University of Bonn - Department of Economics

Public Economics Seminar - Unemployment Insurance

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Lecture No. 2

Unemployment Insurance Market Failure

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introduction

chiu and karni (1998) explain why the private sector fails to provide unemployment insurance.

crowding out by the public sector is not the source of this kind of market failure.

unemployment insurance has never been provided by the private sector (exception: Career Guard in Canada in the 1982-83 recession).

unemployment insurance intends to insure employees against income loss (smoothing the consumption).

it shall not cover cases of voluntary unemployment.

an explanation

1. individuals differ in their preferences for work and leisure.
    - some workers regard work as a “bad” and some as a “good”.
    - insurers cannot screen the preferences.
    - workers with greater risk of becoming unemployed take out unemployment insurance.
    - $\rightsquigarrow$ **adverse selection**
    - insurers may want to design different contracts in accordance with the preferences of the workers.

2. individuals exert effort while working and job-hunting.
    - actions influence the probability of being laid off and thus becoming a case for insurance.

- actions influence the probability of finding a new job when unemployed and thus the duration of the spell of unemployment.
- actions determine the costs of insurers and therefore the profit.
- insurers cannot monitor these actions.
- actions are hidden.
- $\rightsquigarrow$ **moral hazard**

individuals are risk-averse.

model shows that interacting effects of adverse selection and moral hazard lead to a “no unemployment insurance” equilibrium.

$\rightsquigarrow$ **endogenous adverse selection**

(term introduced by chiu and karni (1998))

the model

- competitive economy with identical insurers
- unemployment is caused by altering market conditions.
- workers are either employed full-time or unemployed.
- proportion λ has normal preferences for leisure, the rest $1 - \lambda$ has strong preferences for leisure.
- insurers know λ and that it is stationary.
- ϵ: effort exerted by individuals while working
- $p(\epsilon)$: probability of staying employed

- e: effort exerted by individuals while job-hunting
- $q(e)$: probability of finding a new job (hazard rate). $q(0) = 0$
- properties of the probability functions:
  - strictly monotonic increasing
  - twice-differentiable
  - concave
- $(\epsilon, e) \in [0, 1]^2$, numbers are normalized to unity

timetable

A new period of time starts:

1. The labor market opens. Those who are unemployed and willing to work hunt for a job.

2. The job market closes. Each individual finds out whether she has normal or strong preferences for leisure. Unemployed workers who are eligible for insurance collect benefits.

3. Employed workers choose an unemployment insurance contract that matches their preferences for leisure. Unemployed individuals are not entitled to sign an unemployment insurance contract.

4. Workers are informed whether they are suspended from work or are given work in the next period.

utility function

- an individual can allocate one unit of time between work and leisure.

- utility function of an individual: $u(w(1-l), \gamma l)$
  - first argument: work
  - second argument: leisure
  - l: amount of leisure
  - w: competitive wage rate
  - $\gamma \in \{\gamma_0, \gamma_1\}$ denotes the type of a worker:

- $\max_{l\in[0,1]} u\big(w(1-l), \gamma_0 l\big) = u(0, \gamma_0)$

  $\rightsquigarrow$ γ_0-workers choose $l = 1$ (full-time leisure).

- $\max_{l\in[0,1]} u\big(w(1-l), \gamma_1 l\big) = u(w, 0)$

  $\rightsquigarrow$ γ_1-workers choose $l = 0$ (full-time employment).

- properties of the utility function
  - monotonic increasing in both arguments
  - twice continuously differentiable
  - concave
  - $u_{12} > 0$, partial derivative of u_2 w.r.t. the first argument

- choice of l of γ_0- and γ_1-workers are corner solutions of a maximization problem. thus, the utility function has to satisfy some more properties:
  - the total differential of the utility function w.r.t. l is given by:

$$\frac{du}{dl} = -u_1\big(w(1-l), \gamma l\big)w + u_2\big(w(1-l), \gamma l\big)\gamma$$

- γ_1-workers choose $l = 0$ iff:

$$\frac{du}{dl} < 0 \Leftrightarrow -u_1(w,0)w + u_2(w,0)\gamma_1 < 0$$

$\rightsquigarrow$ more leisure reduces utility.

- γ_0-workers choose $l = 1$ iff:

$$\frac{du}{dl} > 0 \Leftrightarrow -u_1(0,\gamma_0)w + u_2(0,\gamma_0)\gamma_0 > 0$$

$\rightsquigarrow$ more leisure increases utility.

expected utility

- workers maximize expected utility.

