On the existence of private unemployment insurance with advance information on future job losses

Online Appendix

Piotr Denderski* Christian A. Stoltenberg†

June 26, 2023

1 Existence of insurance with history-dependent contracts

As baseline specification, we focus on allocations that depend on the current individual state consisting of a signal and an endowment realization. In this section, we compute the exclusion length thresholds for existence of profitable insurance market when contracts depend on the history of signals and endowments (limited commitment with history-dependent contracts). To do this, we numerically test if an allocation that conditions insurance premiums and transfers on the shortest possible history of one period generates positive profits.[1]

Let an individual state in period t be $s_t = (n_t, e_t)$ where the notation for signal realization n_t is as in the main body of the paper and e_t stands for individual endowment in time t so that $e_t \in \{y, y-l\}$. The set of possible realizations of the individual state S in any period is therefore $S = \{(g,y), (g, y-l), (b, y-l)\}$. The utility allocation that tracks one period history has a generic element $h_t(s_t, s_{t-1}) = u\left[c(s_t, s_{t-1})\right]$ and the one-period histories are elements of the Cartesian product $S \times S$.[2]

* *Corresponding author*, Institute of Economics, Polish Academy of Sciences, Nowy Świat 72, 00-330, Warsaw, Poland and University of Leicester School of Business, Department of Economics, Finance and Accounting, Brookfield, London Road, LE2 1RQ, Leicester, the United Kingdom, email: piotr.denderski@le.ac.uk.

† University of Amsterdam and Tinbergen Institute, Postbus 15867 1001 NJ Amsterdam, Netherlands, email: c.a.stoltenberg@uva.nl.

[1] Considering allocations with the shortest possible history is the relevant case for existence of profitable insurance because Krueger and Perri (2011) show that in limited commitment models these allocations are the first implementable allocations at the border of autarky. In their model, the absence of private information yields the model with two income states conducive to an analytical existence proof as the resulting consumption allocation has at most three distinct elements. Our profit maximization problem however is more complex than theirs; an allocation with a one-period history can have up to nine distinct elements and is additionally constrained by incentive compatibility constraints.

[2] Memoryless allocations are a special case of the (one period) history-dependent ones as they require $u[c(s_t, s_{t-1})] = u[c(s_t)]$.

Table 1: Existence of insurance: minimum exclusion length, history-dependent contracts

	WTP, $u'(c_u)/u'(c_e)$, for various σ		
	1.29 ($\sigma = 1$)	1.58 ($\sigma = 2$)	1.87 ($\sigma = 3$)
Fixed exclusion, N_{min}	2.1868	0.7737	0.3616
Random exclusion, $\mathbb{E}[N_{min}]$	2.3344	0.8349	0.4085

Notes: History-dependent insurance contracts. Minimum number of exclusion periods for the existence of unemployment insurance, N_{min}, and expected exclusion length $\mathbb{E}[N_{min}] = 1/\theta - 1$ as functions of the willingness to pay, WTP.

With a history-dependent consumption allocation c, counterparts to expected utility $\tilde{w}(c)$ can be constructed. Denoting $\tilde{w}(s_t)$ as the expected utility from period $t+1$ onward upon reporting s_t to the insurer in the current period, we can write the counterparts to conditions (4) - (7) in the main text for each past state realization s_{t-1} as follows.

The incentive-compatibility constraint for bad signal agents is:

$$(1-\beta)h\left[(b, y-l), s_{t-1}\right] + \beta\tilde{w}(b, y-l) \geq (1-\beta)h\left[(g, y-l), s_{t-1}\right] + \beta\tilde{w}(g, y-l), \quad (1)$$

while its counterpart for the good signal agents reads:

$$\begin{aligned}(1-\beta)\left\{ph\left[(g, y-l), s_{t-1}\right] + (1-p)h\left[(g, y), s_{t-1}\right]\right\} + \beta\left[p\tilde{w}(g, y-l) + (1-p)\tilde{w}(g, y)\right] \\ \geq (1-\beta)\left\{ph\left[(b, y-l), s_{t-1}\right] + (1-p)u(0)\right\} + \beta\tilde{w}(b, y-l). \quad (2)\end{aligned}$$

