Social insurance programs are based upon events: unemployment, disability, age.

These programs exist to insure individuals against income shocks.

Three major programs: Unemployment insurance, disability insurance, and workers’ compensation.

Participation in social insurance programs is generally mandatory. When voluntary, the cost is subsidized to ensure essentially universal participation.

In 2005, social expenditure was 20.6% of GDP in the OECD countries (around 50% of total public expenditure).
Unemployment insurance is a public program in which payroll taxes are used to pay benefits to workers laid off by firms.

Disability insurance is a program in which a portion of the Social Security payroll tax is used to pay benefits to workers who have suffered a medical impairment that leaves them unable to work (“invalidez”).

Workers’ compensation is a mandated program that pays for medical costs and lost wages associated with an on-the-job injury.
UI across countries

Source: Gruber 2007
Consumption smoothing

- Relatively little evidence on the consumption smoothing implications of these programs
- Gruber (1997) finds that individuals are not fully insured by other sources against the income loss of unemployment
- If they lose their jobs, their consumption falls significantly
- Higher levels of unemployment insurance mitigate the negative effects of this fall in consumption
Moral hazard effects of UI

Unemployment Hazard Rate • Each point on this graph represents the hazard rate of unemployed workers, the rate at which they exit unemployment. Workers in the United States are much more likely to leave unemployment in the 26th week, the week that UI benefits end, than in any earlier week.

Source: Adapted from Meyer (1990), Table 4.
Moral hazard effects of DI

Labor Force Nonparticipation of Older Men and Growth in DI

There is a striking correspondence between the growth in the DI program from the mid-1950s to the mid-1970s, and the rise in nonparticipation rates of men age 45–54 during this same period. This correspondence may indicate that the availability of DI induced older men to leave the labor force, but other factors may also explain the correspondence.

Source: Parsons (1984), Figure 1.
Why social insurance?

The main questions to address are:

1. Why do we need social insurance?
2. If we have social insurance, what is the optimal level?

When dealing with social insurance the basic trade-off is determined by two forces:

1. Protection: the benefits offered by the program reduce fluctuations in consumption. For instance, after retirement
2. Distortion: the program may change incentives for individuals that lead to inefficiency

We begin with the issue of why do we need social insurance
Reasons for social insurance

- The first reason is that the existence of asymmetric information may destroy private insurance markets.
- The second is that government cannot distinguish those who are poor when old or unemployed because they had bad luck or were myopic from those who are intentionally gaming the system by not saving enough in order to get transfers from government. That is, it is impossible to distinguish between “deserving” and “non-deserving” poor.
- The second case is also a problem of information.
A classical result is that risk averse individuals, if offered an actuarially fair insurance, will choose to insure completely. Now the question is why it is necessary government intervention. Why private insurance is not enough? The reason is the existence of market failures, in particular adverse selection and individual optimization failures, like myopia. We concentrate on the problem of asymmetric information. The classical reference is the Rotschild-Stiglitz (1977) paper. The idea is that asymmetric information leads to market failure, but government intervention with mandated insurance may produce a Pareto improvement.
Demand for insurance contracts

- Two types of individuals: low-risk (L) and high-risk (H). The high-risk are a proportion $\pi$
- High-risk individuals face a probability $p_H$ of becoming unemployed. Low-risk individuals have probability $p_L$ ($p_H > p_L$)
- In the good state (state 1), individuals earn $E_1$. In the bad state they earn $E_2 < E_1$. Expected income is $(1 - p_i)E_1 + p_iE_2$. Individuals do not save
- Without insurance, income (and consumption) in the two states (employed, unemployed) is $(E_1, E_2)$
- An insurance contract is a pair $\alpha = (\alpha_1, \alpha_2)$. Consumption in the two states is $(W_1, W_2) = (E_1 - \alpha_1, E_2 + \alpha_2)$. Here $\alpha_1$ is the premium and $\alpha_2$ is the coverage (net of the premium)
Expected utility with insurance contract $\alpha$ for an individual with probability $p_i$ is:

$$V_i(\alpha) = (1 - p_i)u(E_1 - \alpha_1) + p_i u(E_2 + \alpha_2)$$

The consumer will choose, among all available contracts, the one that maximizes $V_i(\alpha)$ provided it is better than not having insurance at all.

