

# Heterogeneous Effects of Social Insurance

## Empirical evidence from Chile

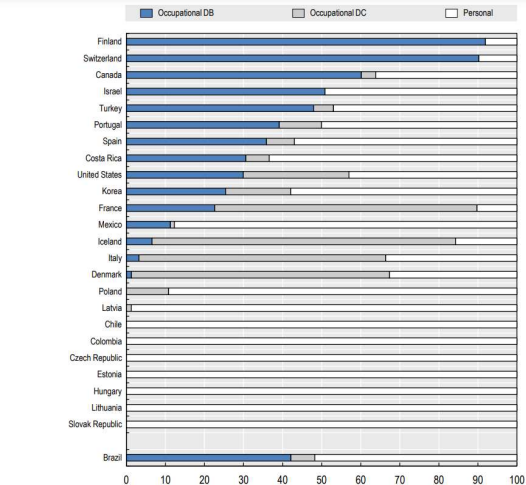
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# Motivation

- ▶ Chile had a fully funded defined contribution (DC) pension system since 1980



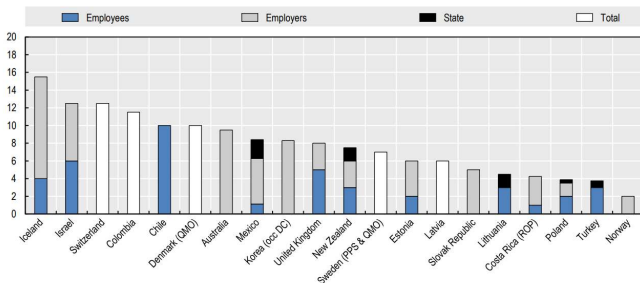
Source: OECD Global Pension Statistics.

# Motivation

- ▶ Formal workers are forced to save 10% of their labor income

Figure 9.1. Minimum or mandatory contribution rates (for an average earner) in mandatory and auto-enrolment plans (unless specified otherwise), 2020 (or latest year available)

As a percentage of earnings

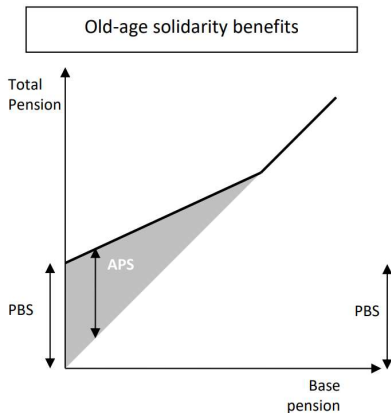


Note: The category "Total" shows the cases where the contribution rates cannot be split precisely between employer, employee (and state). "occ DC" means occupational defined contribution plans. "PPS" means premium pension system. "QMO" means quasi-mandatory occupational plans. "ROP" refers to a mandatory supplementary pension scheme.

Source: ISSA Social Security Country Profiles and other sources.

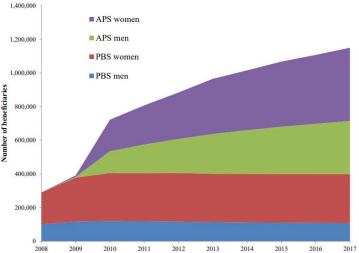
# Motivation

- ▶ In mid-2008 Chile started a minimum pension program

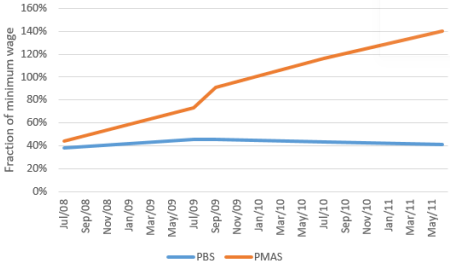


# Motivation

- ▶ The reform initially aimed to cover 40% of the poorest retirees, although by early 2022 a 66% of retirees receives a subsidized pension;



(a) Beneficiaries



(b) Average Benefit (% of MW)

# What is this paper about?

- ▶ How the marginal propensity to save for retirement changes after the introduction of a subsidized pension:
  - ▶ DiD strategy based on a long panel administrative dataset from Chile, before and after the 2008 pension reform;
  - ▶ Robustness test using a sub-sample of workers that also participated in the Social Protection Survey;
- ▶ I conduct an structural analysis to analyze the results implied by the DiD;
- ▶ I implement the IV estimator for the case of mismeasured treatment where instruments are obtained from the a structural model:
  - ▶ Calvi, Lewbel & Tommasi (2022)

