Labor Marlet Risk and the Private Value of Social Security

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Why do we care?

- **One of households' largest assets**
  - Accrued benefits represent $37tr in 2018 according to the Social Security Admin.
  - Saez and Zucman (2019) estimate households' wealth (excl. SS) to be $89tr.
  - Owner's equity in real-estate is $15.5tr
- **Correctly valuing Social Security matters:**
  - To understand wealth inequalities
  - To estimate the cost of privatizing Social Security or moving to a different system
  - To understand households' consumption and portfolio choices...

What we know

- **Households perceive Social Security as very risky**
  - They report high uncertainty regarding their benefits (Dominitz and Manski (2006))
  - ... invest less in stocks in response (Delavande and Rohwedder (2011))
  - ... and would accept a large discount to remove policy uncertainty (Luttmer and Samwick (2018))
- **Social Security is actually risky**: policy adjustments imply significant changes in expected IRR (Shoven and Slavov (2006))
- **Market valuations differ from Social Security Admin. actuarial estimates**
  - Geanakoplos and Zeldes (2010) finds the market value to be 17% *lower*
  - Blocker et al. (2018) find it to be 86% *higher*...

This Paper

- **Compute the certainty equivalent of Social Security in a stylized life-cycle model**
- **Two opposite forces**
  - Social Security offers higher rate of return to low-wage workers → provides insurance
  - Social Security returns depends on aggregate wage growth → exposes to long-run systematic risk
- **No policy uncertainty**
- **Key findings**
  - Workers' certainty equivalent is 50% below the risk-free rate DCF
  - Unlike the risk-free rate DCF, the certainty equivalent is negative for new entrants
  - Exposure to aggregate risk through Social Security varies a lot over the life-cycle

Further motivation

US Social Security

- **Payroll taxes**
  - Pay 10.6% of the part of your wage below the maximum taxable earnings ($132,900 in 2019)
- **Average Indexed Yearly Earnings (AIYE)**
  - **Step 1**: Adjust your past earnings for inflation and wage growth → systematic risk
  - **Step 2**: Keep the best 35 years
- **Low earners gets higher rate of returns than high earners:** → insurance

$$\text{Benefits} = \begin{cases} 0.9 \times AIYE & \text{if } AIYE/L_1(T) < 0.2 \\ 0.116 \times L_1(T) + 0.32 \times AIYE & \text{if } 0.2 \leq AIYE/L_1(T) < 1 \\ 0.286 \times L_1(T) + 0.15 \times AIYE & \text{if } 1 \leq AIYE/L_1(T) \end{cases}$$

Cointegration between wages and dividends

- **Labor and profit shares are stable over long period of time**
- **If so, wages and dividends should be cointegrated**
  - Historically abnormal difference between log aggregate wages and log aggregate dividends

$$y(t) \equiv l_1(t) - \hat{d}(t) - \overline{ld}$$

  - Dynamics of y

$$\Delta y(t) = -\kappa y(t-1) + \epsilon(t)$$

$\rightarrow \kappa > 0$ means cointegration

Estimates of cointegration strength for 1929-2011

$$\Delta y(t) = -\kappa y(t-1) + b_t t + \sum_{1}^{4} b_i \Delta y(t-i) + c + \epsilon(t)$$

	Dividends						Stock Gains	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$y(t-1)$	.160**	.161	.233***	.175**	.196***	.180**	.200*	.180
	(.054)	(.054)	(.050)	(.054)	(.055)	(.061)	(.061)	(.065)
t		-.000					-.011***	-.010***
		(.000)					(.003)	(.003)
$\Delta y(t-1)$			.462***	.577***	.732***	.737***		.018
			(.094)	(.096)	(.104)	(.111)		(.109)
$\Delta y(t-2)$				-.355***	-.525***	-.573***		
				(.106)	(.114)	(.139)		
$\Delta y(t-3)$					.340***	.382***		
					(.108)	(.130)		
$\Delta y(t-4)$						-.071		
						(.116)		
DF p-value	.038	.139	.000	.017	.006	.039	.067	.211
$R^2_{Adj.}$	.09	.09	.31	.40	.44	.41	.10	.06
N	82	82	81	80	79	79	82	81

