Striving now to shirk later? intertemporal effort in car insurance

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Motivation

1. Moral hazard is a theoretical source of economic distortion.

   Can we find empirical evidence of moral hazard?

2. In a simple static framework, insurance / incentive trade-off: a better coverage induces a lower effort.

   In a dynamic framework, does this property still hold theoretically and empirically?

Incentive mechanism under study: the lifetime protection

- Classical bonus/malus system: bonus decreases in case of car crash and increases otherwise.
- Extended bonus/malus system with lifetime protection: insurees at maximum bonus for a long time are freely protected against any loss of bonus, whatever the claims.

Lifetime protection

"Unique from XXX - A LIFETIME no claims discount! - XXX is the only insurer in Ireland with this amazing cover. XXX automatically give this cover for free to loyal XXX Insurance customers who have had a maximum no claims discount with XXX for 10 years or more, you cannot buy or apply for this cover.

This cover means that XXX will not reduce your no-claim discount no matter how many future claims you have or what type of claim they are. This is unique to XXX and is another great example of how XXX are Redefining Standards when it comes to car insurance."

Two contracts

- Old contract with classical bonus/malus system.
- New contract with extended bonus/malus system with lifetime protection.

Two car insurance branches of an Irish insurer

- Branch 1: storefronts directly managed by the insurer.
  New contract enforced in June 2004.
- Branch 2: storefronts owned by independent insurance brokers.
  New contract enforced in March 2006.

Three phases

- *Phase I, until May 2004:* Both branches use the old contract without the lifetime protection, which is the pre-reform situation.
- *Phase II, from June 2004 to February 2006:* Branch 1 uses the new contract with the lifetime protection, while branch 2 still uses the old contract without it.
- *Phase III, from March 2006:* Both branches use the new contract with the lifetime protection.

Main results

- Theoretical consequences under moral hazard of using an extended bonus/malus system with lifetime protection instead of a classical one:
  - Shirking phase: lifetime protected insurees reports more claims.
  - Striving phase: unprotected insurees report less claims to increase their probability to be rewarded with the protection.
- Empirically:
  - Shirking phase: 60 % more claims.
  - Striving phase: 10 % less claims.
  - Shirking effect found for each type of at-fault claims, while striving effect found only for claims implying no third party.
  - Women and young insurees more reactive to incentives.

$\rightarrow$ More complex insurance / incentive trade-off in a dynamic framework.

Empirical literature

- Identification based on incentives changes due to different static covers:
  - Deductible level: Wang, Chung and Tzeng (2008), Weisburd (2015).
  - Third party versus comprehensive cover: Rowell, Nghiem and Connelly (2016).
  - Nighttime and daytime: Gao, Powers and Wang (2016).
- Identification based on incentives changes due to states changes in a dynamic cover:
  - Bonus/malus system: Abbring, Chiappori, Pinquet (2003), Abbring, Chiappori and Zavadil (2008), Dionne, Michaud, Dahchour (2013), Vukina and Nestic (2015).
  - Point-record driver's license: Dionne et al. (2011).
- All papers conclude to the presence of moral hazard, except the pioneer paper Abbring, Chiappori, Pinquet (2003).

Model assumptions (1/2)

- Infinitely living insured agent
- He chooses his instantaneous efforts in order to maximize his expected intertemporal utility (claim probability p directly chosen, ρ rate of time preference).
- $\tau \in [\underline{\tau}, +\infty[$ is his state in the experience rating system. The more advanced he is in the experience rating system, the higher the τ.

Model assumptions (2/2)

- Agent's instantaneous utility:

$$u(\tau) - c(p(\tau))$$

- Transition function between states of the bonus/malus system:

$$\theta(\tau)$$

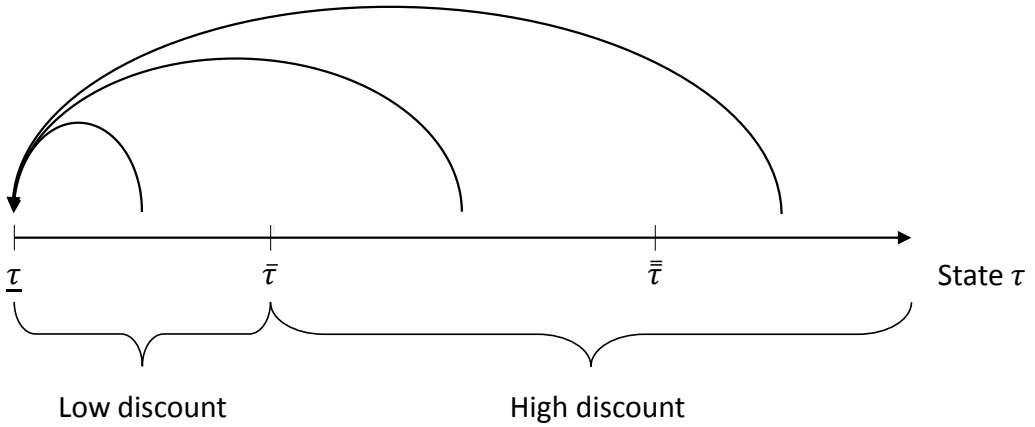
  - If a claim occurs, the insuree's state at the following instant moves to $\theta(\tau + d\tau)$.
  - It it does not, the insuree's state at the following instant system moves to $\tau + d\tau$.