# Contribution Literature

- ▶ Effect of social insurance on labor and financial decisions:
  - ▶ Feldstein (1974) and Barro and MacDonald (1979) debate on the effect of social security on saving and investment behavior, consumption, labor supply, etc.;
- ▶ Behavioral and labor market frictions:
  - ▶ Laibson et al. (1998): Hyperbolic discounting preferences explain low retirement savings, popularity of social security, over borrowing, regret for lack of savings at old age;
- ▶ Chilean pension system:
  - ▶ Diamond (1993) theoretically criticises the Chilean pension system for a lack of redistribution;
  - ▶ Behrman, Mitchell, Soo & Bravo (2012): Financial literacy increases pension wealth accumulation;

## Summary of our main results

- ▶ Using a DiD, I estimate an approximated 10% reduction in the propensity to contribute between the estimated treatment and control groups;
- ▶ Using a structural approach;
  - ▶ This study finds that hyperbolic discounting is needed to explain the retirement saving behavior of Chilean workers;
- ▶ The implemented IV estimator suggest that the DiD may over-estimate the effect of the reform;
- ▶ Applying a non-parametric cross-sectional regression I show that the small effects of the reform may be driven by treated workers' low financial literacy;



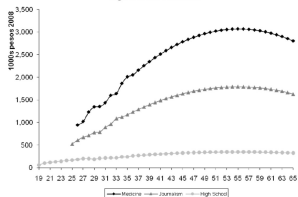
# Institutional framework

## Chilean pension system: since 1981

10%  
Contribution rate

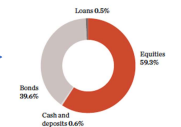


Profile of the expected income for Medicine, Journalism and High School Education



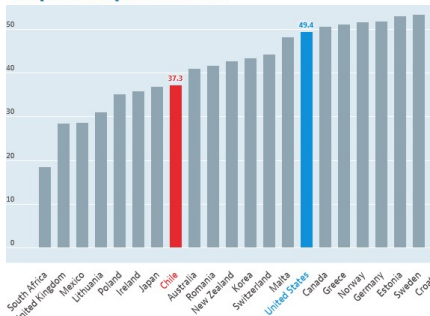
Source: Lara, Meller & Valdés (2017)

Chilean pension funds' asset allocation



Source: OECD, 2015

Net pension replacement rates



Source: OECD Pension at Glance

# Theoretical Model

- ▶ A worker chooses:
  - ▶  $C_{i,t}$  worker's  $i$  consumption;
  - ▶  $h_{i,t}^f$  fraction of time worker  $i$  devotes to formal sector;
- ▶ Such that:

$$V_t = \max_{C_t, L_t, h_t^f} U(C_t) + \sum_{j=t+1}^{T-1} \beta_{t,j} E[U(C_j)] + \theta \beta_{t,T} E[F(W_T^P, W_T, r_T^*)]$$

- ▶  $\beta_{t,t+j}$  measures worker's subjective discount factor from time  $t$  to  $t+j$ ;
- ▶  $E[F(W_T^P, W_T, q, r^*)]$  is worker's expected utility at retirement  $t$  given future liquid and pension assets ( $W_T$  and  $W_T^P$ );

## Wealth process

- ▶ Liquid savings evolve as follows:

$$W_{t+1} = (W_t + y_t(h_t^f) - C_t - \varsigma_t(h_t^f))(1+r) - \varepsilon_{t+1}(h_t^f)$$

- ▶  $\varsigma_t(L_t, h_t^f)$  aggregates social security contributions of worker  $i$  ( $\Delta_t(L_t, h_t^f)$  to health and  $\kappa_t(L_t, h_t^f)$  to pensions);
- ▶  $\varepsilon_{t+1}(L_t, h_t^f)$  is a random health shock;
- ▶  $y_{t+1}(L_{t+1}, h_{t+1}^f)$  is next period's income;
- ▶ The evolution of pension assets is given by:

$$W_{t+1}^P = \left( W_t^P + \kappa_t(h_t^f) \right) (1+r^*)$$

- ▶  $r$  and  $r^*$  measure the short-term and long-term interest rates;