Regarding individual rationality constraints, we assume that following default on the insurance contract, the agents are assigned the continuation value of non-defaulting agents upon their return to the insurance market.[3] Under this assumption, the good-signal agents' individual rationality constraint under deterministic return (the individual rationality constraint under random return are defined analogously) from autarky is:

$$\begin{aligned}(1-\beta)\left\{ph\left[(g, y-l), s_{t-1}\right] + (1-p)h\left[(g, y), s_{t-1}\right]\right\} \\ + \beta(1-\beta^N)\left[p\tilde{w}(g, y-l) + (1-p)\tilde{w}(g, y)\right] \\ \geq (1-\beta)\left[pu(y-l) + (1-p)u(y)\right] + \beta(1-\beta^N)U^{Aut}, \quad (3)\end{aligned}$$

[3] Allowing the insurer to further differentiate the defaulting and non-defaulting agents would provide them with additional instruments to shape the consumption allocation permitting incurring higher profits. This would result in even shorter exclusion lengths necessary to support the existence of a profitable insurance market.

while the individual rationality constraint for the bad signal agents reads:

$$(1-\beta)h\left[(b,y-l),s_{t-1}\right]+\beta(1-\beta^N)\tilde{w}(b,y-l)\geq(1-\beta)u(y-l)+\beta(1-\beta^N)U^{Aut}. \quad (4)$$

The insurer chooses an a consumption allocation $c=\{c(s_t,s_{t-1})\}_{(s_t,s_{t-1})\in S\times S}$ that maximizes slack on the resource constraint within each period subject to a promise-keeping constraint ensuring consistency of life-time expected utilities $\tilde{w}$ and instantaneous utility allocation h and the constraints (1)-(4),

$$\max_{\{c(s_t,s_{t-1})\}}\left[\mu+(1-\mu)p\right](y-l)+(1-\mu)(1-p)y-\sum_{(s_t,s_{t-1})}\pi(s_t,s_{t-1})c(s_t,s_{t-1}), \quad (5)$$

where the probability weights $\pi(s_t,s_{t-1})$ come from the invariant distribution of the Markov chain defined on S.[4] We solve this maximization problem and report in Table 1 the longest exclusion length for which the solution to this problem is still the no-trade consumption allocation with zero profits; for any exclusion larger than this number, the provision of insurance is profitable for the insurer.

Compared to the baseline results in Table 2 in the main body of the paper, the reduction in exclusion lengths that suffice to support insurance market existence is quantitatively important. We find that with history-dependent insurance contracts an exclusion of a single year also suffices for existence not only in case of $\sigma=3$ but also when $\sigma=2$, for deterministic as well as for random exclusion.

2 Theorem 1 with savings.

In our baseline model, we do not explicitly consider agents' consumption-savings decisions. In this section, we show that the no-trade condition we derived in the paper is equivalent to the one derived in a consumption-savings model.

Setup Let's consider an agent who can save and borrow in a non state-contingent asset a subject to a borrowing constraint $a\geq\underline{a}$. The agent discounts the future at rate β and the interest rate on a is equal to r. Employed agents get income y_e and the unemployed get y_u. Agents receive private signals on the likelihood of a job loss. The signals are i.i.d. with $p(n)$

[4] For example, $\pi((g,l),(b,l))=(1-\mu)p\times\mu$, $\pi((g,y),(g,y))=[(1-\mu)(1-p)]^2$etc.

being the income loss probability under signal realization n. In our model, $p(b) = 1$ and $p(g) = p$. With insurance, the employed agents pay a premium δ while the unemployed receive a benefit γ. Thus, disposable income in employment is $y_e(\delta) = y_e - \delta$ and for the unemployed it is $y_u(\gamma) = y_u + \gamma$.