Bellman equation

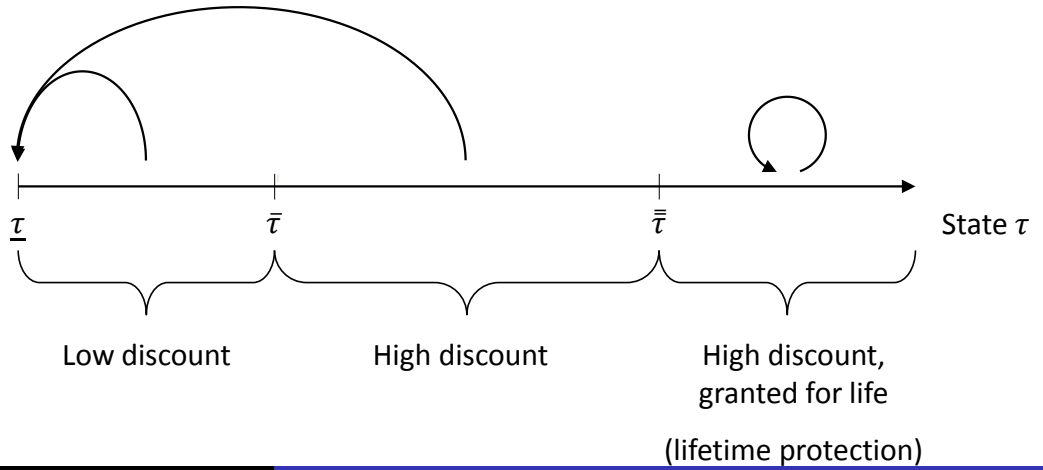
$$V'(\tau) = \rho V(\tau) - u(\tau) + \min_{p(\tau)} \Big\{ \underbrace{c(p(\tau))}_{\substack{\text{Effort} \\ \text{cost}}} - p(\tau) \underbrace{\left(V\left(\theta(\tau)\right) - V(\tau)\right)}_{\substack{\text{Expected intertemporal utility change} \\ \text{due to claim reporting}}} \Big\}$$

The two transition functions

Old contract (C=old)



New contract (C=new)



Theoretical dynamic incentive changes between the two contracts

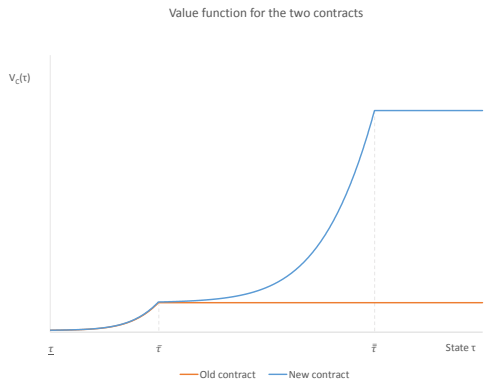
Comparative dynamics

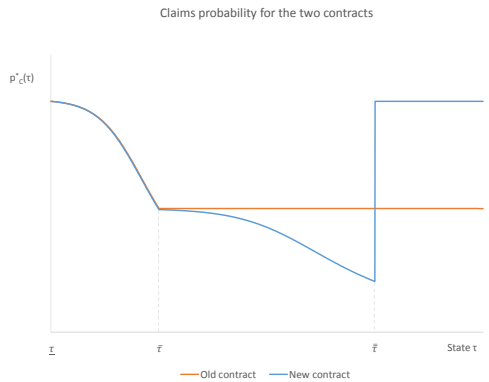
a) $(V_{new} - V_{old})(\tau)$ *is continuous, positive and increasing.*

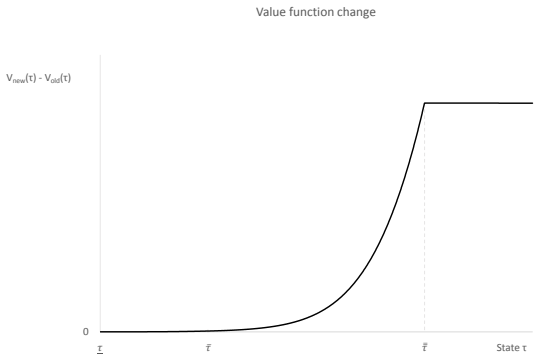
b) $(p^*_{new} - p^*_{old})(\tau)$ *is negative on* $[\underline{\tau}, \overline{\tau}[$*, negative and decreasing on* $[\underline{\tau}, \overline{\overline{\tau}}[$*, positive and constant on* $[\overline{\overline{\tau}}, +\infty[$*.*

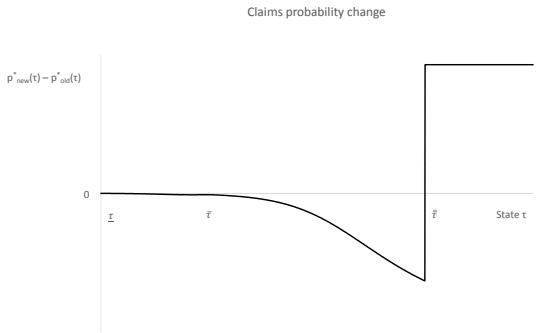
- Shirking phase (on $[\overline{\overline{\tau}}, +\infty[$): lower effort (higher claims rate) when the lifetime protection is granted.
- Striving phase (on $[\underline{\tau}, \overline{\tau}[$): higher effort (lower claims rate) when the lifetime protection is not granted, as it increases the probability to be rewarded with the protection.
- The agent gives up instantaneous utility (strives now) to enjoy more instantaneous utility in the future (shirks later).

Value function (left) and claims probability (right)