# Labor market

- ▶ Worker's earn an hourly wage ( $w_f$ ) if they work in the formal sector ( $h_{i,t}^f(1 - L_t)$ ), and get a hair cut ( $\Delta$ ) if they work in the informal sector;
- ▶ Total labor earnings are given by;

$$y_t = y_t^F + y_t^I = w_f(A, e)h_t^f + \Delta w_f(A, e)(1 - h_t^f)$$

- ▶ The trade-off that workers face is measured by worker's utility function:

$$U(C_t, L_t) = \alpha C_t^\gamma + (1 - \alpha) L_t^{1-\gamma} \quad (1)$$

- ▶  $\gamma$  controls the relative marginal utility of consumption over leisure;

# Social security contributions and forced retirement savings

- ▶ Pensions and public health:

$$\varsigma_t(L_t, h_t^f) = \Delta_t(L_t, h_t^f) + \kappa_t(L_t, h_t^f) = \min \left\{ y_t^F(L_t, h_t^f)\theta, \bar{y}\theta \right\} \\ + \min \left\{ y_t^F(L_t, h_t^f)\tau, \bar{y}\tau \right\}$$

where

- ▶  $\Delta_t(L_t, h_t^f)$  contribution to health ( $\theta = 7\%$ );
- ▶  $\kappa_t(L_t, h_t^f)$  contribution to pensions ( $\tau = 10\%$ );

# Public health subsidies

- ▶ The model intends to capture decisions of people with labor earnings around the minimum wage;
- ▶ Public health subsidies are established based on formal income, such that:

$$\varepsilon_{t+1}(L_t, h_t^f) = \begin{cases} 0 & y_t^F \leq y_l \\ \varepsilon_l & y_l < y_t^F \leq y_m \\ \varepsilon_m & y_t^F > y_m \end{cases}$$

where

- ▶  $y_l$  is the minimum wage;
- ▶  $y_m$  is 1.46 times the minimum wage;
- ▶  $\varepsilon_l$  is a 10% of the health expenditure shock;
- ▶  $\varepsilon_m$  is a 20% of the health expenditure shock;

# First pillar pension plan

- ▶ Depending on worker pension assets her welfare is measured as a function of wealth accumulated and minimum pension rules:

$$F(W_T^P, W_T, r^*) = \begin{cases} \left( p_l + \frac{p_l}{p_m} \frac{W_T^P}{a(r^*)} + \frac{W_T}{a(r^*)} \right)^\nu & 0 < \frac{W_T^P}{a(r^*)} \leq p_m \\ \left( \frac{W_T^P}{a(r^*)} + \frac{W_T}{a(r^*)} \right)^\nu & \frac{W_T^P}{a(r^*)} > p_m \end{cases}$$

- ▶  $p_l$  is the PBS;
- ▶  $p_m$  is the PMAS;
- ▶  $a(r^*)$  is the cost of a life-annuity at T;
- ▶ given a fixed  $\nu$ , the parameter  $\gamma$  controls the lifetime utility value of wealth at retirement.

# Data

- ▶ We exploit two datasets that allow us to study Chilean workers' contribution to the pension system:
  - ▶ Long panel administrative dataset (Chilean Superintendence of Pensions);
  - ▶ A sub-sample of workers that participated in the social protection survey (e.g. financial literacy);



# Summary Statistics

Panel A	Low Inc	Mid Inc	High Inc	diff/sd	
				Low-High	Mid-High
N° of workers	2,249	5,390	7,234		
Men	46%	61%	66%	-0.40	-0.12
Age	35.3	35.7	37.9	-0.24	-0.20
Contribution	35.1%	61.7%	80%	-0.90	-0.36
IPL	1.1	2.0	5.2	-1.39	-1.09
$\bar{Y}$	1.0	1.9	5.1	-1.79	-1.37
$\bar{C}$	35.1%	61.7%	80%	-1.29	-0.52
Pension assets	1.0	1.9	6.3	-0.88	-0.73

Panel B	Low Cont	Mid Cont	High Cont	diff/sd	
				Low-High	Mid-High
N° of workers	5,578	4,698	6,534		
Men	43%	63%	64%	-0.42	-0.02
Age	37.1	34.5	38.7	-0.15	-0.39
Contribution	14%	60%	94%	-1.61	-0.68
IPL	1.6	2.5	4.0	-0.80	-0.50
$\bar{Y}$	1.4	2.4	4.0	-1.11	-0.66
$\bar{C}$	14%	60%	94%	-2.32	-0.98
Pension assets	1.3	2.4	6.5	-0.88	-0.68

