving UI: Card, Chatty and Weber (2007) found again that **there is no evidence of long-term match benefits on subsequent job or duration** using an RRD.

Disability Insurance

Basics

Disability benefits work very **similarly to retirement** due to the limited capacity of some people to work before coming of FBA: indeed, many benefits are akin to those gained upon early retirement. In the US, such programs have the following structure:

- It's a federal program implemented in 1956, funded by payroll taxes and has undergone liberalization and higher replacement rates over time.
- Requires medical proof of having indeed a disability, alongside previous work experience and a five-months waiting period with no earnings.
- Appeal is possible for rejected candidates and DI is seen as an **absorbing state** with many never leaving it for good.

In 80 years, the population on DI has almost quintupled, with a strong growth registered during recessions, sparking the question if beneficiaries are **indeed disabled or pose as disabled to not work** (moral hazard). Indeed, detecting disability is very difficult, especially for not-clearly-crippled levels of disability: one way to solve this is through **audit studies** where a state panel review claims twice, with the second time being reviewed again a year later as anonymous claims. This shows **massive incidence of false-positives and false-negatives** in the decision making.

Empirical Evidence

According to Bound (AER, 1989), only 30% of rejected applicants return to work, earning less than half of the non-DI wage: if rejected applicants do not work, then surely DI recipients will not work as well, showing that **rejected applicants' labor is an upper bound for the labor force participation rate of DI recipients** absent DI. Another AER study in 2011 confirmed the results of Bound.

Again, from the AER, Maestas-Muller-Strand (2013) estimate the causal effects of DI on work using natural variation in the examiners' stringency and administrative data: since the examiners are assigned at random and they have random levels of stringency, **they are a valid instrument**

of DI receipt. The results show that DI reduces the probability of being in employment by 28% (causal effects defensible on marginal cases).

Workers' Compensation

It's a state-level program made to **insure workers for injuries on the job**, especially if short-term: it has a near-100% replacement rate (with substantial variation across states) and requires previous medical clearance. It is considered a **mandated benefit** and firms are expected to provide it upon necessity, even if no payroll taxes are extracted for it: the private sector usually provides them, and premiums are **tightly experience-rated** and high-risk firms are charged way more. Moreover, WC is **no-fault**, meaning that any injury is covered regardless of the worker's actions leading to it.

Again, **moral hazard is still the main issue** as proving that someone is indeed injured is difficult: many workers exploit WC to get Mondays and Fridays off and, through a DiD, Meyer (1995) found that after an increase in WC for high-earners, duration and healthcare costs of recipients increased (elasticity of WC benefits is **approximately 0.4**). This is not causal and there *is no empirical evidence of widespread welfare losses due to moral hazard*.

Health Insurance

Public Provision of Public Healthcare

Healthcare is a costly type of insurance and low-income families persistently fail at obtaining it from the private sector: in the US, underprovision generates massive outstanding costs in terms of GDP and a significant 10% of the population is outright uninsured. Conversely, **all OECD countries** (net the US) provide some form of public health insurance funded via taxation: the state directly controls a significant portion of hospitals and physicians and **regulates the sector to prevent overconsumption** with measures like *patient co-payments*.

Back to the US, HI is partially provided by the state via **Medicare** (for the elderly) and **Medicaid** (for the poor), with some special insurance provision for disabled veterans on the side. The private sector insures **more than half of the population** through employer-provided HI and a minority through individual purchases of insurance. 10% of the population is uninsured, but **that figure used to be 15% pre-ACA**.

Employers provide insurance since WW2, which allows them to *pool risks*. The system was put in place when healthcare costs were relatively low, but now **insurance premiums are significantly impacting workers' wages** as employers usually finance these schemes via payroll costs. Medicare is given to the elderly and non-elderly on DI and is financed through uncapped payroll taxes at 3%: physicians are not-as-well-compensated as under private insurance, but rates are competitive, nonetheless. Medicaid goes primarily to **mothers and kids** and doctor reimbursement is extremely low, so much so that many refuse Medicaid recipients altogether. Generosity for Medicaid is also very shifty and there are **many states that refused Medicaid bolstering in the past**.