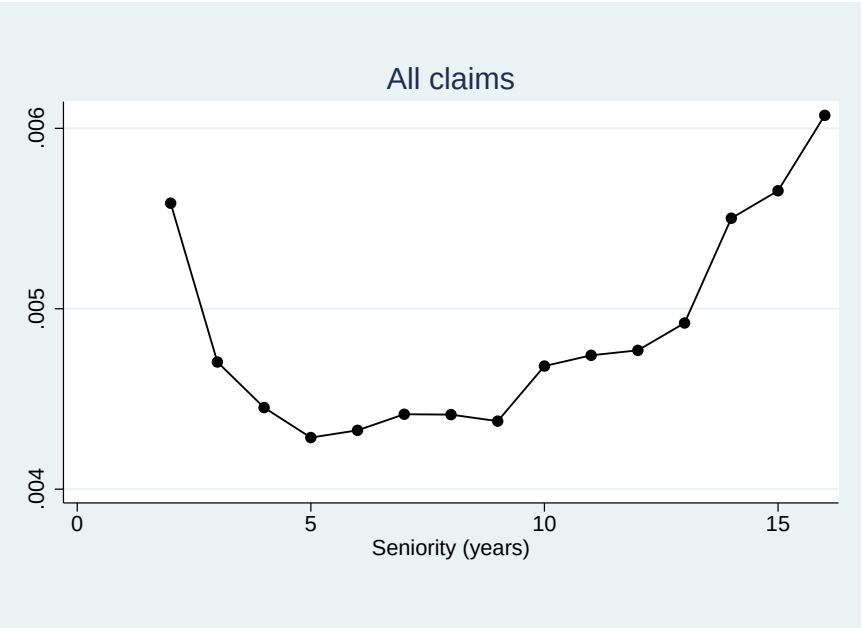


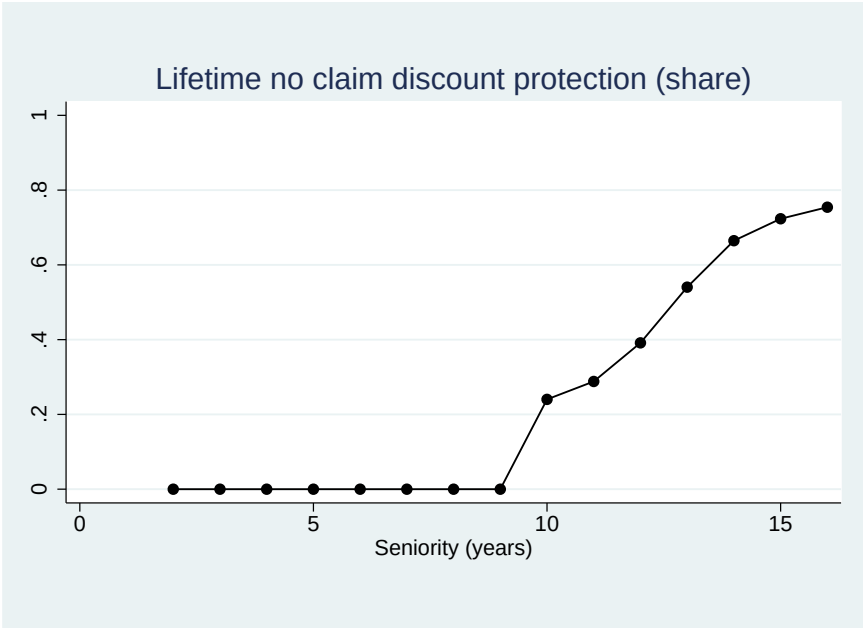


Panel data

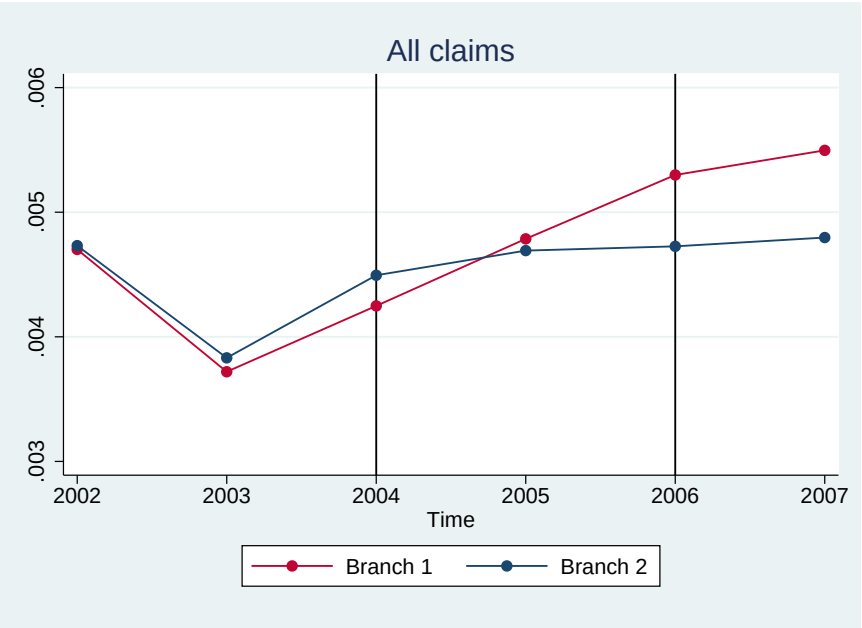
- Administrative data from a major Irish insurer.
- Insurees of privately owned cars.
- From January 2002 to December 2007.
- One record per insuree and per month (characteristics of the insuree, of his vehicle, of his contract, whether he reported at least one claim in the month and which type).
- Only at-fault claims.
- Three types of claims:
  - Type A: no third party is involved.
  - Type B: a third party involved, but no third party injury.
  - Type C: a third part is injured.
- We focus on insurees who joined the insurer between 1991 and 1999.
- 132 thousands insurees.
- 5.8 millions of observations and 26.4 thousands claims (average monthly claims rate: 0.46 %).