Figure: Treated and control groups by income pre-2007 - Administrative dataset

# Summary Statistics

Panel C	Low Inc	Mid Inc	High Inc	diff/sd	
N° of workers	7074	5407	4174	Low-High	Mid-High
Men	44%	55%	63%	-0.37	-0.16
Married	44%	46%	52%	-0.16	-0.13
Kids	1.0	1.1	1.1	-0.06	-0.05
Age	39.8	37.8	38.6	0.12	-0.09
FLI	0.1	0.2	0.6	-0.45	-0.37
Low Educ	95%	91%	62%	0.87	0.77
\$NetWorth	31.0	20.8	-2.5	0.2	0.1

Panel D	Low Cont	Mid Cont	High Cont	diff/sd	
N° of workers	6813	6051	9898	Low-High	Mid-High
Men	41%	58%	58%	-0.35	0.00
Married	0.5	0.5	0.5	-0.04	-0.04
Kids	108%	107%	106%	0.02	0.01
Age	38.3	38.7	40.1	-0.19	-0.14
FLI	0.1	0.4	0.4	-0.28	-0.06
Low Educ	91%	78%	78%	0.35	0.00
\$NetWorth	-0.8	4.5	34.4	-0.2	-0.1

Figure: Treated and control groups by income pre-2007 - Administrative and Survey dataset

# Identification Strategy

- ▶ After the reform, pension subsidies affect retirement savings decision only through workers' long term expectations that are unobservable;
- ▶ The Chilean reform affect workers through their expectations, depending on:
  - ▶  $Y_{i,t}$  income earned if work in formal or informal labor market at time  $t + j$  periods in the future;
  - ▶  $W_T^P$  pension assets accumulated at retirement  $T$ ;

# Difference-in-Differences

- (1) Terciles by Average Income
  - (2) Terciles by Contribution Rate
- Pre-2007

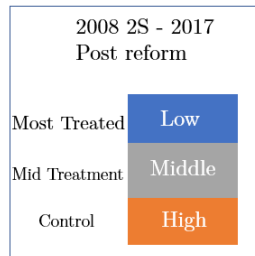
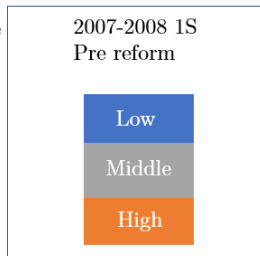


Figure: Treated and control groups

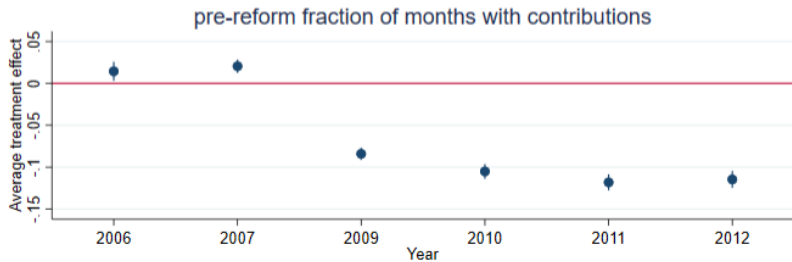
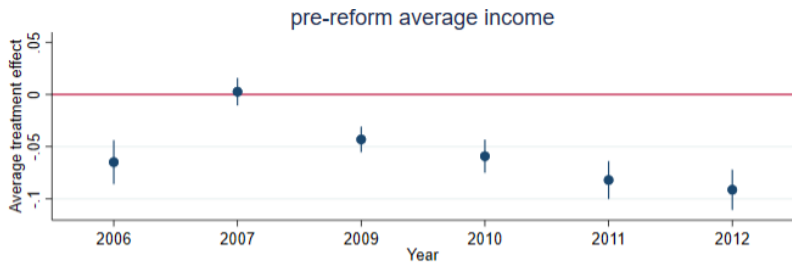
# Difference-in-Differences

- ▶ I propose to estimate the effect of having the option to rely on a pension subsidy during the old-age using the following regression model;

$$Cont_{i,t} = \beta_0 + \sum_{s=2006}^{2007} \beta_s PreTreat_{i,s} \times G_i + \sum_{s=2009}^{2012} \beta_s PostTreat_{i,s} \times G_i + \theta_i + \theta_t + \xi_{i,t}$$