In the space $(W_1, W_2)$, the slope of an indifference curve of this individual is:

$$\frac{\partial W_2}{\partial W_1} = -\frac{(1 - p_i)}{p_i} \frac{u'(W_1)}{u'(W_2)}$$

At the 45-degree line, it is just $-\frac{(1-p_i)}{p_i}$.
Supply of insurance contracts

- Companies are risk neutral and maximize expected profits
- Selling a contract $\alpha$ to an individual with probability $p_i$ gives profits:
  \[(1 - p_i)\alpha_1 - p_i\alpha_2\]
- The market is perfectly competitive because there is free entry. Any contract that is demanded and is expected to be profitable will be supplied
- Individuals know $p_i$, but companies do not
We assume that individuals can buy only one insurance contract.

An equilibrium is a set of contracts such that, when both types choose contracts to maximize utility: (i) no contract in the equilibrium set makes negative expected profits and (ii) there is no contract outside the equilibrium set that, if offered, will make a nonnegative profit (free-entry condition).

We begin with the case of symmetric information in which companies observe $p_i$. 
Symmetric information

- With perfect information, the zero profit condition is 
  
  \((1 - p_i)\alpha_1 - p_i\alpha_2 = 0\) and, therefore:

  \[\alpha_2 = \frac{1 - p_i}{p_i}\alpha_1\]

- We say that insurance contracts are **actuarially fair**. If, for instance 
  \(p_i = 0.1\), then the ratio \(\frac{\alpha_2}{\alpha_1} = 9\). If \(p_i = 0.2\), then the ratio \(\frac{\alpha_2}{\alpha_1} = 4\)

- Since \(W_1 = E_1 - \alpha_1\), then \(W_2 = E_2 + \alpha_2 = E_2 + \frac{1-p_i}{p_i} \alpha_1\)

- The budget line in the space \((W_1, W_2)\) is:
  
  \[W_2 = E_2 + \frac{1-p_i}{p_i} E_1 - \frac{1-p_i}{p_i} W_1\]
Each individual solves:

$$\max_{\alpha_1} (1 - p_i) u(E_1 - \alpha_1) + p_i u(E_2 + \frac{1 - p_i}{p_i} \alpha_1)$$

The FOC is:

$$-(1 - p_i) u'(W_1) + p_i (\frac{1 - p_i}{p_i}) u'(W_2) \leq 0$$

with equality if $\alpha_1 > 0$

Easy to see that $\alpha_1 = 0$ is impossible. Optimal solution entails full insurance ($W_1 = W_2$) for both types. They earn their expected income $(1 - p_i)E_1 + p_i E_2$ in both states
Equilibrium with perfect information

Equilibrium with Perfect Information

\[ \text{Slope} = \frac{1-p}{p} \]

\[ MRS_{12} = \frac{u'(c_1)(1-p)}{u'(c_2)p} \]

E = endowment
\( \alpha^* \) = eq. contract

Source: Rothschild and Stiglitz 1976
Now firms cannot distinguish types. High-risk individuals prefer the contract offered to low-risk individuals (with symmetric information).

The optimal contract with asymmetric information differs from optimal contracts with symmetric information. We look for other possibilities.

