Insurance in Human Capital Models with Limited Enforcement

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Motivation

- Bankruptcy Code limits pledgeability of future labor income
- Constrains household investments in high-return human capital (education, on the job training, health investment)
- Can also limit insurance against human capital risk (health, death, disability, labor market risk)

Questions

- Is effect of limited enforcement on insurance quantitatively important?
  - Cordoba (2004) and Kruger & Perri (2006) find almost perfect insurance in calibrated macro model with aggregate capital accumulation
  - Krebs, Kuhn & Wright (2015) find significant underinsurance for young and middle aged households in life cycle model with physical and (risky) human capital accumulation
- This paper: what features drive the results of Kuhn, Krebs and Wright (2015)?
  - Present generalized version of their model
  - Illustrate main results using simplified version

What We Find

- Two features necessary to reconcile imperfect consumption insurance with large aggregate savings:
  1. Life cycle borrowing and/or high return human capital investment opportunities necessary to drive households onto borrowing constraints
  2. Rich asset structure allows households to be simultaneously borrowing constrained (in some states) and net savers
- Limited enforcement models with human capital accumulation are a tractable framework for studying imperfect consumption insurance
  - our implementation especially tractable

Literature

- Limited enforcement and insurance:
  - Theory: Alvarez & Jermann (2000), Kehoe & Levine (1993), Kocherlakota (1996), Thomas & Worrall (1988), Wright (2000)
  - Quantitative: Cordoba (2004), Krueger & Perri (2006), Ligon, Thomas & Worrall (2002), Krebs, Kuhn & Wright (2015)
- Limited enforcement and human capital accumulation:
  - Andolfatto & Gervais (2006), Lochner & Monge (2011)
- Exogenously incomplete markets with human capital:
  - Krebs (2003), Guvenen, Kuruscu & Ozkan (2011), Hugget, Ventura & Yaron (2011)

Households

- Continuum of households maximize:

$$E\left[\sum_{t=0}^{\infty}\beta^{t}u\left(c_{t}\right)|s_{0}\right]$$

  - $u(c)$ isoelastic/CRRA
  - expectation over histories s^t with probability $\pi(s^t)$ generated by $\pi(s_{t+1}|s_t)$.

- Face flow budget constraints

$$c_t + x_{ht} + \sum_{s_{t+1}} a_{t+1}(s_{t+1})\, q_t(s_{t+1}) \leq \tilde{r}_{ht}(s_t)\, h_t + a_t(s_t)$$

human capital accumulation equations

$$h_{t+1} = (1 + \epsilon(s_t))\, h_t + \phi x_{ht}$$

non-negativity constraints and initial conditions (a_0, h_0).

Households II

- Enforcement constraints:

$$E\left[\sum_{n=0}^{\infty}\beta^{n}u\left(c_{t+n}\right)|s^{t}\right]\geq V_{d}\left(h_{t}\left(s^{t-1}\right),s_{t}\right)$$

- Function V_d captures the value to defaulting on all financial contracts.
- In this paper:
  - all assets seized: $a_t\left(s_t\right)=0$
  - excluded financial markets for an average of $1/\left(1-p\right)$ periods
  - retain ability to work/supply human capital
- Can accomodate alternative assumptions e.g. proportional garnishment, some financial market access

Firms and Technology

- Representative firm hires physical K_t and human capital H_t to produce using CRS production function yielding

$$
\begin{aligned}
\tilde{r}_{kt} &= f'\left(K_t/H_t\right) \equiv f'\left(\tilde{K}_t\right) \\
\tilde{r}_{ht} &= f\left(\tilde{K}_t\right) - f'\left(\tilde{K}_t\right)\tilde{K}_t
\end{aligned}
$$

- Aggregate capital accumulation

$$K_{t+1} = (1-\delta)\,K_t + X_{kt}.$$

Equilibrium

- Risk neutral pricing of financial contracts

$$q_t\left(s_{t+1}\right) = \frac{\pi\left(s_{t+1} \middle| s_t\right)}{1 + r_{ft}}$$

where

$$r_{ft} = \tilde{r}_{kt} - \delta_k .$$

- Market clearing

$$K_{t+1} = E\left[\sum_{s_{t+1}} a_{t+1}\left(s_{t+1}\right) q_t\left(s_{t+1}\right)\right].$$

Theoretical Results

- This limited enforcement framework is especially tractable:
  - all policy functions are linear in wealth
  - allows reduction in aggregate state space
- Can deal with a large amount of heterogeneity across households: Krebs, Kuhn and Wright (2015)