Model

Macroeconomic environment

- **Dividend process**

$$\frac{dD}{D} = g_D dt + \sigma dz_3$$

- **Stock market returns**

$$\frac{dS(t)}{S(t)} = \frac{dP(t) + D(t)dt}{P(t)} = \mu dt + \sigma dz_3$$

- **National average wage**

$$\frac{dL_1}{L_1} = \left(-\kappa y(t) + g_D - \frac{\sigma^2}{2} + \frac{v_1^2}{2}\right) dt + v_1 dz_1(t)$$

- **Cointegration**

$$dy(t) = -\kappa y(t)dt + v_1 dz_1(t) - \sigma dz_3(t)$$

Agent

- **Labor income**

$$\frac{dL_2}{L_2} = \alpha(t)dt + v_2 dz_2(t)$$

where $\alpha(t)$ captures the quadratic effect of experience on wages.

$$\alpha(t) = \alpha_0 + \alpha_1 t$$

- **Individual historical earnings**

$$H(t) = \frac{a}{45}\int_{T-45}^{t} L_2(u)du$$

which has the following dynamic:

$$dH = a\frac{L_2(t)}{45}dt$$

$a = 1.14$ adjusts for the fact that I do not keep only the best 35 years

Social Security and agent

- **Social Security pension**

$$B = \begin{cases} 0.9 \times H \times L_1(T) & \text{if } H < 0.2 \\ 0.116 \times L_1(T) + 0.32 \times H \times L_1(T) & \text{if } 0.2 \leq H < 1 \\ 0.286 \times L_1(T) + 0.15 \times H \times L_1(T) & \text{if } 1 \leq H \leq 2.5 \\ 0.286 \times L_1(T) + 0.15 \times 2.5 \times L_1(T) & \text{if } H > 2.5 \end{cases}$$

- **Agent**

$$J(W(t), L_1(t), L_2(t), y(t), H(t), t) \equiv \max_{[C,\pi]} E_t \left[\int_t^T e^{-\psi u} \frac{(C(u))^{1-\gamma}}{1-\gamma} du + J(T) \right]$$

  - CRRA preferences
  - Can borrow money or short-sell stocks

Certainty Equivalent of Social Security

- **Total wealth**
  - is the sum of financial wealth, human capital and Social Security value

$$\overline{W} = W + HC + SS \tag{1}$$

  - $\overline{W}$ is solution to

$$J^{\overline{ss}}(\overline{W}, 0, L_2, y, 0, t) = J^{ss}(W, L_1, L_2, y, H, t) \tag{2}$$

  - replacing the LHS by Merton (1969)'s solution:

$$\overline{W} = \left[\frac{(1-\gamma)e^{\varphi t}}{b(t)} J^{ss}(W, L_1, L_2, y, H, t)\right]^{\frac{1}{1-\gamma}} \tag{3}$$

- **Human capital** can be computed similarly

$$HC = \left[\frac{(1-\gamma)e^{\varphi t}}{b} J^{\overline{ss}}\left(W, \frac{L_1}{1-\tau}, L_2, y, t\right)\right]^{\frac{1}{1-\gamma}} - W \tag{4}$$