Recursive formulation Let $V(a, n, \gamma, \delta)$ be the value function of an agent facing income endowments $y_e(\delta)$ and $y_u(\gamma)$ who has current assets a and receives a private signal n. Following standard logic, we can write the consumption-savings choice as follows:

$$\begin{aligned} V(a, n, \gamma, \delta) = \max_{c_u, c_e} p(n) &\left[(1-\beta)u(c_u(a, n, \gamma, \delta)) + \beta \mathbb{E}_{n'} V(a'_u, n', \gamma, \delta)\right] \\ &+ (1 - p(n)) \left[(1-\beta)u(c_e(a, n, \gamma, \delta)) + \beta \mathbb{E}_{n'} V(a'_e, n', \gamma, \delta)\right], \\ &\text{subject to: } a'_u \geq \underline{a} \text{ and } a'_e \geq \underline{a}, \end{aligned}$$

with $a'_u = y_u(\gamma) - c_u + (1+r)a$ and $a'_e = y_e(\delta) - c_e + (1+r)a$. The first order conditions for this problem are:

$$\begin{aligned} (1-\beta)u'(c_u(a, n, \gamma, \delta)) &= \beta \mathbb{E}_{n'} V_a(a'_u, n', \gamma, \delta) + \chi_u, \\ (1-\beta)u'(c_e(a, n, \gamma, \delta)) &= \beta \mathbb{E}_{n'} V_a(a'_e, n', \gamma, \delta) + \chi_e. \end{aligned}$$

with χ_u and χ_e being the multipliers on the borrowing constraints following the realization of shock to income and $V_a(a, n, \gamma, \delta)$ is the partial derivative of the value function with respect to wealth. These conditions imply that two agents with different signal realizations but identical assets will choose identical consumption. Therefore, from here onward, we drop the dependence of consumption on n.

Let the optimal choices be $c^*_e(a, \gamma, \delta)$ and $c^*_u(a, \gamma, \delta)$. Denote the law of motion over (a, n) implied by optimal consumption-savings choices of agents and the exogenous process for signals by $\Pi^*(a', n'|a, n, \gamma, \delta)$. Let $V^*(a, n, \gamma, \delta)$ be the value function evaluated at optimal consumption choices given δ and γ. This value function satisfies the following recursive equation:

$$\begin{aligned} V^*(a, n, \gamma, \delta) = (1-\beta) \left[p(n)u\left(c^*_u(a, \gamma, \delta)\right) + (1 - p(n))u\left(c^*_e(a, \gamma, \delta)\right)\right] \\ + \beta \Pi^*(a', n'|a, n, \gamma, \delta) V^*(a', n', \gamma, \delta). \end{aligned}$$

Defining willingness to pay Then, $V^*_{\text{Reject}}(a,n) := V^*(a,n,0,0)$ is the value function of an agent rejecting the contract and then choosing consumption optimally. $V^*_{\text{Accept}}(a,n) := V^*(a,n,\gamma,\delta)$ is the value function of an agent accepting the contract and then choosing consumption optimally. The willingness to pay for the contract stems from the difference $V^*_{\text{Accept}}(a,n) - V^*_{\text{Reject}}(a,n)$. Next, we also need to account for the opportunity to review the decision on whether to accept the contract or not after exclusion. Let $\tilde{V}(a,n) = \max\left\{V^*_{\text{Accept}}(a,n), V^*_{\text{Reject}}(a,n)\right\}$ capture that.

To introduce the exclusion length as a parameter, we need to generalise notation for future period state variables. Assuming (a,n) is the current state and (a',n') is the one period ahead state, and $(a^{(k)},n^{(k)})$ is k periods ahead. Under N periods of exclusion, the evaluation of accepting the contract reads:

$$\begin{aligned}
V^*_{\text{Accept}}(a,n) - V^*_{\text{Reject}}(a,n) &= (1-\beta)p(n)\left[u\left(c^*_u(a,\gamma,\delta)\right) - u\left(c^*_u(a,0,0)\right)\right] \\
&\quad + (1-\beta)(1-p(n))\left[u\left(c^*_e(a,\gamma,\delta)\right) - u\left(c^*_e(a,0,0)\right)\right] \\
+ \sum_{k=1}^{k=N} \beta^k \Pi^*(a^{(k)},n^{(k)}|a,n,\gamma,\delta)(1-\beta)&\left[p(n^{(k)})u\left(c^*_u(a^{(k)},\gamma,\delta)\right) + \left(1-p(n^{(k)})\right)u\left(c^*_e(a^{(k)},\gamma,\delta\right)\right] \\
- \sum_{k=1}^{k=N} \beta^k \Pi^*(a^{(k)},n^{(k)}|a,n,0,0)(1-\beta)&\left[p(n^{(k)})u\left(c^*_u(a^{(k)},0,0)\right) + \left(1-p(n^{(k)})\right)u\left(c^*_e(a^{(k)},0,0\right)\right] \\
+ \beta^{N+1}\left[\Pi^*(a^{(N+1)},n^{(N+1)}|a,n,\gamma,\delta) - \Pi^*(a^{(N+1)},n^{(N+1)}|a,n,0,0)\right]&\tilde{V}(a^{(N+1)},n^{(N+1)}). \qquad (6)
\end{aligned}$$