Calibration

- Annual with $\beta = 0.95$
- Log utility in benchmark
- Three ages: $s_1 \in \{y, m, o\} = \{[20, 40], [41, 60], [61 - 80]\}$.
  - $\pi(y|y) = \pi(m|m) = \pi(o|o) = 19/20$
  - $\pi(y|o) > 0$ household dies and is replaced by grandchildren who they care about
- Enforcement: $1 - p = 1/7$

Calibration: Investment Returns

- $r_f = 3\%$
- Idiosyncratic human capital shock

$$\epsilon(s_t) \equiv \epsilon(s_{1t}, s_{2t}) = \varphi(s_{1t}) + \eta(s_{2t}) - \delta_h$$

- Mean zero $\eta(s_2)$ yields expected return to human capital

$$\bar{r}_h(s_1) = \tilde{r}_h + \varphi(s_1) - \delta_h$$

    - choose returns to match empirical earnings growth
        - young: earnings growth 4.1% $\Longrightarrow \bar{r}_h(y) = 9.77\%$
        - middle: earnings growth $-0.76\% \Longrightarrow \bar{r}_h(m) = 4.65\%$

- Assume $\bar{r}_h(o) = 0\%$
- Earnings risk: $\sigma_\eta = 0.15$

Calibration: Technology

- Capital share $\alpha = 0.32$
- Aggregate $K/Y = 2.94$ and $r_f = 3\% \Longrightarrow \delta_k = 0.0785$
- Aggregate $X_h/Y = 0.06$ and market clearing$\Longrightarrow \tilde{r}_h = 1.6\%$ and $\phi = 4.721$

Results

- Focus on three features of equilibrium:
  1. Human capital choice θ_h
  2. Consumption insurance

$$CI(s_1) = 1 - \frac{\sigma_c}{\sigma_{c,d}}$$

  3. Welfare $\Delta(s_1)$: equivalent variation of moving to full insurance, θ_h fixed

General Equilibrium Results

	young	middle	old
θ_h	0.98	0.91	0.00
CI	0.43	0.76	1.00
Δ	3.5%	1.4%	0.0%

Portfolio Shares

$$\frac{wealth}{earnings} = \frac{1-\theta_h}{\tilde{r}_h \theta_h}$$

	young	middle	old
SCF			
Total	0.63	2.49	7.34
excl. Housing	0.36	1.17	3.34
Model	0.37	1.88	inf

Partial Equilibrium Results

- What forces matter?
  - excess returns to human capital
  - risk aversion
  - income risk
  - enforcement (plausible variation doesn't matter)
- Assume types are permanent and plot effects on:
  - human capital investment
  - consumption insurance
  - welfare costs of imperfect insurance