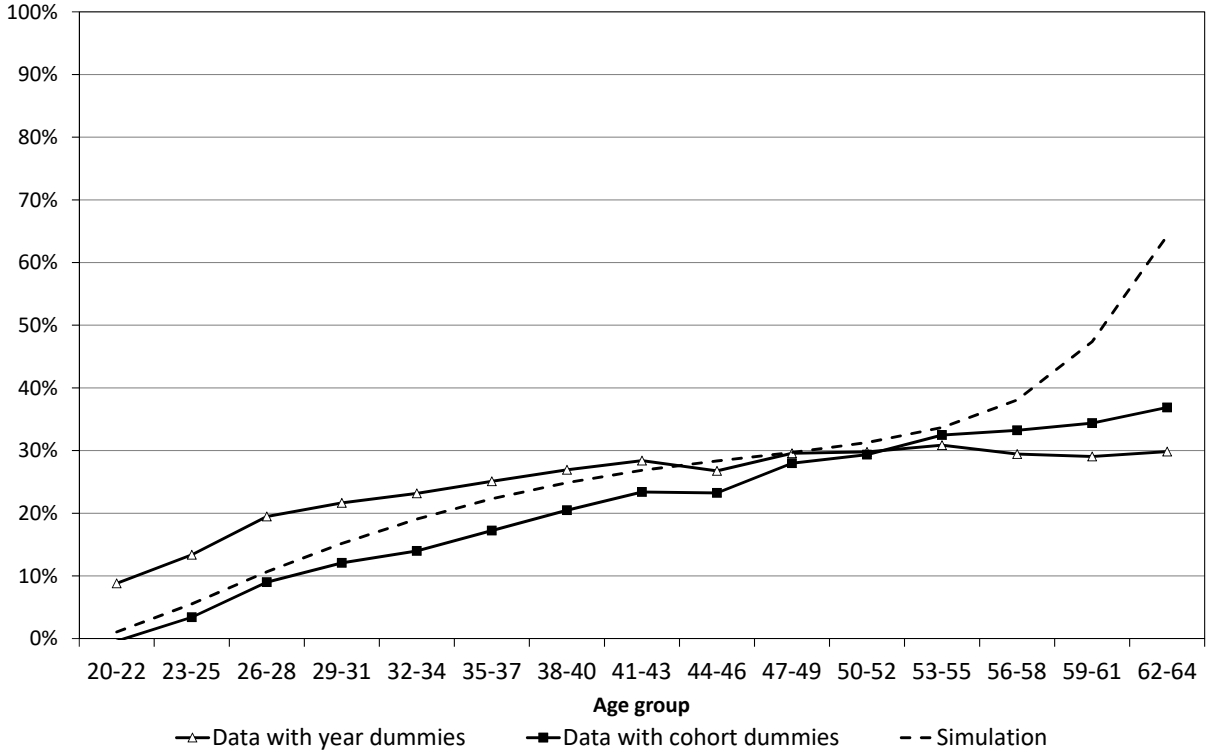
- **Social Security** can then be derived using equation (1)

Calibration

Calibration

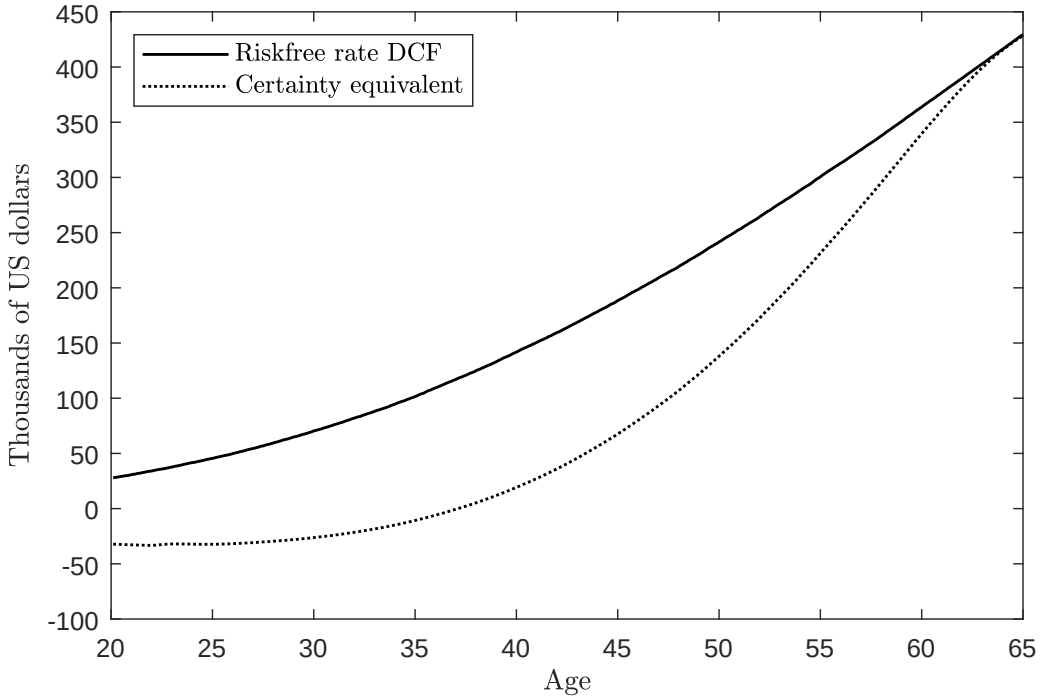
Financial markets		
r	risk-free rate	0.02
g_D	dividends growth rate	0.012
μ	expected stock returns	0.08
σ	stock market volatility	0.16
Labor income		
v_1	SD of permanent labor market shocks	0.025
v_2	SD of permanent idiosyncratic shocks	0.15
κ	speed of mean-reversion of y	0.15
α_0	quadratic effect of experience	-0.0024
α_1		0.0581
Preferences		
γ	relative risk aversion	5
ψ	discount rate	0.03
T	working years (from 20 to 65 years old)	45
R	retirement years	20
Initial conditions		
$L_1(0)$	average wage index (in thousands)	40
$L_2(0)$	wage in percentage of L_1	0.60
$W(0)$	wealth (in thousands)	50