We focus on the first dollar of insurance and consider the limiting case of $\gamma \to 0$ and $\delta \to 0$. To begin with, we show the differences in the law of motion in the contract and outside the contract vanish:

$$\forall k \geq 0 \lim_{\gamma\to 0,\delta\to 0}\left[\Pi^*(a^{(k)},n^{(k)}|a,n,\gamma,\delta) - \Pi^*(a^{(k)},n^{(k)}|a,n,0,0)\right] = 0. \qquad (7)$$

To see this, let's focus on one period ahead transition without loss of generality. Using the budget constraint we get:

$$\begin{aligned}
\lim_{\gamma,\delta\mapsto 0}\left[a'_e(a,n,\gamma,\delta) - a'_e(a,n,0,0)\right] &= \lim_{\gamma,\delta\mapsto 0}\left[-\delta + c_e(a,0,0) - c_e(a,\gamma,\delta)\right] = 0, \\
\lim_{\gamma,\delta\mapsto 0}\left[a'_u(a,n,\gamma,\delta) - a'_u(a,n,0,0)\right] &= \lim_{\gamma,\delta\mapsto 0}\left[\gamma + c_u(a,0,0) - c_u(a,\gamma,\delta)\right] = 0.
\end{aligned}$$

Applying this logic iteratively at each future period, (7) follows. Next, we can replace the differences in utilities by marginal utility approximation. By the envelope theorem, only γ is relevant for consumption in unemployment and δ for consumption in employment. Hence, we are left with:

$$
\begin{aligned}
& V^*_{\text{Accept}}(a,n) - V^*_{\text{Reject}}(a,n) \approx \left[p(n)u'\left(c^*_u(a,0,0)\right)d\gamma - (1-p(n))u'\left(c^*_e(a,0,0)\right)d\delta\right] \\
+ & \sum_{k=1}^{k=N} \beta^k \Pi^*(a^{(k)}, n^{(k)}|a,n,0,0)\left[p(n^{(k)})u'\left(c^*_u(a^{(k)},0,0)\right)d\gamma - \left(1-p(n^{(k)})\right)u'\left(c^*_e(a^{(k)},0,0\right)d\delta\right].
\end{aligned}
$$

To establish the link between the no-trade condition derived in the model without savings and the data, we integrate out assets in the above equation. Let the (stationary) distribution of assets in an economy without the insurance contract be $f(a)$. Let $\overline{c_e}$ and $\overline{c_u}$ be average consumption choices in employment and unemployment in the absence of insurance, respectively. Following Lemma 2 in Chetty (2006), if the third and higher order terms of u are small, $\mathbb{E}_a u'(c_e(a,0,0)) \approx u'(\overline{c_e})$ and $\mathbb{E}_a u'(c_u(a,0,0)) \approx u'(\overline{c_u})$.

Whether the insurance contract is profitable or not depends on the willingness to accept it by good signal agents. From here onwards we focus on their willingness to pay. Imposing the parametrization of our model, we obtain:

$$
\begin{aligned}
& \int_{\underline{a}}^{\infty}\left[V^*_{\text{Accept}}(a,g) - V^*_{\text{Reject}}(a,g)\right] f(a)da \geq 0 \iff \\
& \left[p + \sum_{k=1}^{N}\beta^k\left(\mu + (1-\mu)p\right)\right]u'(\overline{c_u})d\gamma \geq \left[(1-p) + \sum_{k=1}^{N}\beta^k(1-\mu)(1-p)\right]u'(\overline{c_e})d\delta \iff \\
& \qquad \frac{p + \sum_{k=1}^{N}\beta^k\left(\mu + (1-\mu)p\right)}{(1-p) + \sum_{k=1}^{N}\beta^k(1-\mu)(1-p)}\frac{u'(\overline{c_u})}{u'(\overline{c_e})} \geq \frac{d\delta}{d\gamma} \iff \\
& \qquad\qquad \frac{\beta(1-\beta^N)\mu + \left(1-\beta\mu-\beta^{N+1}(1-\mu)\right)p}{\left(1-\beta\mu-\beta^{N+1}(1-\mu)\right)(1-p)}\frac{u'(\overline{c_u})}{u'(\overline{c_e})} \geq \frac{d\delta}{d\gamma}.
\end{aligned}
$$

Contract profitability to the insurer The insurer's profits on selling the (γ,δ) contract are:

$$\pi = (1-\mu)(1-p)\delta - (\mu + (1-\mu)p)\gamma.$$

The contract is independent of asset levels hence this holds for all a. The marginal profits are, integrating the signals and assets out:

$$d\pi = (1-\mu)(1-p)d\delta - (\mu + (1-\mu)p)d\gamma.$$

Table 2: Existence of insurance: minimum exclusion length, 3-point distribution of p

	WTP, $u'(c_u)/u'(c_e)$, for various σ		
	1.29 ($\sigma = 1$)	1.58 ($\sigma = 2$)	1.87 ($\sigma = 3$)
Fixed exclusion, N_{min}	2.6782	1.1724	0.6915
Random exclusion, $\mathbb{E}[N_{min}]$	2.8998	1.2286	0.7273

Notes: 3-point distribution of p. Minimum number of exclusion periods for the existence of unemployment insurance, N_{min}, and expected exclusion length $\mathbb{E}[N_{min}] = 1/\theta - 1$ as functions of the willingness to pay, WTP.

The insurer is willing to offer the contract to the population of agents in the economy iff:

$$(1-\mu)(1-p)d\delta - (\mu + (1-\mu)p)d\gamma \geq 0 \iff \frac{d\delta}{d\gamma} \geq \frac{\mu + (1-\mu)p}{(1-\mu)(1-p)}.$$

Establishing equivalence As before, there will be trade if some agents are willing to pay for insurance and the insurer is making non-negative profits on those agents. Then, the no-trade condition is:

$$\frac{u'(\overline{c_u})}{u'(\overline{c_e})} \leq \frac{\mu + (1-\mu)p}{(1-\mu)(1-p)} \frac{\left(1 - \beta\mu - \beta^{N+1}(1-\mu)\right)(1-p)}{\beta(1-\beta^N)\mu + \left(1 - \beta\mu - \beta^{N+1}(1-\mu)\right)p} \iff$$

$$\frac{u'(\overline{c_u})}{u'(\overline{c_e})} \leq \underbrace{\frac{\mu + (1-\mu)p}{(1-\mu)p}}_{T_s(p,\mu)} \underbrace{\frac{\left(1 - \beta\mu - \beta^{N+1}(1-\mu)\right)p}{\beta(1-\beta^N)\mu + \left(1 - \beta\mu - \beta^{N+1}(1-\mu)\right)p}}_{T_r(p,\mu,\beta,N)}.$$

Thus, the no-trade condition that we derive in the paper is equivalent to the one in an economy with savings that we consider here as long as $y = \overline{c_e}$ and $y - l = \overline{c_u}$.

3 Finer approximation of the distribution of p with safe and uninformed agents

Hendren (2017) uses a three-point approximation to the underlying distribution of subjective beliefs by introducing *uninformed* agents whose belief on their job loss is equal to the unconditional probability of unemployment, $\text{Prob}(U)$. We follow his example and enrich the type space in our model accordingly. Furthermore, we consider *safe* agents who are certain of remaining employed in the current period. As in the baseline, there are also bad-signal agents that become unemployed for sure. More precisely, we now consider $p \in \{0, 0.031, 1\}$; μ_s and μ_b are the shares of safe and bad-signal agents in the population, respectively, and $1 - \mu_s - \mu_b$