Figure 1: Portfolio choice for benchmark model

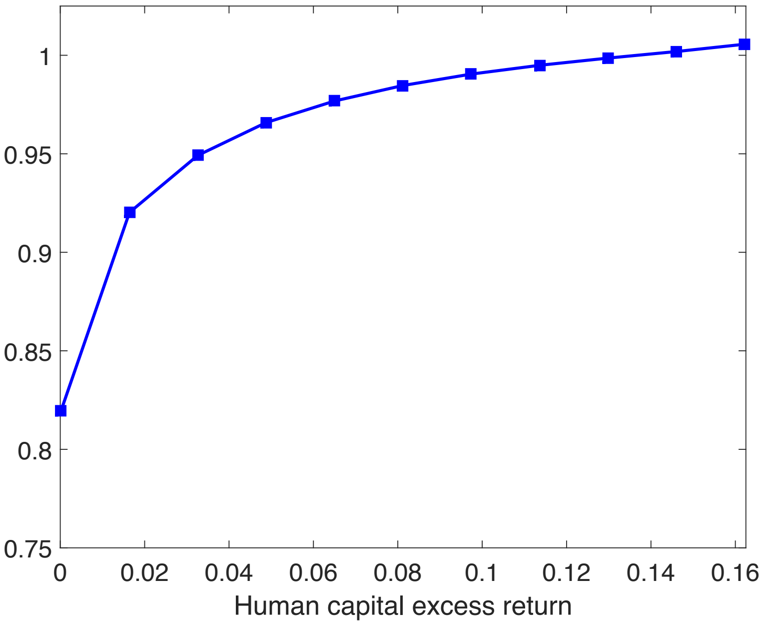


Figure 2: Consumption insurance for benchmark model

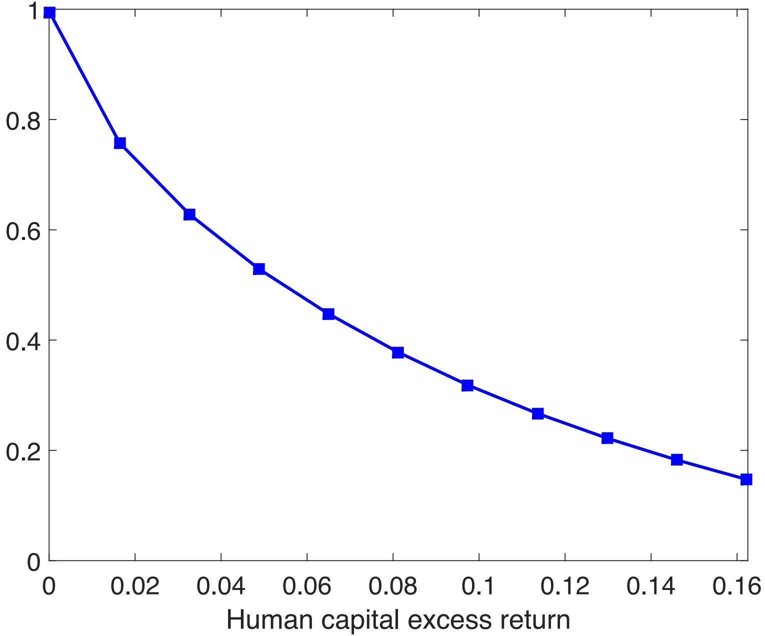


Figure 3: Welfare cost of underinsurance for benchmark model

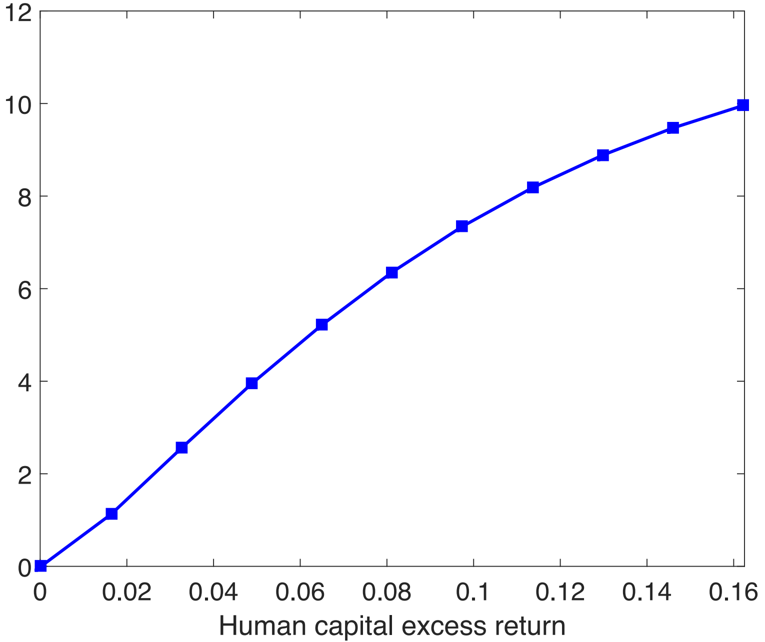


Figure 4: Portfolio choice for different degrees of risk aversion

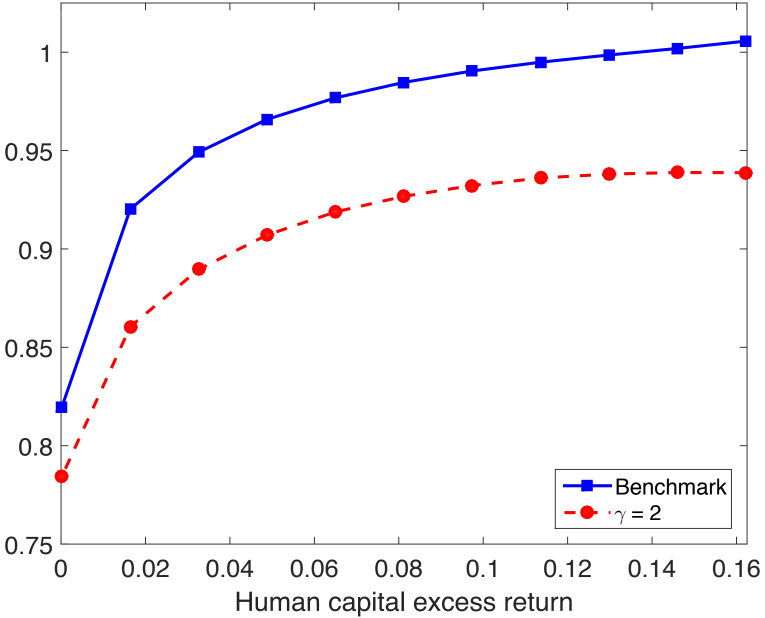


Figure 5: Consumption insurance for different degrees of risk aversion