Validation – Observed vs predicted equity share

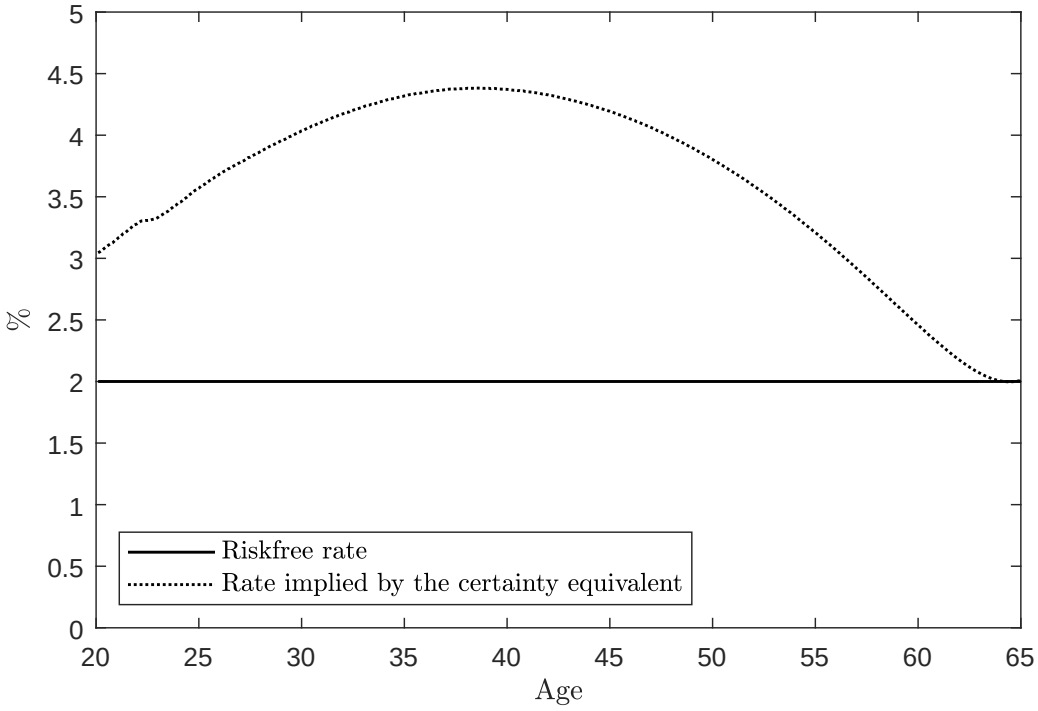


Results

Value of Social Security



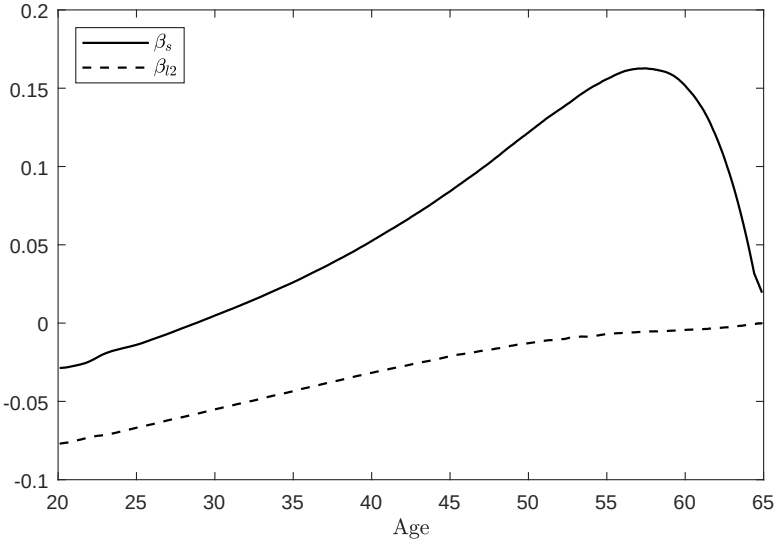
Discount rate implied by the certainty equivalent