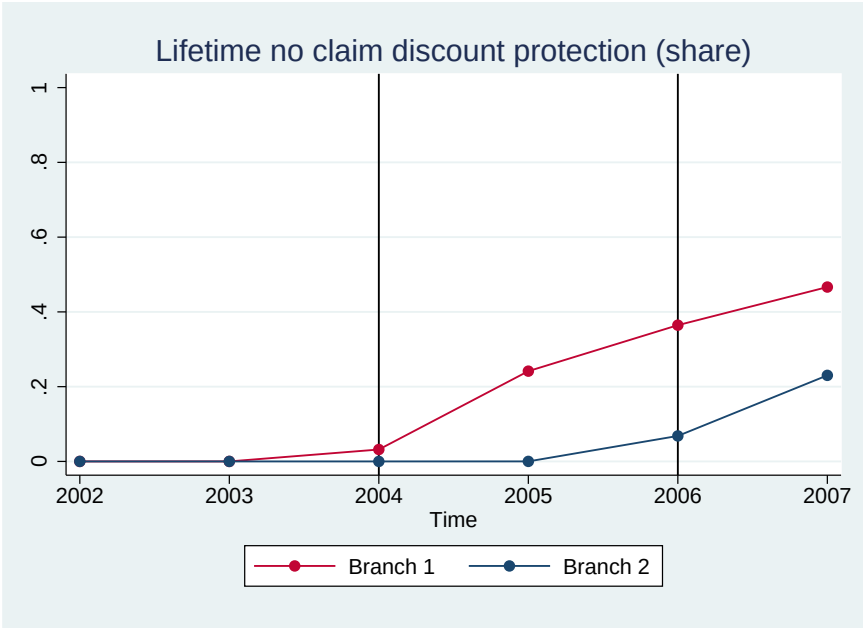
All claims rate over seniority



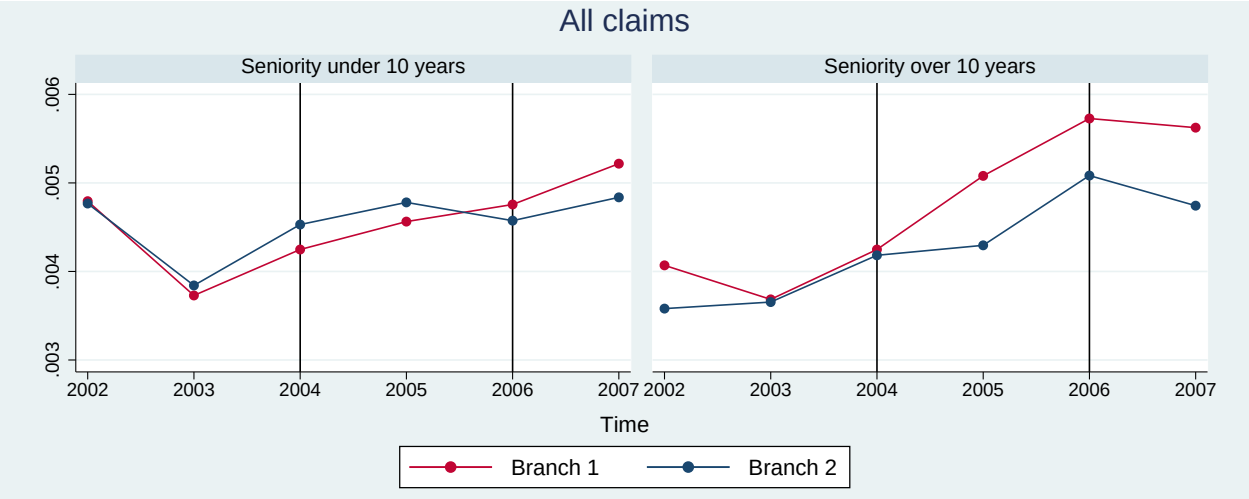


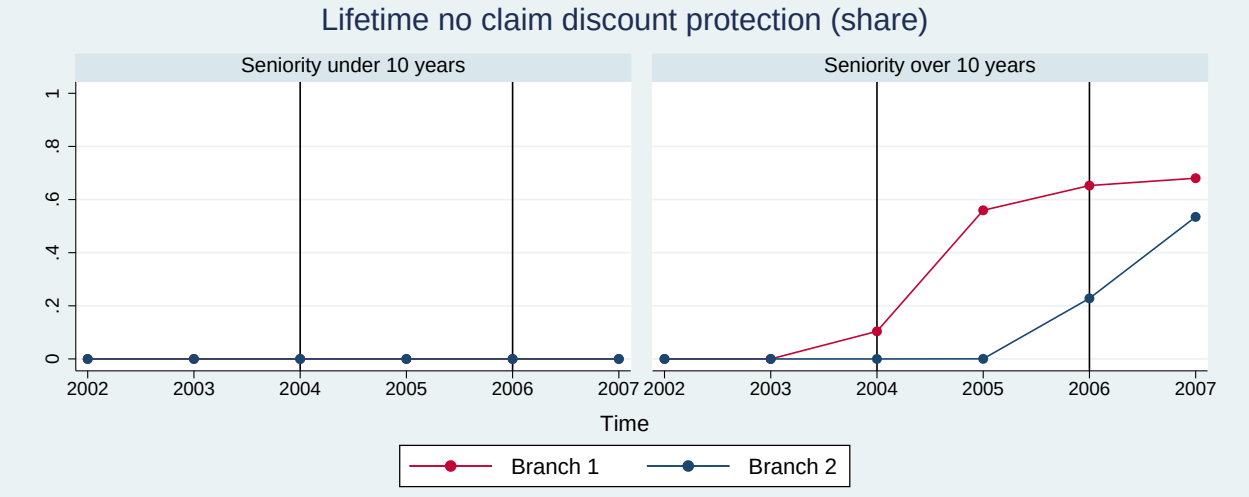
All claims rate over time



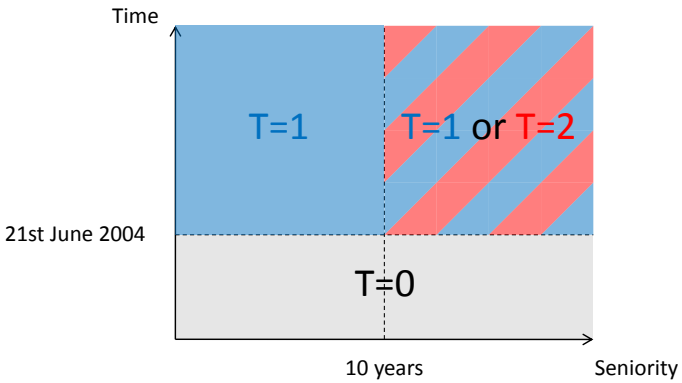


All claims rate over time, by seniority category

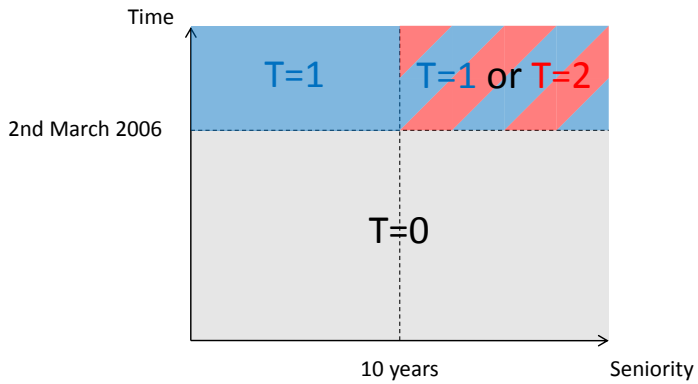




Three treatment levels



Branch 1



Branch 2

- $T = 0$: classical bonus/malus contract (reference).
- $T = 1$: extended bonus/malus contract and lifetime protection not granted (striving phase).
- $T = 2$: extended bonus/malus contract and lifetime protection granted (shirking phase).