The Affordable Care Act (2010, Obamacare) **overhauled the insurance market** allowing for *nongroup insurance to* flourish and go past the adverse selection issues. It is financed via a surtax on the rich and forces individuals and large employers to buy insurance or face a fine. At the same time, **it banned pre-existing conditions as an exclusion criterion for HI** and increased Medicaid eligibility up to 140% of the poverty line.

Legally, Obamacare was ratified, but the feds couldn't force states to expand Medicaid, leading to many states having *gaps in their health insurance provision* where people fall into grey areas. Nonetheless, **coverage increased dramatically and allowed for easier access to healthcare**.

Most OECD Countries find that **universal healthcare is desirable** and the costs of uninsured people falling sick or facing pre-existing health risks, or outright moral hazard (i.e., people with unhealthy lifestyles) is acceptable in the pursuit of a more equal provision. In the US, this proposition is known as **Medicare for All**, and it would require a *massive shift from private to public provision of insurance*: Obamacare was a step towards that direction by making it easier for people to get ACA exchanges or better access to Medicaid, while maintaining the massively expensive employer-sponsored insurance system.

Healthcare Effects on Utilization and Health

Finkelstein conducted a study in 2012 to explore the effects of healthcare utilization using the **Oregon Medicaid Lottery**: if an individual won the lottery, they were taken out of the waiting list and allowed to apply and receive Medicaid: not all winners received the lottery and some went on to buy their own coverage. The lottery was used as an IV to estimate the causal effects of insurance coverage. The results show that **winning the lottery caused higher healthcare utilization, lower out-of-pocked expenditures and better self-reported health**.

Card, Dobkin and Maestas (QJE, 2008 and 2009) found through an RDD the effects of Medicare when individuals become eligible at 65. The 2008 study evaluates the effects of inequity in utilization and the 2009 study estimates the impacts on outcomes: in general, **disadvantaged groups receive a large increase in insurance coverage and healthcare utilization spikes**. Mortality for ER visits decreases as well.

From the providers' POV, doctors are not passive in the US and routinely refuse treatment to Medicaid recipients due to low reimbursement: physicians respond to financial incentives within the US system and payment schemes must be engineered to avoid underprovision from the supply-side. Payments to physicians is structured in the following way:

$$P = \alpha + \beta \cdot c$$

Where α is a fixed cost payment per diagnosis and β is the payment for the proportional cost: the general trend is to **prioritize fixed-costs payments and reduce β as much as possible**, but this leads to underprovision. This **prospective payment scheme** (PPS) is done to reduce costs but there have been reports of complaints about lower quality care.

Indeed, Cutler (1993) found that PPS is Medicare led to reductions in treatment intensities, while **no meaningful outcomes impact has been found**. Cost growth decreased dramatically in the short-run and picked up again later. An unintended consequence of cost-cutting was the **overprescription of opioid painkillers to wounded people**, which fueled the Oxycodone Opioid Crisis (which is still ongoing) with millions addicted.

Inequality, Poverty, Taxes and Transfers

Redistribution

Even if markets are perfectly competitive, they **can generate substantial inequality**, which increases social tensions and fuels political extremism. By this, people tend to **pool their wealth**

to fund transfer programs to aid the poor through welfare and benefits: this creates the equity-efficiency trade-off.

Production requires (broadly) **labor and capital** as factors of production, which provide individuals their incomes:

$$z = w \cdot \ell + r \cdot k$$

And this can generate inequalities on the grounds of **labor** (many people have low paying jobs due to differences in aptitude or opportunity) and **capital holdings** (many people are just born richer and thus leverage more wealth for production). Macro-wise, the main components of National Income (GDP minus depreciation of capital and net foreign income) are **labor and private wealth** with $r \approx 5.5\%$. Capital income is more concentrated than labor income, with the bottom-50% wealth holders having basically no wealth at all (Saez-Zucman 2016). According to the World Inequality Lab, **income and wealth inequality are rather similar for the world**.