Companies know that a fraction $\pi$ of individuals are high-risk. Then, the average probability of unemployment is:

$$\bar{p} = \pi p_H + (1 - \pi) p_L$$

There can be two types of equilibrium: pooling in which both groups buy the same contract, and separating, in which different types buy different contracts.
In a pooling equilibrium, zero-profit condition requires:

\[ \alpha_2 = \frac{1 - \bar{p}}{\bar{p}} \alpha_1, \]

where \( \bar{p} = \pi p_H + (1 - \pi) p_L \)

For fixed \( p_H \) and \( p_L \), the higher is \( \pi \) the lower is \( \alpha_2 / \alpha_1 \)

Since \( \bar{p} > p_L \), low-risk individuals get less in the bad state than with symmetric information

This creates an opportunity for a new company to enter and offer them another contract with a little less coverage at a better price

Only the low-risk will want to deviate, because they value more consumption in the good state

Since this contract is profitable for the new company, the pooling equilibrium is destroyed
No pooling equilibrium (figure)

No Pooling Equilibrium with Asymmetric Information

E = endowment
β = new contract

Source: Rothschild and Stiglitz 1976
Separating equilibrium

- In any separating equilibrium, high-risk individuals will be fully insured while low-risk individuals will be under-insured.
- Both types get actuarially fair insurance because of the zero-profit condition.
- Companies will provide full insurance to the high-risk individuals, since the worst can happen is that some low-risk purchase that contract, raising the profits of the firm.
- Offering full insurance to the low-risk individuals will induce the high-risk to buy this contract, and the firm loses money.
- In the equilibrium, low-risk individuals get as much insurance as possible without inducing the high-risk to purchase the contract designed for the low-risk.
Separating equilibrium 2

The equilibrium contract for the low-risk, called \((\alpha_1^L, \alpha_2^L)\) has to satisfy two conditions:

1. Because of the zero profit condition: \(\alpha_2^L = \frac{1-p_L}{p_L} \alpha_1^L\)
2. To discourage the high risk:

\[
u((1 - p_H)E_1 + p_H E_2) \geq (1 - p_H)u(E_1 - \alpha_1^L) + p_H u(E_2 + \alpha_2^L)\]

Using the zero profit condition above, we see that the term on the right is strictly increasing in \(\alpha_1^L\). The second condition, therefore, defines an upper bound for \(\alpha_1^L\).
Equilibrium?

- However, the above situation will be an equilibrium only when the proportion of high-risks ($\pi$) is high enough. If $\pi$ is low, it is dominated by a pooling equilibrium at an actuarially fair rate with full insurance.

- High-risks are clearly better, since they are pooled with the low-risk individuals, and get higher consumption in both states.

- Low-risks can be better off if there are few high-risks. In particular, if:

$$u((1 - \bar{p})E_1 + \bar{p}E_2) \geq (1 - p_L)u(E_1 - \alpha_1^L) + p_L u(E_2 + \alpha_2^L)$$

  - The lower is $\pi$, the higher is the term on the left.
  - When $\pi$ is low, the low risk individuals benefit from being pooled with them and getting full insurance. Since we have already seen that a pooling equilibrium cannot exist, we find that adverse selection can destroy the market.
Numerical example

- Take $E_1 = 100$, $E_2 = 0$, $p_H = 3/4$, $p_L = 1/4$, and $u(c) = \sqrt{c}$
- With symmetric information individual $H$ chooses (25, 25) while individual $L$ chooses (75, 75). Note that $H$’s contract must satisfy $\alpha^H_2 = \alpha^H_1 / 3$ and $L$’s contract is $\alpha^L_2 = 3\alpha^L_1$
- The candidate for separating equilibrium satisfies $\alpha^L_2 = 3\alpha^L_1$ and:

\[
5 = \sqrt{\frac{1}{4} 100} \geq \frac{1}{4} \sqrt{100 - \alpha^L_1} + \frac{3}{4} \sqrt{\alpha^L_2}
\]

We get $\alpha^L_1 = 3.85$ and $\alpha^L_2 = 11.55$
For this to be an equilibrium, it cannot be dominated by a pooling contract at an actuarially fair rate

In a pooling equilibrium, \( \bar{p} = \pi \frac{3}{4} + (1 - \pi) \frac{1}{4} = \frac{1 + 2\pi}{4} \)

Suppose that:

\[
\sqrt{100(1 - \bar{p})E_1} \geq \frac{3}{4} \sqrt{100 - \alpha_1^l} + \frac{1}{4} \sqrt{\alpha_2^l} \approx 8,204
\]

Then, there is no equilibrium. This happens if \( \pi \leq 0,154 \)
Government intervention

- Government can produce a Pareto improvement because of mandatory participation.
- An unemployment insurance program that pools both types and replicates the pooling equilibrium above leads to a Pareto improvement over the separating equilibrium.
- Both types are better off than in the separating equilibrium, although the low-risks are not fully insured.
- The crucial issue is that the public program has to be mandatory, both types must participate.
- If not, a company can take the low risks.
Empirical evidence on adverse selection

- There is empirical evidence showing that there is adverse selection in insurance markets.