- they have a von Neumann-Morgenstern utility function
  - represents preferences over income, leisure, ϵ, and e
  - is additively separable in effort

- if no unemployment insurance is available, the expected utility function of a γ_1-worker is:

$$p(\epsilon)u(w,0) + \big[1 - p(\epsilon)\big]\Big[q(e)u(w,0) + \big[1 - q(e)\big]u(0,\gamma_1) - e\Big] - \epsilon$$

- if a γ_0-worker is not laid off, she will quit the job and will not hunt for a new job, thus $\epsilon^* = e^* = 0$. the expected utility function is:

$$\begin{aligned} & p(0)u(0,\gamma_0) + \big[1 - p(0)\big]\Big[q(0)u(0,\gamma_0) + \big[1 - q(0)\big]u(0,\gamma_0)\Big] \\ = \quad & u(0,\gamma_0) \end{aligned}$$

unemployment insurance

- optimal choices of efforts are denoted by $\epsilon^*(c;\gamma)$ and $e^*(c;\gamma)$.
- $c = (\alpha, \beta)$ represents a contract with insurance premium α and net indemnity β.
- average probability of unemployment of individuals possessing insurance policy c:

$$\pi(c, C') = \sum_{\gamma} \mu\big(\gamma \mid I(c, C')\big)\left[1 - p\big(\epsilon^*(c,\gamma)\big)\right]\left[1 - q\big(e^*(c,\gamma)\big)\right] \quad (1)$$

- I: set of workers who are eligible for unemployment insurance in the current period
- $C' \subset C$, $\hat{c} \in C'$
- $I(\hat{c}, C') = \{i \in I \mid U_i^*(\hat{c}) \geqslant U_i^*(c) \ \forall \ c \in C'\} \subset I$: subset of workers that prefer $\hat{c}$ to every other policy c in C'
- $\mu(\gamma \mid I(\hat{c}, C'))$: proportion of γ-workers in $I(\hat{c}, C')$

- an insurance contract is actuarially sound if the expected profit is nonnegative:

$$\big(1 - \pi(c; C')\big)\alpha - \pi(c, C')\beta \geqslant 0$$

$$\Leftrightarrow \quad \alpha \geqslant \frac{\pi(c, C')}{\big(1 - \pi(c; C')\big)}\beta$$

definition 1. *if*

1. *for each* $c = (\alpha, \beta) \in C^*$

$$\alpha \geqslant \frac{\pi(c; C^*)}{1 - \pi(c; C^*)}\beta \tag{2}$$

2. *for any* $c' = (\alpha', \beta') \notin C^*$

$$\alpha' < \frac{\pi(c'; C^* \cup \{c'\})}{1 - \pi(c'; C^* \cup \{c'\})}\beta' \tag{3}$$

then the set C^* *constitutes an equilibrium.*

if the set $I(c; C^*)$ *consists of more than one type of worker then, for some* $c \in C^*$, C^* *constitutes a pooling equilibrium. it is a separating equilibrium if* $I(c, C^*)$ *consists of only one type of worker.*

- first condition states that an insurance contract in equilibrium must be actuarially sound given the subset of workers that sign it.

- off-equilibrium contracts make negative profits given any subset of workers that are attracted.

maximization problem

given unemployment insurance (α, β), γ-workers choose ϵ and e so as to maximize:

$$p(\epsilon)u(w-\alpha,0)+\big[1-p(\epsilon)\big]\Big[q(e)u(w-\alpha,0)+\big[1-q(e)\big]u(\beta,\gamma)-e\Big]-\epsilon \tag{4}$$

the first-order-conditions are:

$$p'(\epsilon^*)\Big[\big[1-q(e^*)\big]\big[u(w-\alpha,0)-u(\beta,\gamma)\big]-e^*\Big]=1$$

and

$$q'(e^*)\big[u(w-\alpha,0)-u(\beta,\gamma)\big]=1$$

first conclusions

lemma 1. *γ_0-workers choose $\epsilon^* = e^* = 0$.*

proof. γ_0-workers prefer $l = 1$. utility from α and β is $u\big(w(1-l) - \alpha; \gamma_0 l\big) = (-\alpha, \gamma_0)$ and $u\big(w(1-l) + \beta; \gamma_0 l\big) = u(\beta, \gamma_0)$, respectively. monotonicity implies:

$$
\begin{aligned}
& u(-\alpha, \gamma_0) < u(\beta, \gamma_0) \\
\Leftrightarrow\ & u(-\alpha, \gamma_0) - u(\beta, \gamma_0) < 0 \\
\Rightarrow\ & q'(e^*) \cdot \big[u(-\alpha, \gamma_0) - u(\beta, \gamma_0)\big] - 1 < 0 \\
\Rightarrow\ & \text{corner solution} \\
\Rightarrow\ & e^* = 0
\end{aligned}
$$