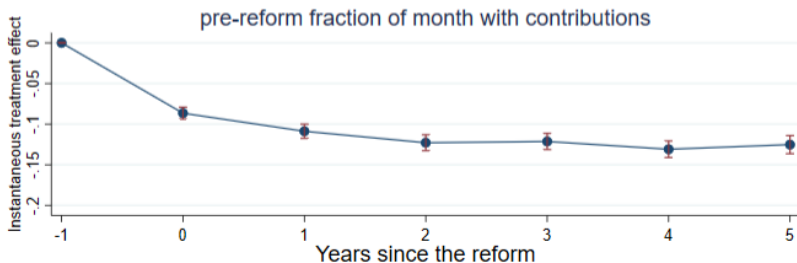
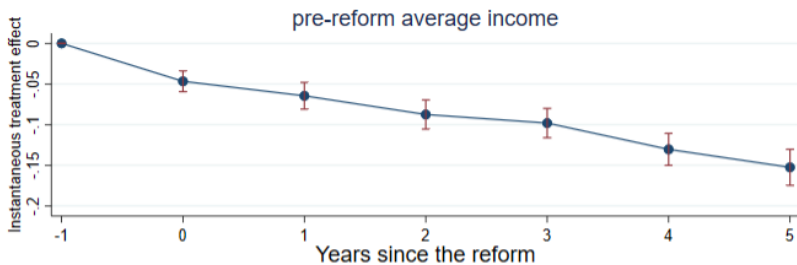
- ▶  $Cont_{i,t}$  takes a 1 if worker  $i$  contributes to the pension system at time  $t$ ;
- ▶  $PreTreat_{i,s}$  is a dummy variable that takes a 1 if worker  $i$  is observed at  $s$  before the reform (since June 2008);
- ▶  $PostTreat_{i,s}$  is a dummy variable that takes a 1 if worker  $i$  is observed at  $s$  after the reform (since July 2008);

# DiD Results



(a) OLS estimates

# DiD Results



(b) De Chaisemartin and d'Haultfoeuille (2022) DiD estimator

# Structural analysis

- ▶ The estimated model suggests that the estimated effects of the reform obtained from the DiD are rationalizable:

Moments fit	Panel A: Baseline estimated elasticity				Panel B: Replacement rate and time on contribution			
	Hyperbolic discounting		Exponential discounting		Hyperbolic discounting		Exponential discounting	
	Male	Female	Male	Female	Male	Female	Male	Female
Long-run discount factor ( $\delta$ )	0.80	0.87	0.77	0.80	0.77	0.87	0.73	0.87
					(101.81)	(3.56)	(74.06)	(5.83)
Marginal utility of consumption before retirement ( $\gamma$ )	0.50	0.53	0.57	0.43	0.40	0.60	0.40	0.47
					(0.70)	(1.72)	(3.12)	(3.59)
Elasticity ( $\varepsilon$ )	-0.14	-0.15	-0.15	-0.15	0.03	-0.02	-0.05	-0.19
Moments fit	Panel C: Elasticity and replacement rate				Panel D: Elasticity and time on contribution			
	Hyperbolic discounting		Exponential discounting		Hyperbolic discounting		Exponential discounting	
	Male	Female	Male	Female	Male	Female	Male	Female
Long-run discount factor ( $\delta$ )	0.80	0.87	0.77	0.87	0.70	0.87	0.70	0.87
	(220.25)	(0.56)	(122.91)	(7.63)	(12.41)	(7.11)	(5.22)	(3.79)
Marginal utility of consumption before retirement ( $\gamma$ )	0.40	0.47	0.40	0.47	0.50	0.60	0.40	0.47
	(2.81)	(0.15)	(4.09)	(5.07)	(1.99)	(3.28)	(0.18)	(2.57)
Elasticity ( $\varepsilon$ )	-0.16	-0.19	-0.18	-0.25	-0.16	0.01	-0.05	-0.38