- Finkelstein and Poterba (2004) study annuity markets in the UK and find that those who purchase backloaded annuities have lower mortality rates.

- An annuity is a contract that makes a series of payments in the future in exchange for the immediate payment of a lumpsum. The value of the annuity depends on life expectancy, interest rates, etc. Payment does not stop until the buyer dies.

- A more backloaded annuity is one with a payment profile that provides a greater share of payments in later years (also “escalating annuity” ).
Individual failures

- If the existence of adverse selection prevents markets from reaching efficiency, people should self insure against these shocks. For example, by saving to have enough assets in case of unemployment.

- However, it seems that most individuals do not save adequately. In the US, the median job loser has less than $200 in assets. This may be because individuals do not perceive the risk of unemployment. They may be myopic, or they may discount the future too much.

- If this is the case, a mandatory public program can help to save the problem. Note that this is a paternalistic view.

- The reason for intervention is not the existence of adverse selection, but the fact that individuals do not behave “rationally”
Optimal level of social insurance

- In the model above, perfect insurance is optimal.
- In the real world we have to take care of the moral hazard problem: if individuals are perfectly insured, they will not work. This is a distortion that we have to take into account.
- To find the optimal level of social insurance we have to deal with the trade-off between protection and moral hazard.
- In the sequel, we focus on unemployment insurance.
The positive effect of UI is that it allows individuals to smooth consumption.

It creates distortions through various channels: unemployment duration can be longer, workers may reduce effort at work since the risk of losing the job is less severe, etc.

The size of the unemployment program is measured by the replacement rate $r$, which is the ratio between the net benefit and the net wage (prior to being unemployed).

This ratio varies a lot across countries.
Baily-Chetty model

- All workers are identical
- There are two periods: individuals work in period 1, and can be unemployed in period 2
- Utility depends only on income
- There is a fixed probability of losing the job
- There are no general equilibrium effects: wages are fixed
- No externalities in search (no crowding out effects)
Basic model

- Income is $w_H$ in the good state and $w_L$ in the bad state (unemployment). We assume $w_L < w_H$
- Individual has wealth $A$, and consumption in each state is $c_H$ and $c_L$
- When unemployed, individual must search for a job. Search effort $e$ has cost $\psi(e)$
- We choose units such that the probability of the good state is $p(e) = e$
- UI pays $b$ to the unemployed, and it is financed by a lump sum tax $t(b)$ in the good state. The budget constraint of the program is:
  \[ e \times t(b) = (1 - e) \times b \]
- Expected utility of the individual is:
  \[ e \times u(A + w_H - t(b)) + (1 - e) \times u(A + w_L + b) - \psi(e) \]
In 1st best, no moral hazard because government observes $e$.

The problem of the government is to choose $b$ and $e$ to maximize the utility of the individual, subject to the constraint $t = \frac{1-e}{e} b$. That is:

$$\max_{b,e} e \times u(A + w_H - \frac{1-e}{e} b) + (1-e) \times u(A + w_L + b) - \psi(e)$$

The FOC is:

$$e \times \left(-\frac{1-e}{e}\right) \times u'(c^*_H) + (1-e) \times u'(c^*_L) = 0$$

Solution is $u'(c^*_H) = u'(c^*_L)$, complete insurance.
• Since $c_H^* = c_L^*$, we get $A + w_H - \frac{1-e}{e} b = A + w_L + b$, and $w_H - w_L = b/e$