$\Rightarrow q(0) = 0$

$\Rightarrow p'(\epsilon^*) \cdot \left[u(-\alpha, 0) - u(\beta, \gamma_0)\right] - 1 < 0$

$\Rightarrow$ corner solution

$\Rightarrow \epsilon^* = 0$

q.e.d.

γ_0-workers' objective function is therefore:

$$p(0)u(-\alpha, \gamma_0) + \left[1 - p(0)\right]u(\beta, \gamma_0)$$

substituting $(\alpha, \beta) = (0, 0)$ yields:

$$u(0, \gamma_0)$$

lemma 2. *the objective function of* γ_1*-workers is concave in* ϵ *and* e*.*

proof. differentiate the first-order-conditions w.r.t. to ϵ and e and note that $p'' < 0$ and $q'' < 0$. q.e.d.

assume that the optimization problem of γ_1-workers has interior solutions $e^*(\alpha, \beta; \gamma_1, q)$ and $\epsilon^*(\alpha, \beta; \gamma_1, p, q)$.

$\rightsquigarrow$ e^* depends on q.

$\rightsquigarrow$ ϵ^* depends on p and q.

the next results describe the phenomenon of moral hazard.

differentiating the first-order-conditions w.r.t β and α yields:

$$\epsilon^*_\beta = \frac{p'(\epsilon^*)\big[1-q(e^*)\big]u_1(\beta,\gamma_1)}{p''(\epsilon^*)\Big\{\big[1-q(e^*)\big]\big[u(w-\alpha,0)-u(\beta,\gamma_1)\big]+e^*\Big\}} < 0$$

$$\epsilon^*_\alpha = \frac{p'(\epsilon^*)\big[1-q(e^*)\big]u_1(w-\alpha,0)}{p''(\epsilon^*)\Big\{\big[1-q(e^*)\big]\big[u(w-\alpha,0)-u(\beta,\gamma_1)\big]+e^*\Big\}} < 0$$

$$e^*_\beta = \frac{q'(e^*)u_1(\beta,\gamma_1)}{q''(e^*)\big[u(w-\alpha,0)-u(\beta,\gamma_1)\big]} < 0$$

$$e^*_\alpha = \frac{q'(e^*)u_1(w-\alpha,0)}{q''(e^*)\big[u(w-\alpha,0)-u(\beta,\gamma_1)\big]} < 0$$

$\rightsquigarrow$ negative sign characterizes the problem of **moral hazard**

fair insurance

assume that insurers can identify the type of a worker. ϵ and e are still private information. profits are zero due to competition. fair unemployment insurance requires:

$$\big[1-\pi(c;C^*)\big]\alpha = \pi(c;C^*)\beta$$

workers are offered different contracts in $C_0 \subset C^*$ and $C_1 \subset C^*$, with $C_0 \cap C_1 = \emptyset$. therefore, $\mu\big(\gamma_0 \mid I(c;C_0)\big) = 1$ and $\mu\big(\gamma_1 \mid I(c;C_1)\big) = 1$. this gives the average probability of unemployment:

$$\pi(c,C_0) = \big[1-p(0)\big]\big[1-q(0)\big] = 1-p(0)$$

and

$$\pi(c,C_1) = \big[1-p(\epsilon^*(\alpha,\beta;\gamma_1))\big]\big[1-q(e^*(\alpha,\beta;\gamma_1))\big]$$

hence, a fair unemployment insurance for γ_0-workers means

$$p(0)\alpha = \big[1 - p(0)\big]\beta \tag{5}$$

and for γ_1-workers

$$\begin{aligned} &\Big[1 - \big[1 - p(\epsilon^*(\alpha, \beta; \gamma_1))\big]\big[1 - q(e^*(\alpha, \beta; \gamma_1))\big]\Big]\alpha \\ &\quad = \big[1 - p(\epsilon^*(\alpha, \beta; \gamma_1))\big]\big[1 - q(e^*(\alpha, \beta; \gamma_1))\big]\beta \end{aligned} \tag{6}$$

since the type of a worker is unknown, the actuarial value of an insurance contract depends crucially on the population of workers attracted.