Risk profile of Social Security

- I regress unexpected change in Social Security value on stock market returns and idiosyncratic income shocks

$$\frac{dSS_{it} - \tau L_{it} dt}{\overline{W}_{it}} = \beta_{s,t} \times \frac{dS_t}{S_t} + \beta_{l2,t} \times \frac{dL_{2,t}}{L_{2,t}} + u_t + \epsilon_{it}$$

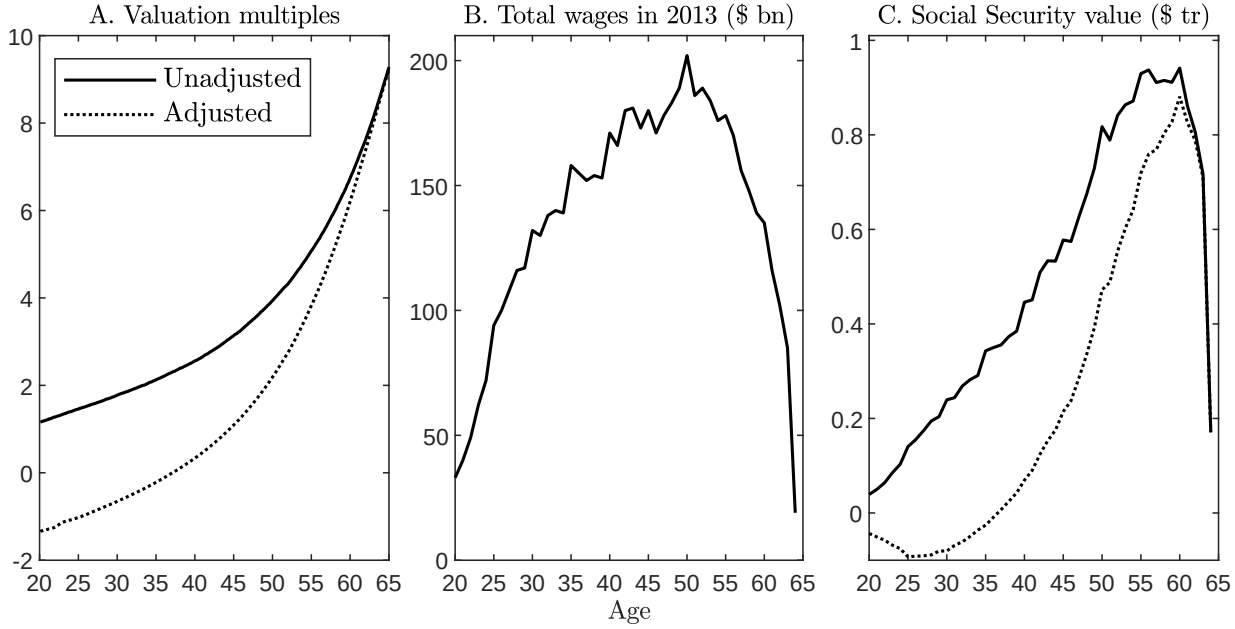


Nationwide valuation (1)

A. Compute the total Social Security value/total wages in simulated data

B. Compute total wages in the American Community Survey

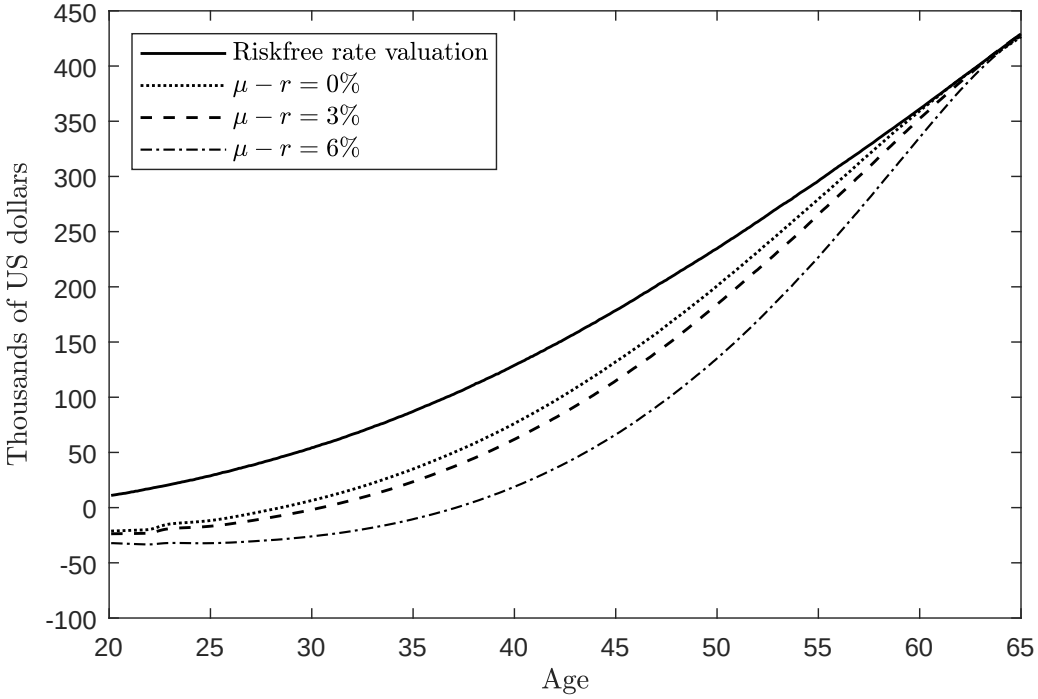
C. Deduce total Social Security value for US workers