• The FOC for optimal effort is:

$$u(c_H^*) - u(c_L^*) + eu'(c_H^*) \left( \frac{b}{e^2} \right) - \psi'(e) = 0$$

• Solving:

$$u'(c_H^*) \frac{b}{e} = \psi'(e)$$
Now effort is not observed by the government. The agent maximizes expected utility taking \( t(b) \) and \( b \) as given:

\[
\max_e e \times u(A + w_H - t) + (1 - e) \times u(A + w_L + b) - \psi(e)
\]

The FOC is:

\[
u(c_H) - u(c_L) = \psi'(e)
\]

The term on the right is the marginal cost of search
The indirect utility function is $V(b, t)$. Now the objective of the government is to choose $b$ and $t$ to maximize the expected utility of the agent, taking into account that the individual will react optimally to the program:

$$\max_{b,t} V(b, t) \quad \text{s.t.} \quad e(b)t = (1 - e(b))b$$

At an interior solution, the optimal benefit satisfies $\partial V / \partial b(b^*) = 0$.
To calculate that condition, we write $V(b)$ as:

$$V(b) = \max_{e} e \times u(A + w_{H} - t(b)) + (1 - e) \times u(A + w_{L} + b) - \psi(e)$$

Since the individual has already optimized with respect to $e$, the Envelope Theorem implies:

$$\frac{\partial V(b)}{\partial b} = (1 - e)u'(c_{L}) - \frac{\partial t}{\partial b}eu'(c_{H})$$

To see this, calculate $\frac{\partial V(b)}{\partial b}$ without taking into account that the individual chooses $e$ optimally.
In that case we have:

\[
\frac{\partial V(b)}{\partial b} = (1 - e)u'(c_L) - \frac{\partial t}{\partial b} eu'(c_H) + \frac{\partial e}{\partial b} [u(c_H) - u(c_L) - \psi'(e)]
\]

But the last term is zero, because the first order condition when the individual solves for \( e \) is:

\[
u(c_H) - u(c_L) - \psi'(e) = 0
\]

The budget condition of the government is:

\[
t(b) = \frac{1 - e}{e} b
\]
We use the budget constraint to calculate \( \frac{\partial t}{\partial b} \).

In particular:

\[
\frac{\partial t}{\partial b} = \frac{1 - e}{e} - \frac{b}{e^2} \frac{\partial e}{\partial b} = \frac{1 - e}{e} + \frac{b}{e^2} \frac{\partial (1 - e)}{\partial b}
\]

\[
= \frac{1 - e}{e} + \frac{b}{e^2} \frac{\partial (1 - e)}{\partial b} \frac{b}{1 - e} = \frac{1 - e}{e} (1 + \frac{\varepsilon_{1-e,b}}{e})
\]

Here \( \varepsilon_{1-e,b} \) is the elasticity of the probability of unemployment with respect to \( b \).
Plugging it into the condition:

\[ \frac{\partial V(b)}{\partial b} = (1 - e) \left\{ u'(c_L) - \left(1 + \frac{\varepsilon_{1-e,b}}{e}\right) u'(c_H) \right\} \]

At the optimum, this must be zero and then:

\[ \frac{u'(c_L) - u'(c_H)}{u'(c_H)} = \frac{\varepsilon_{1-e,b}}{e} \]

On the left, we have the benefit of transferring one euro from the good to the bad state. On the right we have the cost of that transfer, because of the reduction in effort.
We can use a Taylor expansion to write:

\[ u'(c_L) - u'(c_H) \approx u''(c_H)(c_L - c_H) \]

The coefficient of relative risk aversion is \( \gamma = -\frac{cu''(c)}{u'(c)} \). Then:

\[ \frac{u'(c_L) - u'(c_H)}{u'(c_H)} \approx \frac{u''(c_H)(c_L - c_H)}{u'(c_H)} \frac{c_H}{c_H} = \gamma \frac{(c_H - c_L)}{c_H} \]