the properties of a fair unemployment insurance are summarized in

proposition 1. $\hat{\alpha}(\beta \mid \gamma)$ *is the premium which makes* $(\hat{\alpha}(\beta \mid \gamma), \beta)$ *actuarially fair for every population of workers and benefits* β.
then there exists a $\beta^0 \geqslant 0$ *such that* $\hat{\alpha}(\beta \mid \gamma)$ *is a monotonic convex increasing function on* $[0, \beta^0)$ *and a monotonic increasing and linear function on* $[\beta^0, \infty)$.

proof. the fair insurance line of γ_0-workers is (see (5))

$$\hat{\alpha}(\beta) = \frac{1 - p(0)}{p(0)} \beta$$

$\rightsquigarrow$ a linear and increasing function differentiating the condition of fair insurance of γ_1-workers w.r.t. β yields:

$$\frac{d\hat{\alpha}}{d\beta} = \frac{(1-p)(1-q) - (\hat{\alpha}+\beta)\big[(1-q)p'\epsilon^*_\beta + (1-p)q'e^*_\beta\big]}{p + q(1-p) + (\hat{\alpha}+\beta)\big[(1-q)p'\epsilon^*_\alpha + (1-p)q'e^*_\alpha\big]}$$

$\epsilon^*(\hat{\alpha}(\beta),\beta) > 0$ or $e^*(\hat{\alpha}(\beta),\beta) > 0$ implies:

$$\begin{aligned}(1-q)p'\epsilon^*_\beta + (1-p)q'e^*_\beta &< 0 \quad \text{and}\\ (1-q)p'\epsilon^*_\alpha + (1-p)q'e^*_\alpha &< 0\end{aligned}$$

hence,

$$\begin{aligned}\frac{d\hat{\alpha}}{d\beta} &> \frac{(1-p)(1-q)}{p+q(1-p)} = \frac{\hat{\alpha}}{\beta} \quad \text{and}\\ \frac{d^2\hat{\alpha}}{d\beta^2} &> \frac{\frac{d\hat{\alpha}}{d\beta}\beta + \hat{\alpha}}{\beta^2} \quad \rightsquigarrow \text{a convex and increasing function}\end{aligned}$$

define:

$$\beta^0 = \sup\big\{\beta \geqslant 0 \mid \epsilon^*(\hat{\alpha}(\beta), \beta) = e^*(\hat{\alpha}(\beta), \beta) = 0\big\}$$

$$\begin{aligned} & \beta \geqslant \beta^0 \\ \Rightarrow \quad & \epsilon^*(\hat{\alpha}(\beta), \beta) = e^*(\hat{\alpha}(\beta), \beta) = 0 \\ \Rightarrow \quad & p(0)\hat{\alpha}(\beta) = \big[1 - p(0)\big]\beta \\ \Leftrightarrow \quad & \hat{\alpha}(\beta) = \frac{1 - p(0)}{p(0)}\beta \qquad \rightsquigarrow \text{a linear and increasing function} \end{aligned}$$

q.e.d.

- fair insurance line of γ_0-workers is a linear function.
- if $p(0)$ increases, the slope of this line decreases. insurances become cheaper.

- fair insurance line of γ_1-workers is a convex and increasing function.
- as β increases ϵ decreases and so does $p(\cdot)$.
- it is more likely that γ_1-workers become a case for insurance.
- therefore insurers have to charge a higher premium α to break even.
- $(\hat{\alpha}(\beta \mid \gamma_1), \beta)$ with $\beta \geqslant \beta^0$: γ_1-workers choose $\epsilon^* = e^* = 0$.
- there is no incentive left to work or to hunt for a job if unemployed.
- from this point on, the fair insurance line is identical to that of γ_0-workers.

$\rightsquigarrow$ see figure 1.

indifference curves of γ_0- and γ_1-workers

by examining the first-order-conditions it can be shown that a γ_1-worker's utility from working and paying insurance premium α is less or equal than the utility from being unemployed and collecting benefits β if and only if she chooses not to exert any effort to stay employed or to find new employment if laid off, put mathematically:

$$u(w-\alpha,0)-u(\beta,\gamma_1)\leqslant 0 \Leftrightarrow \epsilon^* = e^* = 0$$

in the light of this define two sets. the zero-effort locus (ZEL) is given by:

$$\text{ZEL} := \big\{(\alpha,\beta) \mid u(w-\alpha,0)=u(\beta,\gamma_1)\big\} \tag{7}$$

furthermore,

$$\text{Z} := \big\{(\alpha,\beta) \mid u(w-\alpha,0)\leqslant u(\beta,\gamma_1)\big\} \tag{8}$$

moreover, since $u(w, 0) > u(0, \gamma_1)$, the first-order conditions imply $\epsilon^* > 0$ and $e^* > 0$. hence, $c^0 \notin \mathrm{Z}$.