is the share of the uninformed agents. To render the distribution of subjective beliefs similar to the baseline, the shares of safe and bad-signal agents are chosen to satisfy:

$$\text{Prob}(U) = (1 - \mu_s - \mu_b)\,\text{Prob}(U) + \mu_b \tag{8}$$

$$\begin{aligned}\text{Var}(p) &= \mu_s(0 - \text{E}[\text{Prob}(U|n)])^2 \\ &\quad + (1 - \mu_s - \mu_b)(\text{Prob}(U) - \text{E}[\text{Prob}(U|n)])^2 \\ &\quad + \mu_b(1 - \text{E}[\text{Prob}(U|n)])^2,\end{aligned} \tag{9}$$

where $\text{Var}(p) = 0.0230$ is the variance of subjective beliefs in the baseline approximation. This procedure yields $\mu_s = 0.7419$ and $\mu_b = 0.0238$. We report the necessary exclusion lengths for existence of insurance for this richer specification of subjective beliefs in Table 2. Comparing the necessary exclusion length to the ones is Table 2 in the main body of the paper, there is hardly any difference between the richer and the baseline specification. Remarkably, the transfers to the unemployed agents are not stemming only from the uninformed agents. Instead, also the safe agents transfer resources, which confirms that the insurance of future news is key for the higher profitability of insurance in the dynamic model.

4 A life-cycle economy

We fill in the details on the incentive compatibility constraints and the cost minimisation problem of the insurer in the deterministic economy and then we discuss how to adjust the individual rationality constraints to arrive at the random exclusion formulation.

Deterministic exclusion The future utilities don't depend on the current private signal hence the incentive compatibility constraints are similar to those in the baseline version of the model, for each tenure k:

$$h^k_{bl} \geq h^k_{gl},$$
$$ph^k_{gl} + (1-p)h^k_{gy} \geq ph^k_{bl} + (1-p)u(0).$$

The insurer solves:

$$\max_{\{h_l^k, h_{gy}^k\}_{k=1}^K} \left[\mu + (1-\mu)p\right] C\left[u(y-l)\right] + (1-\mu)(1-p)C\left[u(y)\right]$$
$$-\frac{1}{K}\sum_{k=1}^{K}\left[\left[\mu + (1-\mu)p\right] C(h_l^k) + (1-\mu)(1-p)C(h_{gy}^k)\right],$$

subject to incentive compatibility and individual rationality constraints.

Random exclusion The incentive compatibility and the resource constraint slack functions are unchanged when agents randomly return from autarky. For the individual rationality constraints, it's convenient to define the expected remaining lifetime utilities of the contract and autarky, as follows. When $k = 1$,

$$\hat{w}^k = (1-\beta)\left[\left((1-\mu)\,p + \mu\right) h_l^k + (1-\mu)\,(1-p)\,h_{gy}^k\right],$$

and for $1 \leq k < K$

$$\hat{w}^k(1-\beta)\left[\left((1-\mu)\,p + \mu\right) h_l^k + (1-\mu)\,(1-p)\,h_{gy}^k\right] + \beta\hat{w}^{k+1}.$$

These can be used to define corresponding objects for autarky, when $k = 1$,

$$\hat{U}^{Aut,k} = (1-\beta)\left[\left((1-\mu)\,p + \mu\right) u(y-l) + (1-\mu)\,(1-p)\,u(y)\right]$$

and for $1 \leq k < K$:

$$\hat{U}^{Aut,k} = (1-\beta)\left[\left((1-\mu)\,p + \mu\right) u(y-l) + (1-\mu)\,(1-p)\,u(y)\right]$$
$$+\beta\left(\theta\hat{w}^{k+1} + (1-\theta)\hat{U}^{Aut,k+1}\right).$$

The individual rationality constraints for $k < K$ are:

$$(1-\beta)h_l^k + \beta(1-\theta)\hat{w}^{k+1} \geq (1-\beta)u(y-l) + \beta(1-\theta)\hat{U}^{Aut,k+1},$$
$$(1-\beta)\left(ph_l^k + (1-p)h_{gy}^k\right) + \beta(1-\theta)\hat{w}^{k+1} \geq$$
$$(1-\beta)\left(pu(y-l) + (1-p)u(y)\right) + \beta(1-\theta)\hat{U}^{Aut,k+1}.$$