Here \( \triangle c = c_H - c_L \) represents the drop in consumption from the good to the bad state.
The optimal level of unemployment benefit $b^*$ satisfies:

$$\gamma \frac{\Delta c}{c} (b^*) \approx \frac{\varepsilon_{1-e}, b}{e}$$

The optimal value of $b^*$ depends on: (i) The coefficient of risk aversion; (ii) The reduction in consumption when unemployed; (iii) The elasticity of the probability of unemployment with respect to the unemployment benefit

The term in the left represents the marginal social benefit of $b$, and the term on the right the marginal social cost

To get an empirical estimation of the optimal level of $b$, we need estimates of the three parameters above
Gruber (1997) estimates the consumption smoothing response
He uses the drop in food consumption to estimate the term on the left with data from the PSID. In particular he estimates:

\[ \frac{\Delta c}{c} = \beta_1 + \beta_2 \frac{b}{w} \]

The values estimated are \( \hat{\beta}_1 = 0,24 \), and \( \hat{\beta}_2 = -0,28 \). Without the existence of unemployment insurance, consumption drops a 24%. With UI, taking \( b/w = 0,5 \), the drop is \( 0,24 - 0,28(0,5) = 0,1 \), that is, a 10%.

Increasing \( b/w \) a 10% (from 0.5 to 0.6), the drop in consumption reduces from 10% to 7.2%.

This is telling that UI plays an important role in consumption smoothing
The formula can be written as:

\[ \gamma (\beta_1 + \beta_2 \frac{b^*}{w}) = \frac{\varepsilon_{1-e,b}}{e} \]

Solving for the optimal replacement rate:

\[ \frac{b^*}{w} = \frac{\varepsilon_{1-e,b} / e}{\beta_2} \frac{1}{\gamma} - \frac{\beta_1}{\beta_2} \]

Using \( \varepsilon_{1-e,b} = 0.43 \) and \( e = 0.95 \) (unemployment rate of 5\%), we obtain:

\[
\frac{b^*}{w} = - \frac{0.43/0.95}{0.28} \frac{1}{\gamma} - \frac{(-0.24)}{0.28} \\
= - \frac{1.616}{\gamma} + 0.857
\]
Some numbers

- If $\gamma = 2$, $b^*/w$ is only 5%.
- If $\gamma = 4$, $b^*/w$ is 45.3%.
- Need $\gamma \approx 4.5$ to get $b^*/w \approx 50\%$.
- If we take now $e = .75$ (Spanish case today), we get:
  \[
  \frac{b^*}{w} = -\frac{0.43}{0.28} \frac{1}{\gamma} - \frac{(-0.24)}{0.28} = -\frac{2.05}{\gamma} + 0.857
  \]
- Again, if $\gamma = 2$, $b^*/w \approx 16.8\%$.
It seems that an empirically implausible value of the coefficient of relative risk aversion is needed to justify the actual replacement rate in the US (around 0.5).

With the values of $\gamma$ most commonly used in the literature ($\gamma \approx 2$), the optimal replacement rate is much lower.

Chetty and Szeidl (2007) try to reconcile the model with the existing replacement rate.

They extend the model to capture the fact that individuals cannot adjust many elements of consumption because of the existence of adjustment costs.

Suppose utility is defined over two goods, food ($f$) and housing ($h$). Adjusting $h$ requires to pay a fixed cost $k$. 
Now suppose an individual that spends half of his income in food and half in housing.

When he gets unemployed, he must reduce expenditure by a 10%. If he cannot reduce expenditure in housing, he must reduce expenditure in food by a 20%.

According to this, it is very likely that a reasonable value for $\gamma$ is larger than usual, maybe around 4.
According to many people, moral hazard is a big problem when dealing with UI.

Chetty (2008) suggests that it is not moral hazard per se why a higher benefit seem to lead to more unemployment. He stresses the fact that unemployment benefits not simply pay individuals for being out of work, it also allows them to look more carefully for the next job. That is, instead of having to accept the first offer they receive, they can wait for a better match.

He finds that those with savings do not take any longer to find a job when paid more generous benefits, while this is observed for those who have no savings.

It seems that those who have no savings use the benefits to buy time to find the right job.