The Gini Coefficient is a major index to calculate inequality and is calculated as:

$$\text{Gini} = 2 \cdot \text{Area between a } 45° \text{ Line and the Lorentz Curve}$$

With the Lorentz Curve being the locus where all percentiles of the population are plotted with respect to the fraction of the total national wealth they hold. Empirically speaking, the following trends emerge:

- Labor income inequality is on the rise since the 1970s.
- The gender pay-gap is shrinking but still significant at the top echelons.
- Bottom-50% pretax income has stagnated since the 1980s despite a 60% aggregate increase nationwide.
- Top income shares fell until the 1950s and picked up again in the 1980s, especially in English-speaking countries.

Poverty

Poverty is an evanescent concept and is usually geographically determined. The World Bank defines **absolute poverty as a threshold**: everyone earning **less than 1.90 2015-USD daily** falls below it, while all countries define poverty as a *fraction of some median or average income* (in the EU, it's 60% of median). The former **naturally falls with economic growth**, while the latter does not and is best geared to *capture the inequality effects of production*. Poverty is also usually evaluated via **health measures** like stunting or mortality in the long run.

Poverty is **always calculated on disposable income**, calculated in the Current Population Survey and defined as:

$$c = z - T(z) + B(z) + E$$

Where $-T(z) + B(z)$ are taxes and benefits respectively and E are private transfers. Ideally, poverty should be **tackled at the individual level** on an individual-consumption basis. However a lot of goods are shared within families and it's more challenging to measure consumption at the individual level, that's why **poverty is also calculated at the family level using a unitary household assumption**.

In the US, poverty thresholds are adjusted annually on a CPI-basis and the **absolute poverty rate has hardly fallen since the 1970s** despite enormous economic growth. There are conceptual weaknesses to the US model (which values only money income):

- Income and payroll taxes are not deducted.
- Income tax credits and in-kind welfare transfers are not added.

Intergenerational Mobility

There is the consensus that children's success shouldn't entirely depend on their parents' wealth and this creates the need to **maintain intergenerational mobility**: measuring it is difficult and Chetty (2014) does it by measuring average adult children income rank by average parents' income rank. The results of Chetty's research, both in 2014 and in 2020 is that:

- The US has a **lower level of intergenerational mobility**.
- There is substantial heterogeneity in mobility across cities in the US, with cities that have low segregation and income inequality being on top.
- Substantial racial disparity in mobility has been found (Asians appear to be the nimblest group, blacks and whites the least).

Transfers and Tax Systems

Governments tax individuals based on income and consumption and if z is the pretax income, we define post-tax income as:

$$y = z - T(z) + B(z)$$

And if inequality in y is less than in z across citizens, then the tax system is considered **progressive**, otherwise it will be considered **regressive**.

In the US, 2/3 of all tax burden is federal and the overwhelming majority of that is made out of **income, payroll and corporate taxes**. State and local tax systems levy income, corporate and sales/excise taxes. The decentralized system, as per the Tiebout model, creates tax competition and can make redistribution harder, especially in sales taxes that are **highly regressive**.

In general, progressivity has increased until 1950 and then decreased over time. However, transfers through welfare happen and have increased since the 50s.

Empirical Evidence on Redistribution

Piketty-Saez-Zucman (2018) distribute both pretax and post-tax national income across all adults, showing a more comprehensive view of progressiveness in the tax system based on actual income earned by residents. They find that in the US; **real income post-tax is far higher on average than pre-tax** except for the top 10% of earners. Such results were confirmed in 2020. Blanchet-Saez-Zucman (2022) showed that COVID had a very large and negative impact on **factor income**, especially on low earners, but all income groups recovered fast. Government transfers increased a lot **causing a spike in disposable income**.