5 Additional tables & figures

Table 3: Existence of insurance: minimum number of exclusion periods

	WTP, $u'(c_u)/u'(c_e)$, for various σ		
	1.29 ($\sigma = 1$)	1.58 ($\sigma = 2$)	1.87 ($\sigma = 3$)
$\beta = 0.96$	2.7796	1.2195	0.7210
$\beta = 0.94$	2.9013	1.2495	0.7345
$\beta = 0.92$	3.0394	1.2816	0.7488

Notes: Permanent unobserved heterogeneity specification with permanently safe agents measure $\nu = 0.58$. Baseline discount factor is $\beta = 0.96$. Minimum number of exclusion periods for the existence of unemployment insurance, N_{min} as functions of the willingness to pay, WTP, and the discount factor, β.

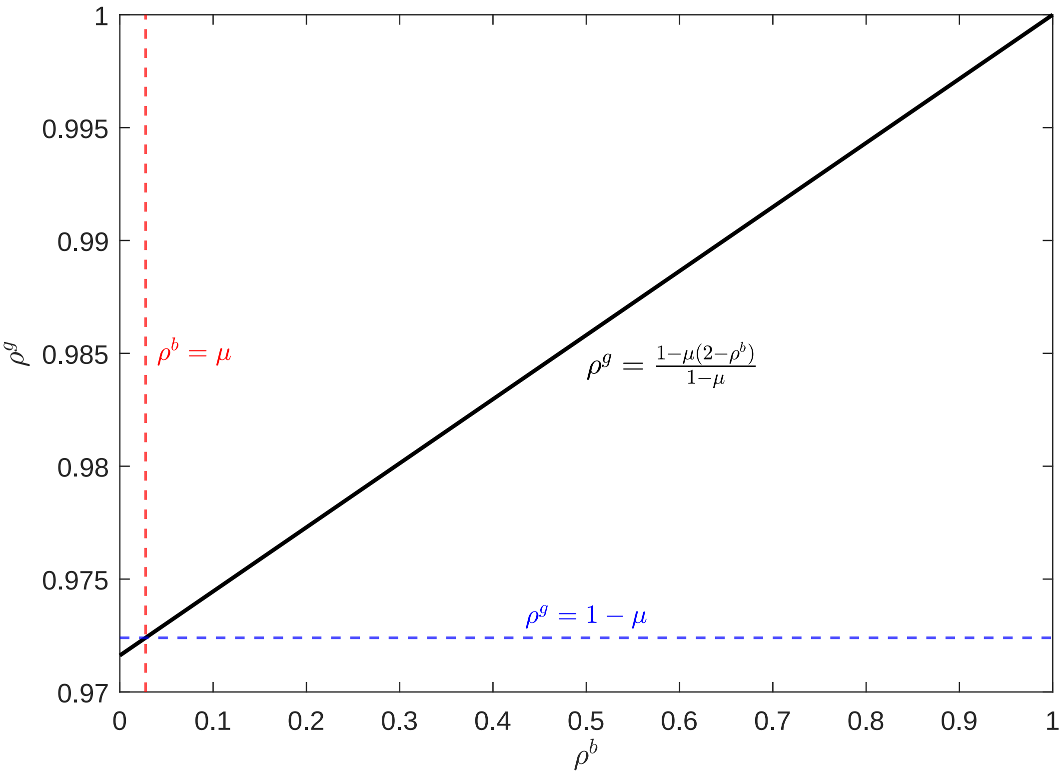

Figure 1: Set of signal persistencies keeping μ and p constant as in our main calibration. The point of blue and red dashed lines crossing corresponds to the i.i.d. signals case.

References

CHETTY, R. (2006): "A general formula for the optimal level of social insurance," *Journal of Public Economics*, 90, 1879–1901.

HENDREN, N. (2017): "Knowledge of Future Job Loss and Implications for Unemployment Insurance," *American Economic Review*, 107, 1778–1823.

KRUEGER, D. AND F. PERRI (2011): "Public versus Private Risk Sharing," *Journal of Economic Theory*, 146, 920–956.