$\rightsquigarrow$ γ_1-workers exert efforts ϵ and e when they have no unemployment insurance.

$\rightsquigarrow$ see figure 1.

the next result describes the curvature of a γ_1-worker's indifference curve.

proposition 2. *the proposition has two parts:*

1. *if u is concave in its first argument and $e^*_\beta + e^*_\alpha(d\alpha/d\beta)$ and $\epsilon^*_\beta + \epsilon^*_\alpha(d\alpha/d\beta)$ are sufficiently small, then $(d\alpha/d\beta)|_{u=const}$ is everywhere positive and decreasing in β.*

2. *if u is linear in its first argument, then $(d\alpha/d\beta)|_{u=const}$ is everywhere positive and increasing in β.*

proof. by the envelope theorem, the slope of the indifference curve of γ_1-workers is:

$$\frac{d\alpha}{d\beta} = \frac{\overbrace{\Big[1 - p(\epsilon^*)\Big]\Big[1 - q(e^*)\Big]u_1(\beta, \gamma_1)}^{=:\mathrm{N}}}{\underbrace{\Big[p(\epsilon^*) + \Big[1 - p(\epsilon^*)\Big]q(e^*)\Big]u_1(w - \alpha, 0)}_{=:\mathrm{M}}} > 0$$

positive sign: α is a bad, β is a good. ✓

the second derivative w.r.t. β is:

$$\frac{d^2\alpha}{d\beta^2} = \overbrace{\frac{N}{M}\left[\frac{u_{11}(\beta,\gamma_1)}{u_1(\beta,\gamma_1)} + \frac{u_{11}(w-\alpha,0)}{u_1(w-\alpha,0)}\cdot\frac{d\alpha}{d\beta}\right]}^{=:\text{A}} - \frac{1}{M^2}\big[u_1(\beta,\gamma_1)M + u_1(w-\alpha,0)N\big]$$
$$\times\left\{p'(\epsilon^*)\big[1-q(e^*)\big]\left(\epsilon^*_\beta + \epsilon^*_\alpha\frac{d\alpha}{d\beta}\right) + \big[1-p(\epsilon^*)\big]q'(e^*)\left(e^*_\beta + e^*_\alpha\frac{d\alpha}{d\beta}\right)\right\}$$

ad 1.: u is concave. $\Rightarrow$ A is negative. $\epsilon^*_\beta + \epsilon^*_\alpha(d\alpha/d\beta)$ and $e^*_\beta + e^*_\alpha(d\alpha/d\beta)$ are sufficiently small $\Rightarrow$ whole expression is negative. ✓

ad 2.: u is linear. $\Rightarrow u_{11} = u_{22} = 0$. hence,

$$\frac{d^2\alpha}{d\beta^2} = -\frac{1}{M^3}\Bigg\{\frac{1}{G}\Big[p'(\epsilon^*)\big[1 - q(e^*)\big]\big[u_1(\beta,\gamma_1)M + u_1(w-\alpha,0)N\big]\Big]^2 + \frac{1}{H}\Big[q'(e^*)\big[1 - p(\epsilon^*)\big]\big[u_1(\beta,\gamma_1)M + u_1(w-\alpha,0)N\big]\Big]^2\Bigg\},$$

where

$$G := p''(\epsilon^*)\Big[\big[1 - q(e^*)\big]\big[u(w-\alpha,0) - u(\beta,\gamma_1)\big] + e^*\Big] < 0$$

and

$$H := \big[1 - p(\epsilon^*)\big]q''(e^*)\big[u(w-\alpha,0) - u(\beta,\gamma_1)\big] < 0$$

G and H denote the second derivatives of the expected utility function. M is positive, G and H are negative. thus, the whole expression is positive.✓ q.e.d.

remarks:

- worker is risk-neutral.
  - indifference curve is convex.
  - as α increases by $\Delta\alpha$, she needs $\Delta\beta < \Delta\alpha$ to stay on the same indifference curve.