Preliminary strategy: DID

We consider regressions of the form:

$$y_{it} = \alpha_{1,2} \cdot 1[T_{it} \geq 1] + \beta \cdot x_{it} + \mu_i + \nu_t + \varepsilon_{it}$$

- y_{it} is the dummy of the insuree i reporting a claim in month t.
- $\alpha_{1,2}$ is the parameter of interest. It captures the causal effect of holding the new contract compared to the old one.
- x_{it} are covariates.
- μ_i and ν_t are respectively individual (insuree) and time (month) fixed effects.
- ε_{it} is an error term.
- For all the results we report heteroskedasticity robust standard errors while allowing for clustering at the insuree level.

Core strategy: DID with IV

We note Z the seniority of the insuree. $1[T = 2]$ being instrumented using $1[Z \geq 10]$, we consider the regressions:

$$y_{it} = \alpha_1 \,.\, 1[T_{it} \geq 1] + \alpha_2 \,.\, 1[T_{it} = 2] + \beta^{SS} \,.\, x_{it} + \mu_i^{SS} + \nu_t^{SS} + \varepsilon_{it}^{SS}$$

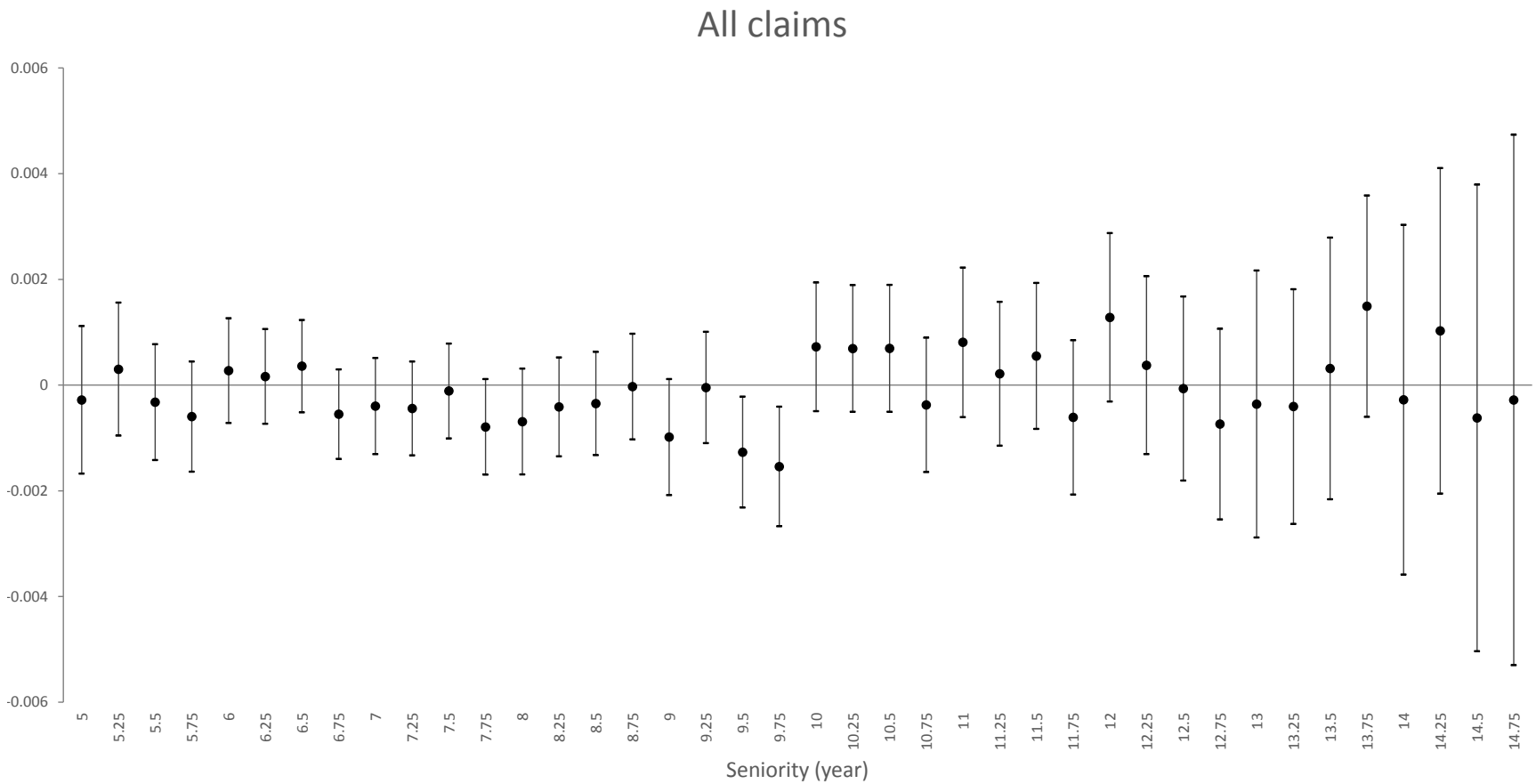
- α_1 and α_2 are the parameters of interest. α_1 capture the causal effect of being in the unprotected state of the new contract compared to holding the old contract. α_2 capture the causal effect of being in the protected state of the new contract compared to being in the unprotected state of the new contract.
- x_{it}, μ_i, ν_t and ε_{it} are as previously. We also report for all the results heteroskedasticity robust standard errors while allowing for clustering at the insuree level.