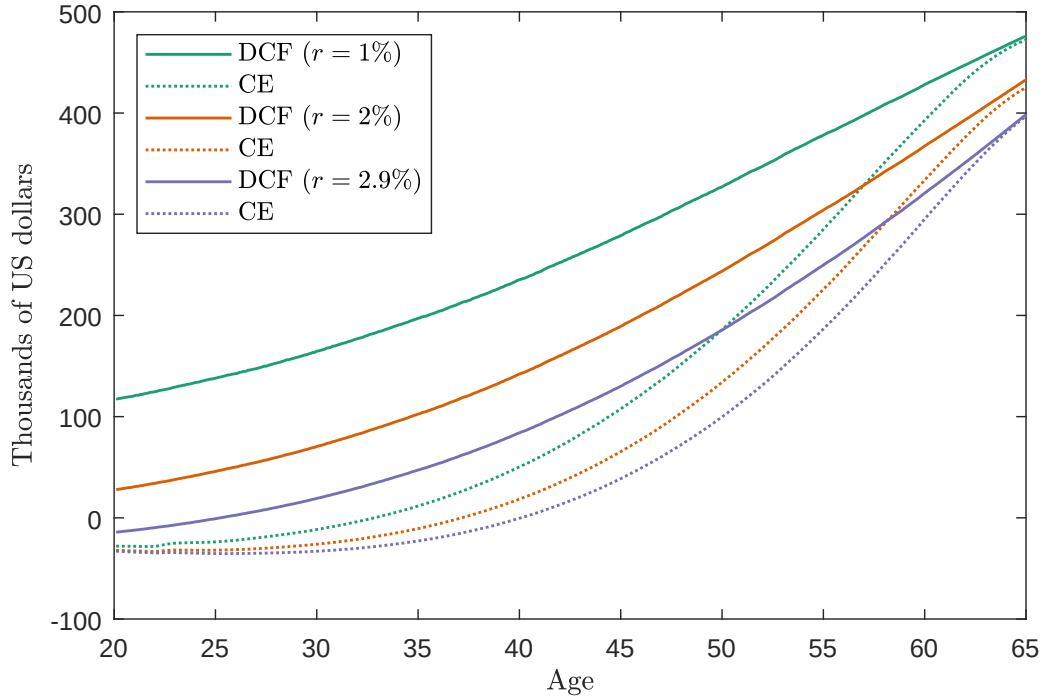
Nationwide valuation (2)

	Retirees	Workers			Workers and retirees		
		Unadj.	Adjusted	Diff.	Unadj.	Adjusted	Diff.
Baseline							
	6.20	24.80	13.40	-46.0%	31.00	19.60	-36.8%
Equity premium							
$\mu - r = 0$	6.20	24.80	20.41	-21.7%	31.00	26.61	-14.2%
$\mu - r = .03$	6.20	24.80	17.61	-29.0%	31.00	23.81	-23.2%
Risk-free rate							
$r = .010$	6.66	37.41	18.48	-50.6%	44.01	25.14	-43.0%
$r = .029$	5.82	16.47	9.85	-40.2%	22.29	15.68	-29.7%
Cointegration							
$\kappa = .12$	6.20	24.80	14.00	-43.5%	31.00	20.20	-34.8%
$\kappa = .18$	6.20	24.80	12.82	-48.3%	31.00	19.02	-38.6%
Relative risk aversion							
$\gamma = 3$	6.20	24.80	11.70	-52.8%	31.00	17.90	-42.2%
$\gamma = 4$	6.20	24.80	12.66	-48.9%	31.00	18.86	-39.2%
$\gamma = 6$	6.20	24.80	13.44	-45.8%	31.00	19.64	-36.6%
Growth rate of wages							
$g_D = .006$	6.20	21.40	11.61	-45.8%	27.60	17.81	-35.5%
$g_D = .017$	6.20	28.16	14.64	-48.0%	34.36	20.84	-39.4%