- $e^*_\beta + e^*_\alpha(d\alpha/d\beta) < 0$ and $\epsilon^*_\beta + \epsilon^*_\alpha(d\alpha/d\beta) < 0$ describe the phenomenon of moral hazard.

- if moral hazard dominates risk aversion.
  - indifference curve is convex.
  - worker is less afraid to become unemployed.

- if risk aversion dominates moral hazard.
  - indifference curve is concave.
  - as α increases by $\Delta\alpha$, she needs $\Delta\beta > \Delta\alpha$ to stay on the same indifference curve.
  - worker is more afraid to become unemployed.

- if the individual is risk averse, the indifference curve is concave in the set Z $(\epsilon^* = e^* = 0 \Rightarrow \epsilon^*_\beta + \epsilon^*_\alpha(d\alpha/d\beta) = e^*_\beta + e^*_\alpha(d\alpha/d\beta) = 0)$.

$\leadsto$ see figure 1.

corollary 1. γ_0*-workers' indifference curves are increasing and concave.*

proof. from lemma 1 follows $\epsilon^* = e^* = 0$. hence, $e^*_\beta + e^*_\alpha(d\alpha/d\beta) = \epsilon^*_\beta + \epsilon^*_\alpha(d\alpha/d\beta) = 0$. the proof of proposition 2 implies:

$$\frac{d\alpha}{d\beta} = \frac{\overbrace{\left[1-p(0)\right]u_1(\beta,\gamma_0)}^{:=N}}{\underbrace{p(0)u_1(-\alpha,\gamma_0)}_{=:M}} > 0 \quad \text{and}$$

$$\frac{d^2\alpha}{d\beta^2} = \frac{N}{M}\left[\frac{u_{11}(\beta,\gamma_0)}{u_1(\beta,\gamma_0)} + \frac{u_{11}(-\alpha,\gamma_0)}{u_1(-\alpha,\gamma_0)}\cdot\frac{d\alpha}{d\beta}\right] < 0$$

q.e.d.

$\rightsquigarrow$ see figure 2.

optimal insurance for γ_0-workers

separating equilibrium: γ_0- and γ_1-workers are offered different contracts $c^H = (\alpha^H, \beta^H)$ and $c^L = (\alpha^L, \beta^L)$, respectively.

proposition 3. $(\alpha, \beta) = (0, 0)$ *is the only actuarially sound unemployment insurance that* γ_0*-workers accept.*

proof. γ_0-workers choose $\epsilon^* = e^* = 0$.
expected utility if no unemployment insurance is available: $u(0, \gamma_0)$
expected utility if they choose $c \neq c^0$: $p(0)u(-\alpha, \gamma_0) + \big[1 - p(0)\big]u(\beta, \gamma_0)$
monotonicity of u implies:
$u(-\alpha, \gamma_0) < u(0, \gamma_0) < u(\beta, \gamma_0)$
hence, by Jensen's inequality:
$u(0, \gamma_0) \geqslant p(0)u(-\alpha, \gamma_0) + \big[1 - p(0)\big]u(\beta, \gamma_0)$
risk aversion implies that γ_0-workers choose the trivial policy c^0. q.e.d.

by corollary 1, the slope of a γ_0-worker's indifference curve is:

$$\frac{d\alpha}{d\beta} = \frac{[1 - p(0)]u_1(\beta, \gamma_0)}{p(0)u_1(-\alpha, \gamma_0)}$$

at c^0 it attains the value:

$$\frac{d\alpha}{d\beta} = \frac{1 - p(0)}{p(0)}$$

- the slope of this indifference curve equals the slope of the fair insurance line.

- γ_0-workers' indifference curves are concave throughout.

- the indifference curve through the origin lies below the fair insurance line.

$\rightsquigarrow$ insurers cannot distinguish whether a person who has been laid off is a γ_0-worker who did not work $(\epsilon^* = 0)$ or a γ_1-worker who tried hard to stay employed.

$\rightsquigarrow$ a laid off γ_0-worker therefore played with fire and burned down her cabin.

$\rightsquigarrow$ insurers will make negative profits from laid-off γ_0-workers.

$\rightsquigarrow$ a γ_0-worker's decision to take out unemployment insurance adversely affects the uninformed insurers.