Preliminary result (1/2)

	(1) OLS	(2) OLS
$1[T \geq 1]$	-0.000188	
	(0.000153)	
$1[T \geq 1]$. $1[Z < 10]$		-0.000344*
		(0.000173)
$1[T \geq 1]$. $1[Z \geq 10]$		0.000365
		(0.000312)
Observations	5,772,578	5,772,578
R^2	0.001	0.001

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Preliminary result (2/2)



Core result

	(1) OLS	(2) 2SLS	(3) 2SLS
$1[T \geq 1]$	-0.000608***	-0.000379*	-0.000411**
	(0.000147)	(0.000153)	(0.000149)
$1[T = 2]$	0.00473***	0.00261***	0.00291***
	(0.000143)	(0.000453)	(0.000285)
Instruments	0	1	7
Observations	5,772,578	5,772,578	5,772,578
R^2	0.001	0.001	0.001

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Interpretation

Presence of moral hazard.

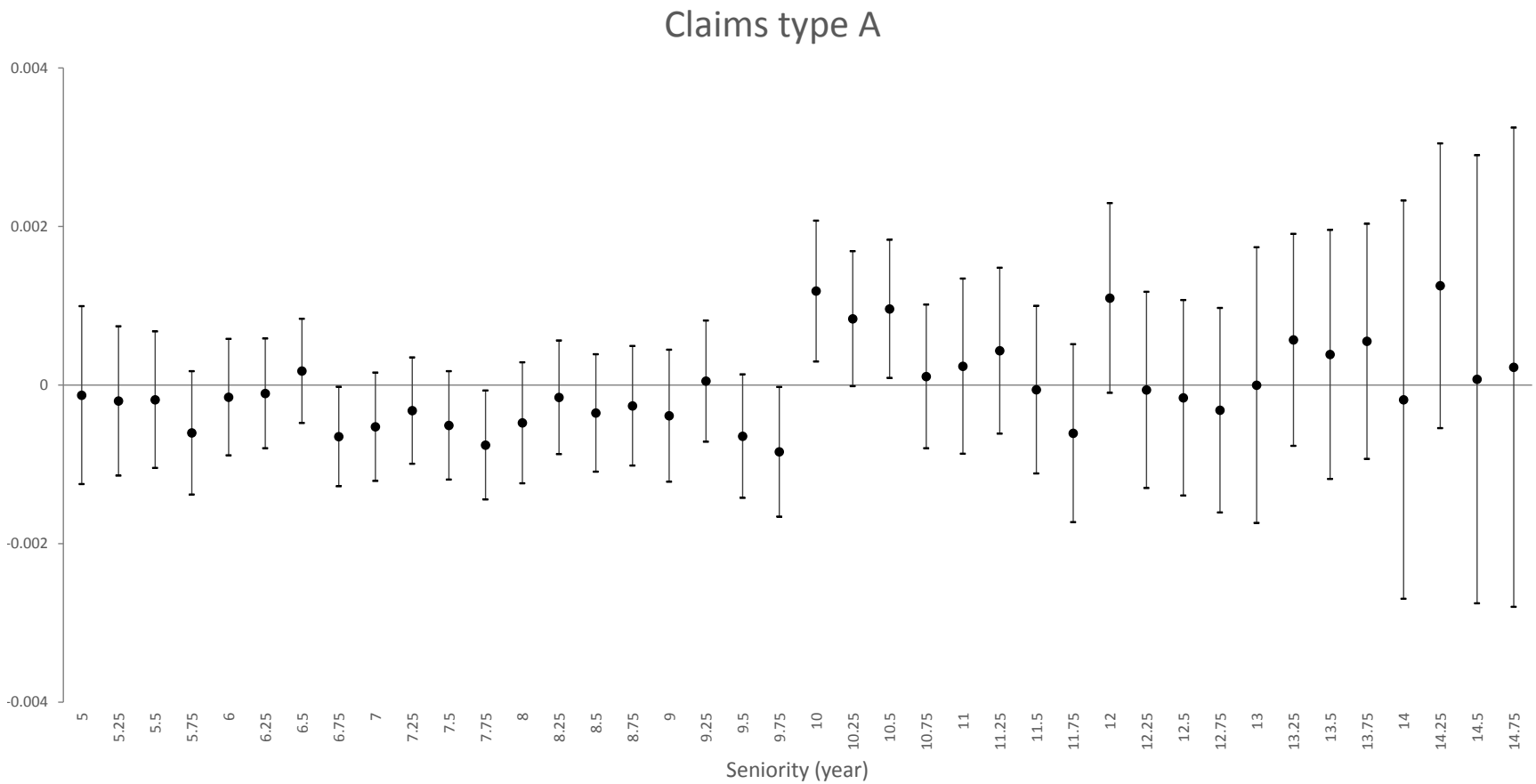
- Protected insurees report 60 % more claims (shirking phase).
- Unprotected insurees report 10 % less claims (striving phase), whereas the protection is not worst.

Preliminary result (1/2)