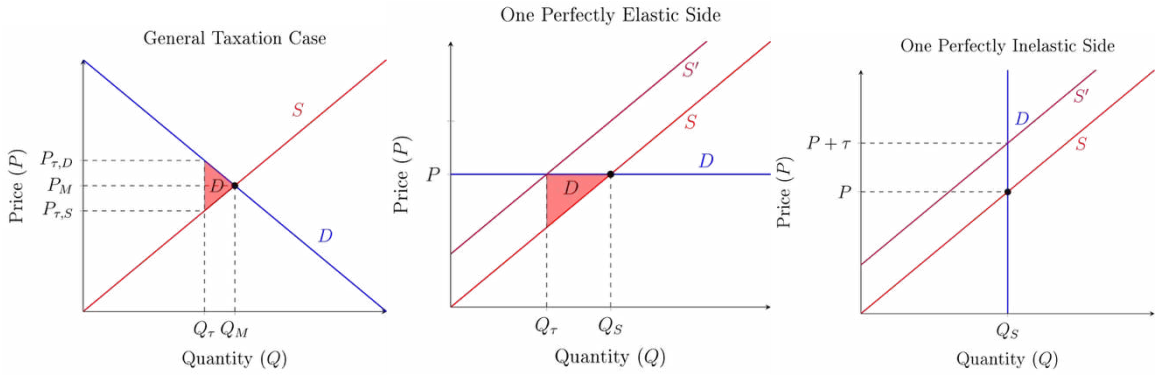
Tax Incidence

Definitions and Partial Equilibrium Incidence

Tax incidence is the **study of the effects of taxation on the economic welfare of individuals** through price changes. If something is taxed, the entire incentive structure to consume and produce shifts. It's not an accounting exercise and it's an analytical characterization of the change in the economic equilibrium:

- The **statutory burden of a tax does not describe who really bears it**.
- The **market side the tax is imposed on is irrelevant**.
- Parties with **inelastic supply or demand bear the tax** while elastic parties do not.

Considering an economic model with a single taxed good is a good start to understand taxation. Imagine the levy of an **excise** (based on quantity) **tax on a good** that can be either *ad-valorem* or *fixed in nominal terms*. The side of the market it's levied on *is entirely irrelevant* and to determine who is actually bearing the cost of the tax we need to look at the **elasticity of demand and supply**: the more elastic one side of the market, the least the effect of the tax.



Notably, if a side of the market is perfectly inelastic, it will absorb the entire tax burden and the economy will face no welfare cost. To measure the tax burden on a party, we measure the **portion of government tax revenue coming from that side of the market**.

Efficiency Costs of Taxation

Deadweight Loss of taxation is defined as the **welfare loss caused by the levy of a tax**: it is calculated as the *difference between the total producer and consumer surplus minus the value of the tax* and it shows as the **Harberger Triangle** in the quantity-price space:

$$\text{DWL} = -\frac{1}{2} \cdot \frac{\varepsilon_S \varepsilon_D}{\varepsilon_S - \varepsilon_D} \cdot \tau^2 \cdot \frac{Q}{P}$$

Which implies that DWL increases with **the absolute size of elasticities** and it increases with the **square of the tax rate**, meaning that is best to *spread the tax burden on a lot of relatively inelastic goods* to reduce the loss caused by the tax. Moreover, it's considered best to **finance through debt costly endeavors like wars** and not through super-high taxes, and it's **very costly to stack taxes on pre-existing distortions**.

An example of such model can be found in Finland's cut on hairdressers' VAT rate in 2007: Kosonen (2015) found through a DiD study that **VAT's have a consumer pass-through rate of**

50% (half the tax burden falls on consumers) and after the reform the firms' profits increased substantially with no substantial effects on unemployment.

Tax Incidence in General Equilibrium

The previous discussion focused on the **concept of partial equilibrium**, or the effects of a tax levied on a good *in that good's market*, but taxes can **impact adjacent markets and generate knock-on effects**. This means that incidence must also be measured in terms of **General Equilibrium**.

Let's assume a tax is levied on restaurant meals in a fantasy world where demand is perfectly elastic. By this, **restaurants bear the entire tax burden**, leading to a *shrinkage in the demand for the factors of production for restaurants*. Specifically, labor demand will automatically fall and so would demand for capital goods: if the former market is very elastic supply-side, then the effect will be a **fall in employment** and if the latter market is stiffer, it will lead to a **fall in the rate of return for capital goods**.

By this, such a tax reduces employment in the hospitality sector and ROI for investors whose capital is tied up in restaurants. *However, in this framework, the effects are expected to be short-term for capital investments due to money fungibility*: it's likely that investors will just shift their cash elsewhere in the long-term.

It's time to do this! Go Forth and Conquer!

- *Piergiulio.*

FOR DOUBTS OR SUGGESTIONS ON THE HANDOUTS

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TEGAMINO'S

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