$\rightsquigarrow$ **endogenous adverse selection**

$\rightsquigarrow$ see figure 2.

optimal insurance for γ_1-workers

to design an optimal contract for γ_1-workers that does **not** attract γ_0-workers insurers solve the following maximization problem:

$$\max_{(\alpha,\beta)} \quad p(\epsilon^*(\alpha,\beta;\gamma_1))u(w-\alpha,0)+\big[1-p(\epsilon^*(\alpha,\beta;\gamma_1))\big]\times\Big\{q(e^*(\alpha,\beta;\gamma_1))u(w-\alpha,0)$$
$$+\big[1-q(e^*(\alpha,\beta;\gamma_1))\big]u(\beta,\gamma_1)-e^*(\alpha,\beta;\gamma_1)\Big\}-\epsilon^*(\alpha,\beta;\gamma_1)$$

(expected utility function of γ_1-workers including their reaction functions $\epsilon^*(\alpha,\beta;\gamma_1)$ and $e^*(\alpha,\beta;\gamma_1)$)

subject to

$$\alpha = \frac{\left[1 - p(\epsilon^*(\alpha, \beta; \gamma_1))\right]\left[1 - q(e^*(\alpha, \beta; \gamma_1))\right]}{1 - \left[1 - p(\epsilon^*(\alpha, \beta; \gamma_1))\right]\left[1 - q(e^*(\alpha, \beta; \gamma_1))\right]}\beta$$

fairness constraint ⇝ fair insurance line

$$u(0, \gamma_0) \geqslant p(0)u(-\alpha, \gamma_0) + \left[1 - p(0)\right]u(\beta, \gamma_0)$$

incentive compatibility constraint ⇝ proposition 3

if insurers can find a solution to this maximization problem, a separating equilibrium occurs.

⇝ no "no unemployment insurance" equilibrium

main result

if the following conditions hold, then **no** unemployment insurance is provided in equilibrium:

1. $J(\gamma_1; p) \subset S(0, 0; \gamma_0, p)$

2. $\Pi(\lambda\gamma_1 + (1-\lambda)\gamma_0; p) \cap J(\gamma_1; p) = \{(0,0)\}$

where

- $\Pi(\lambda\gamma_1 + (1-\lambda)\gamma_0; p)$
  $= \big\{(\alpha, \beta) \mid \alpha \geqslant \lambda\hat{\alpha}(\beta \mid \gamma_1) + (1-\lambda)\hat{\alpha}(\beta \mid \gamma_0); \beta \geqslant 0\big\}$
  set of contracts that are actuarially sound if sold to both types of workers

- $\lambda = 1 \Rightarrow \Pi(\gamma_1; p) = \big\{(\alpha, \beta) \mid \alpha \geqslant \hat{\alpha}(\beta \mid \gamma_1); \beta \geqslant 0\big\}$
  set of contracts that are actuarially sound if sold solely to γ_1-workers

- $S(0,0;\gamma,p) = \{(\alpha,\beta) \mid (\alpha,\beta) \succsim_\gamma (0,0)\}$
  set of contracts that γ-workers weakly prefer to c^0, upper contour set

- $J(\gamma_1,p) = S(0,0;\gamma_1,p) \cap \Pi(\gamma_1,p)$
  set of contracts that γ_1-workers weakly prefer to c^0 and that are actuarially fair if sold solely to γ_1-workers

$\rightsquigarrow$ see figure 2.

ad condition 1.: no separating equilibrium can occur since contracts preferred by γ_1-workers are also in the upper contour set of γ_0-workers.
$\rightsquigarrow$ a pooling equilibrium arises.

ad condition 2.: γ_1-workers do not accept any contract $c \neq c^0 \in \Pi(\lambda\gamma_1 + (1-\lambda)\gamma_0; p)$.

conditions 1. and 2. are only satisfied for $\lambda < 1$, because $\lambda = 1$ implies:

$$\Pi(\lambda\gamma_1 + (1-\lambda)\gamma_0; p) \cap J(\gamma_1; p) = J(\gamma_1; p)$$

if the population consists of only γ_1-workers, then an insurer will offer a contract in the set $\Pi(\gamma_1; p)$.

when are conditions 1. and 2. satisfied?