Robustness – Equity premium



Robustness – risk free rate



Model with time-varying discount rates

- **So far, we assumed that the wage-to-dividend ratio only predicted wage growth**
- **This assumption is incorrect if there is mean-reversion in returns and overestimates long-run labor market risk.**
- **Now, let's assume that there is mean-reversion in returns**
  - the dynamics of return becomes:

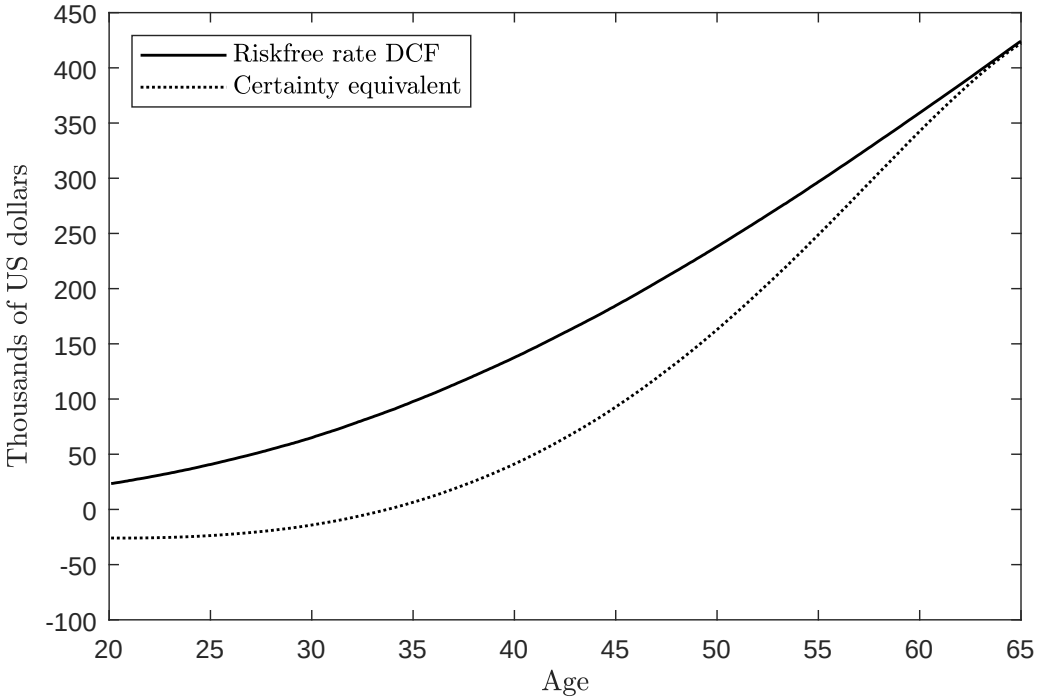
$$\frac{dS}{S} = (\mu + \phi y(t))\, dt + \sigma dz_3$$

    where ϕ represents the predictability in returns
  - and the dynamics aggregate wages becomes:

$$\frac{DL_1}{L_1} = \left(-(\kappa - \phi)y(t) + g_D - \frac{\sigma^2}{2} + \frac{v_1^2}{2} + \frac{(\sigma - v_3)^2}{2} \right) dt + v_1 dz_1(t) + (\sigma - v_3)\, dz_3(t)$$

Model with time-varying discount rates

- Robustness test for $\phi = 0.06$ (Benzoni et al. (2007)) → generates long-run aggregate earnings risk consistent with historical data



Conclusions

- **Discounting Social Security at the risk-free rate is incorrect** to:
  - estimate the maximum transition cost to a funded system
  - understand whether Social Security is a good deal for new entrants
  - estimate the value of governments' implicit liabilities
- **The equity premium is critical to understand Social Security**