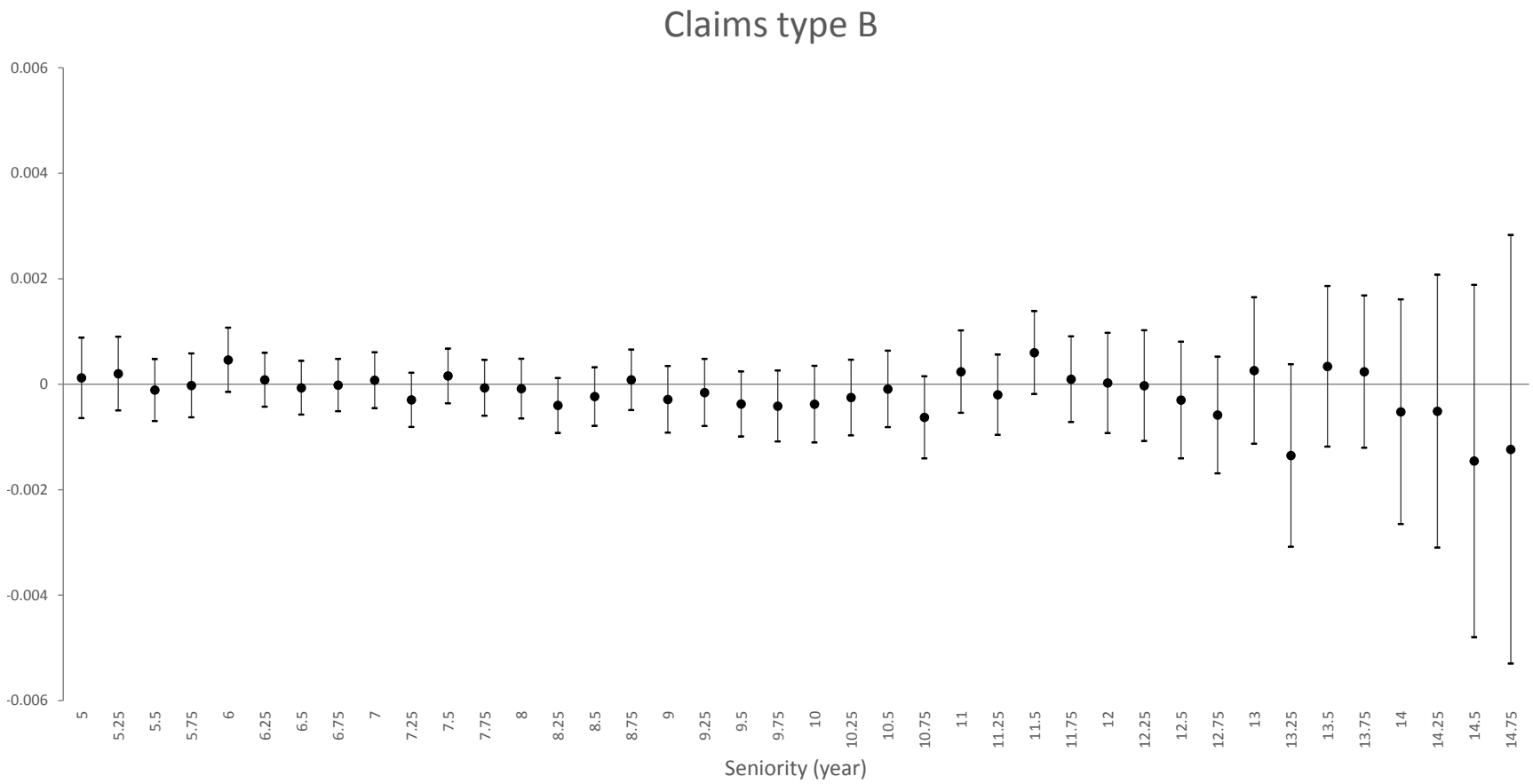
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS
Claims type	A	B	C	A	B	C
$1[T \geq 1]$	-0.000182	-0.0000662	0.0000600			
	(0.000114)	(0.0000894)	(0.0000486)			
$1[T \geq 1]$. $1[Z < 10]$				-0.000355**	-0.0000348	0.0000458
				(0.000129)	(0.0000994)	(0.0000553)
$1[T \geq 1]$. $1[Z \geq 10]$				0.000432	-0.000178	0.000111
				(0.000221)	(0.000192)	(0.0000957)
Observations	5,772,578	5,772,578	5,772,578	5,772,578	5,772,578	5,772,578
R^2	0.001	0.000	0.000	0.001	0.000	0.000