$\rightsquigarrow$ the theorem

the theorem

if the probability $p(0)$ is sufficiently small, no unemployment insurance is offered in equilibrium.

the following results are derived from comparing the slope of the $\Pi(\lambda\gamma_1 + (1-\lambda)\gamma_0; p)$-fair insurance line to the slope of the indifference curve of γ_1-workers and to the slope of γ_0-workers' indifference that both run through the origin.

the slope of the $\Pi(\lambda\gamma_1 + (1-\lambda)\gamma_0; p)$-fair insurance line depends on $p(0)$, $p(\epsilon^*(0, 0, \gamma_1)$, and λ.

ceteris paribus

- $p(0) \nearrow$ slope $\searrow$
- $\lambda \searrow \Leftrightarrow (1-\lambda) \nearrow$ slope $\nearrow$

thus, the smaller λ is, the larger $p(0)$ can be for condition 2 to hold.

as λ decreases, the number of workers who do not join the workforce voluntarily increases. therefore a "no unemployment insurance" equilibrium is more likely to occur.

ceteris paribus

- $p(\epsilon^*(0,0,\gamma_1)) \nearrow$ slope of γ_1-workers' indifference curve $\searrow$
- $p(0) \nearrow$ slope $\searrow$ and slope of γ_0-workers' indifference curve $\searrow$

thus, the larger $p(\epsilon^*(0,0;\gamma_1))$ is, the larger $p(0)$ can be for conditions 1 and 2 to hold.

if the difference between $p(0)$ and $p(\epsilon^*(0,0,\gamma_1))$ is sufficiently large, no unemployment insurance is provided.

put differently, if the difference between the probability that an individual will stay employed even though she does not work and the probability that a γ_1-worker is being retained when no unemployment insurance is available is sufficiently large, a "no unemployment insurance" equilibrium occurs.

or, given some probability that a γ_1-worker will stay employed in a state where she is not covered by an unemployment insurance, then the probability of staying employed when shirking must be sufficiently small for the conclusion to hold.

the theorem formalizes these ideas and imposes some restrictions on the probability function such that conditions 1 and 2 are satisfied.

a precise statement of it is omitted and the proof as well (very technical).

concluding remarks - role of the public sector

1. pareto-improving unemployment insurance
   - competitive "no unemployment insurance" equilibrium is not necessarily pareto optimal.
   - can a central authority find a pareto-improving unemployment insurance?
   - does this imply that existing unemployment insurances are better than none?
   - the model shows that a self-financing pooling equilibrium that γ_1-workers prefer to c^0 does not exist.
   - low-risk workers are obliged by law to take out unemployment insurance.
   - $\leadsto$ low-risk workers subsidize high-risk workers.
   - therefore, a pooling unemployment insurance does not improve upon the c^0-situation.

- what about a separating unemployment insurance?
- design a mechanism that makes high-risk and low-risk workers choose different contracts in equilibrium.

2. business cycle

- the business cycle represents an aggregate risk.
- insurers require a premium high enough to be compensated for this risk.
- an argument in favor of public provision?
- the risk argument is not convincing since the private sector provides other (even more?) risky insurances (e.g. pension funds, life insurances).

3. the taxpayers

   - taxpayers bear the costs of aggregate risk.
   - this results in an inefficient risk allocation.
   - individuals do not face the true costs of unemployment risk.

concluding remarks - firm type adverse selection

1. firm-specific risk
   - employees know firm-specific conditions better than insurers.
   - thus, employees may know in advance if they are likely to be made redundant.
   - these workers represent a higher risk.

2. temporary layoffs
   - variations in demand can result in temporary layoffs.
   - presence of unemployment insurance makes it easier for employers and employees to cope with temporary layoffs as a response to lower demand.
   - various firms face different variations in demand.
   - hence, unemployment risk across firms is diverse.

- $\rightsquigarrow$ experience rating
- imperfect experience rating results in moral hazard.
- employers with fewer layoffs subsidize employers with more layoffs (cross-subsidization).
- this contributes to unemployment.
- $\rightsquigarrow$ the overall $p(\cdot)$ decreases.
- a "no unemployment insurance" equilibrium is more likely to occur (see the model).

some critique

- the model considers ex-ante identical employees.
  $\rightsquigarrow$ given some level of effort ϵ all workers are equally likely to be retained.
  $\rightsquigarrow$ given some level of effort e all workers have the same chance to find a new job.

- the model is not dynamical.
  $\rightsquigarrow$ if the public sector provides unemployment insurance, moral hazard occurs only once since the central authority has a legal right to observe the work history.
  $\rightsquigarrow$ a private insurer does not have this possibility.
  $\rightsquigarrow$ moral hazard has different effects on the public and private sectors.
  $\rightsquigarrow$ the public sector can face a different situation than that described by conditions i. and ii..

the end