## IV regression

- ▶ Following Calvi, Lewbel & Tommasi (2022): construction of instrumental variable using structural model to deal with a mis-measured treatment variable;
- ▶ The instrument is the predicted effect of the reform on retirement contribution rates ( $h_i^{f*}$ ) and consumption ( $C_i^*$ ) given worker's  $i$  age ( $Age_i$ ), pension assets ( $W_i^P$ ) and average income ( $\overline{Y}_i$ ) at the moment of the reform;
- ▶ I estimate the following 2SLS regression:

$$G_{i,t} = \beta_0 + \beta_1 Post_{i,t} \times Z_i + Age_{i,t} + Age_{i,t}^2 + \theta_i + \xi_{i,t}$$
$$Cont_{i,t} = \beta_0 + \beta_1 \times \hat{G}_{i,t} + Age_{i,t} + Age_{i,t}^2 + \theta_i + \xi_{i,t}$$

- ▶  $G_{i,t}$  is the dummy that identifies groups in the low contribution and income groups;
- ▶  $Z_i$  is the instrument for the potentially mismeasured treatment variable;

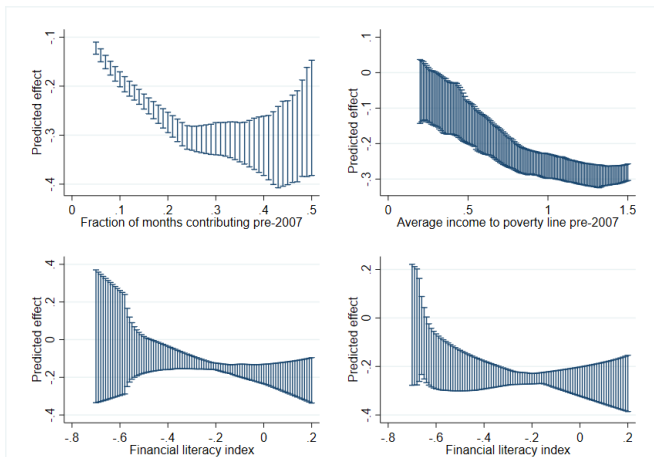
## IV regression results

- ▶ The IV estimates are smaller than DiD estimates;
- ▶ 2SLS estimates suggest reduction in probabilities between 1% (admin dataset) to 4% (survey dataset):

Panel A. First stage estimates					Panel B. 2SLS IV estimates				
Administrative dataset									
Dependent:	$G_{C,i} = 1$	$G_{Y,i} = 1$	$G_{C,i} = 1$	$G_{Y,i} = 1$	Dependent:	$Cont_{i,t}$			
$h_i^*$	-0.181*** (0.005)	-0.229*** (0.007)			$G_{C,i} = 1$	-0.048*** (0.017)			-0.067 (0.063)
$C_i^*$			7.071*** (0.979)	10.660*** (0.930)	$G_{Y,i} = 1$		-0.038*** (0.013)		-0.044 (0.043)
F-stat	1185	1005	52.19	131.6					
N* workers	2,088	2,088	2,088	2,088	N* workers	2,088	2,088	2,088	2,088
Administrative and survey dataset									
Dependent:	$G_{C,i} = 1$	$G_{Y,i} = 1$	$G_{C,i} = 1$	$G_{Y,i} = 1$	Dependent:	$Cont_{i,t}$			
$h_i^*$	-0.051*** (0.005)	-0.043*** (0.005)			$G_{C,i} = 1$	-0.720*** (0.103)			-4.264*** (0.838)
$C_i^*$			0.870*** (0.179)	3.060*** (0.634)	$G_{Y,i} = 1$		-0.818*** (0.143)		-1.192*** (0.347)
F-stat	99.94	90.52	23.57	23.38					
N* workers	879	879	879	879	N* workers	879	879	879	879

# Heterogeneity

- ▶ Using a nonparametric kernel regression I document heterogeneity along financial incentives an index of financial literacy:
- ▶ Results suggest that less responsive workers are also the ones with lower financial literacy;



# Conclusion

- ▶ The Chilean pension reform included an almost universal minimum pension program to increase welfare of poor Chilean retirees;
- ▶ My empirical analysis suggest that the policy reduced labor supply and formalization;
- ▶ However, I also show a degree of heterogeneity according to financial literacy;
- ▶ My analysis suggest that smaller effects compared to the traditional neoclassical model can be rationalized by introducing hyperbolic discounting;
- ▶ My contribution is related to the inclusion of behavioral assumption at the moment of conducting welfare analysis of policy reforms;