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

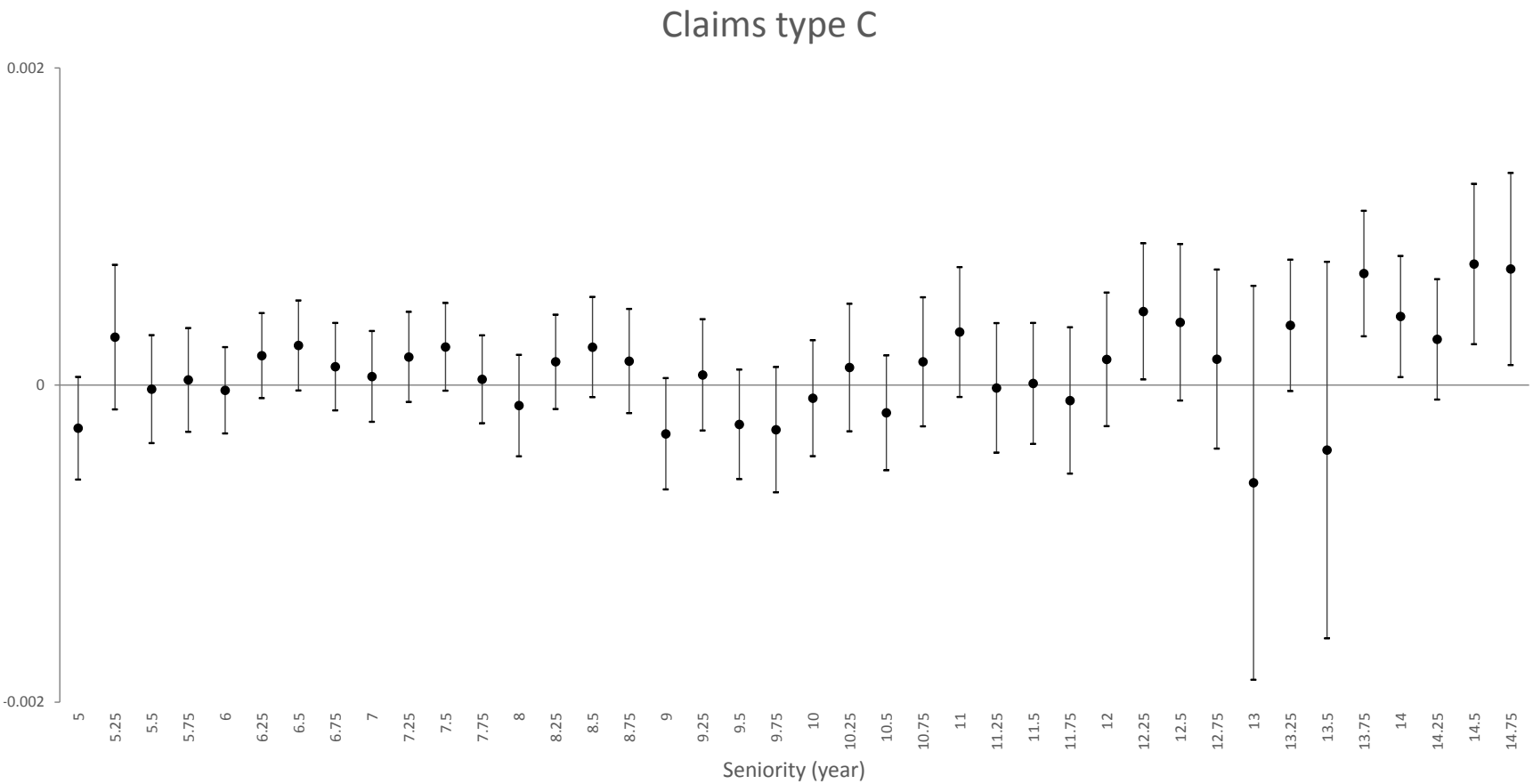
Preliminary result (2/2), claims type A



Preliminary result (2/2), claims type B



Preliminary result (2/2), claims type C



Core result

	(1) 2SLS	(2) 2SLS	(3) 2SLS
Claims type	A	B	C
$1[T \geq 1]$	-0.000383***	-0.0000787	0.0000506
	(0.000111)	(0.0000868)	(0.0000467)
$1[T = 2]$	0.00205***	0.000485**	0.000365***
	(0.000215)	(0.000163)	(0.0000925)
Instruments	7	7	7
Observations	5,772,578	5,772,578	5,772,578
R^2	0.000	0.000	0.000

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Interpretation

- Shirking effect found for each type of claims, including claims implying third party injury: presence of *ex ante* moral hazard.
- Striving effect found only for claims type A: *ex post* moral hazard? Increase just after the reward: report postponement?

Gender and age

	(1) Women	(2) Men	(3) Age under 50	(4) Age over 50
$1[T \geq 1]$	-0.000375*	-0.000452	-0.000522*	-0.000189
	(0.000188)	(0.000249)	(0.000210)	(0.000219)
$1[T = 2]$	0.00317***	0.00235***	0.00323***	0.00216***
	(0.000359)	(0.000470)	(0.000431)	(0.000403)
Instruments	7	7	7	7
Observations	3,473,771	2,298,612	3,512,684	2,258,020
R^2	0.001	0.001	0.001	0.001

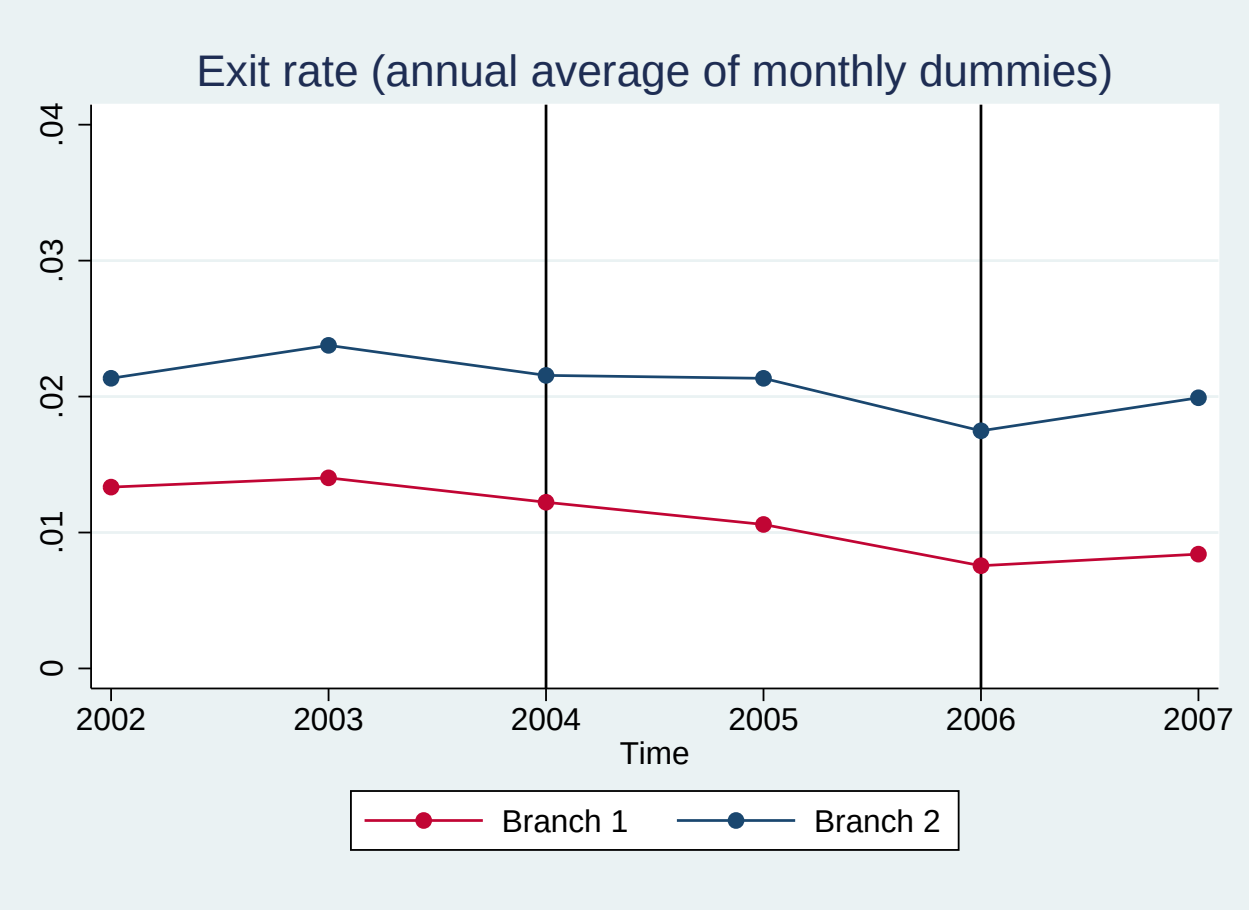
Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Conclusion

- Presence of moral hazard.
- In a dynamic framework, the classical insurance / incentive trade-off is more complex.
- Effects of the introduction of a protected state on protected and especially unprotected agents in other fields?

Thank you!

Exit rate over time



Exit rate over time, by seniority category