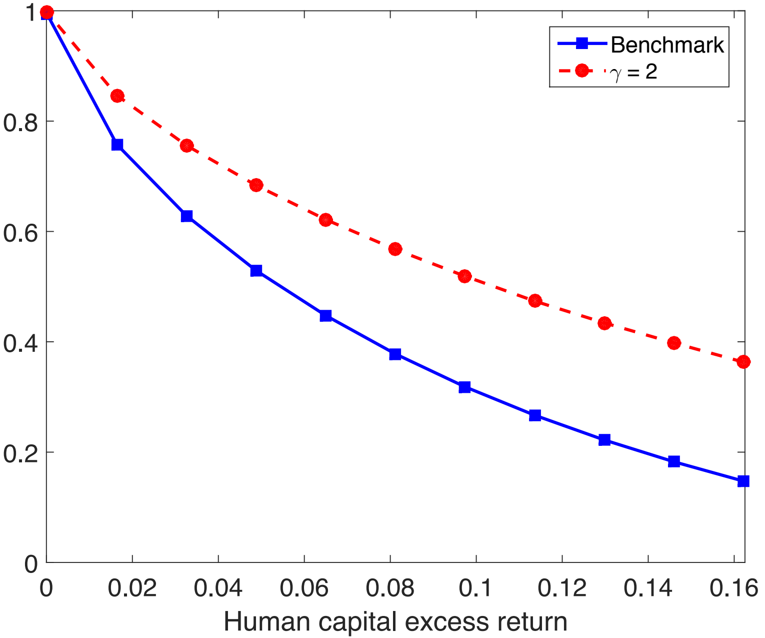


Figure 6: Welfare cost of underinsurance for different degrees of risk aversion

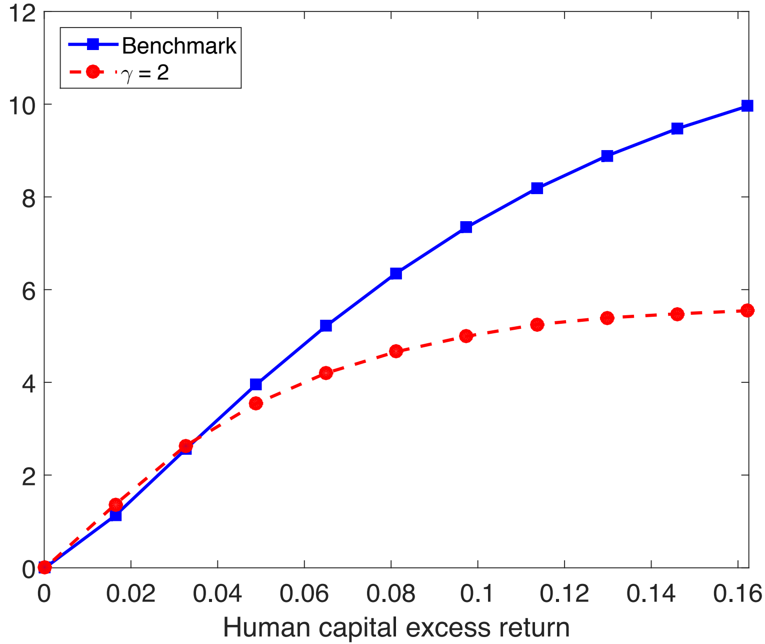


Figure 7: Portfolio choice for different levels of income risk

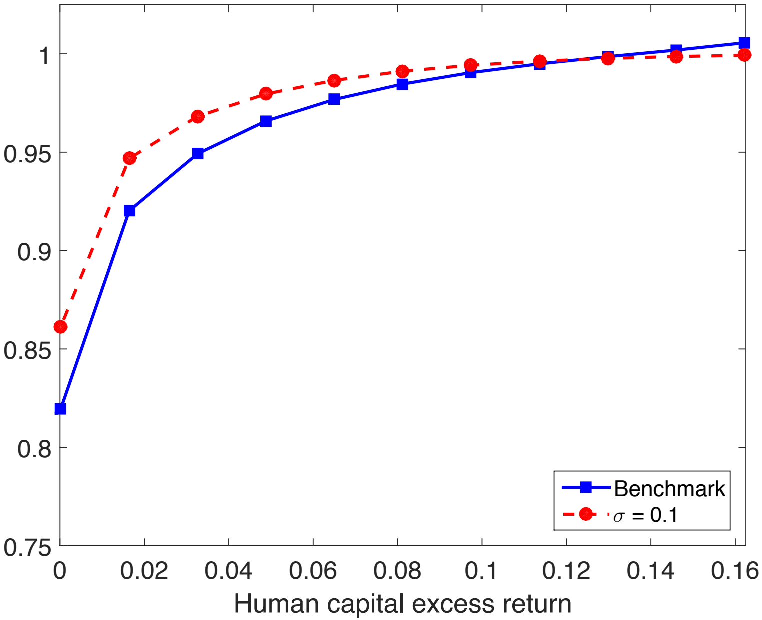


Figure 8: Consumption insurance for different levels of income risk

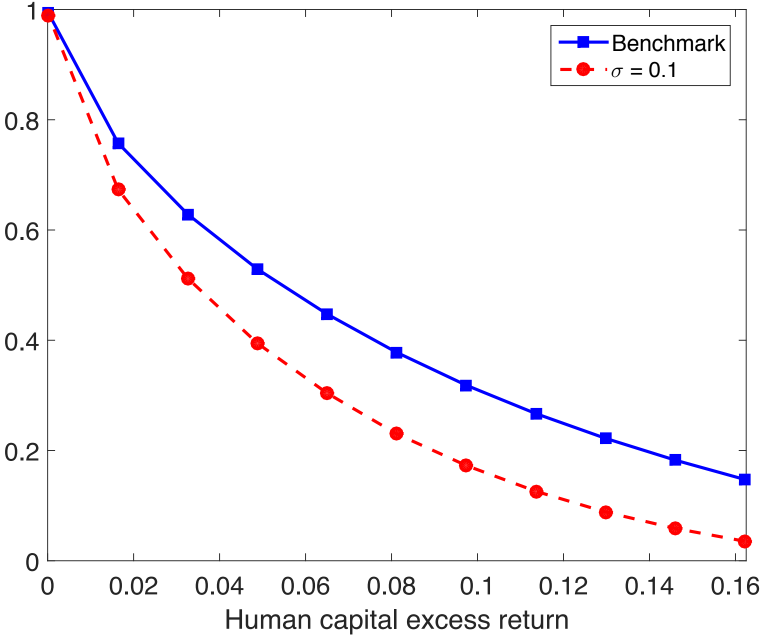
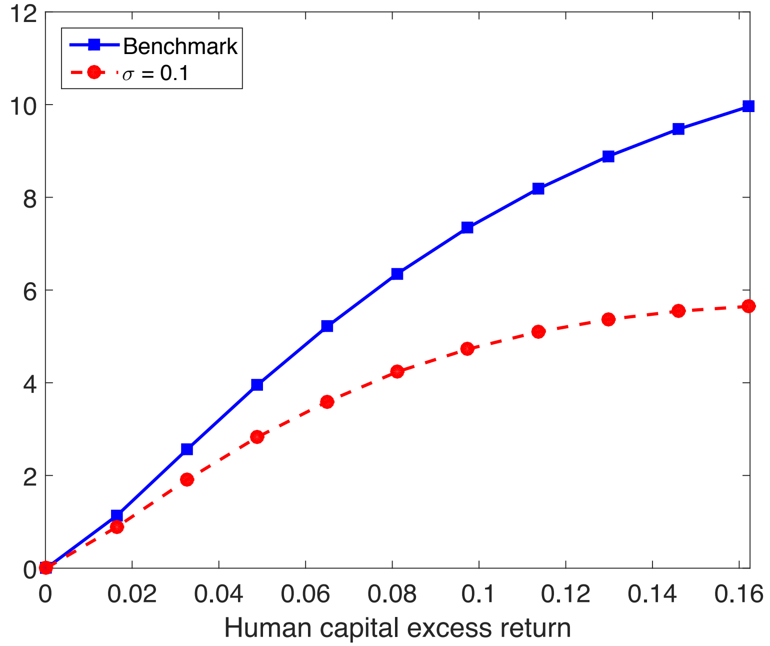


Figure 9: Welfare cost of underinsurance for different levels of income risk



Conclusion

- Existing models of imperfect enforcement predict too much insurance
  - Insufficient reason for households to borrow
- Limited enforcement with life cycle earnings and/or high returns to human capital investment give greater incentive to borrow and produce significantly imperfect consumption insurance
- Also consistent with high levels of aggregate savings

Figure 11: Networth to labor income ratio

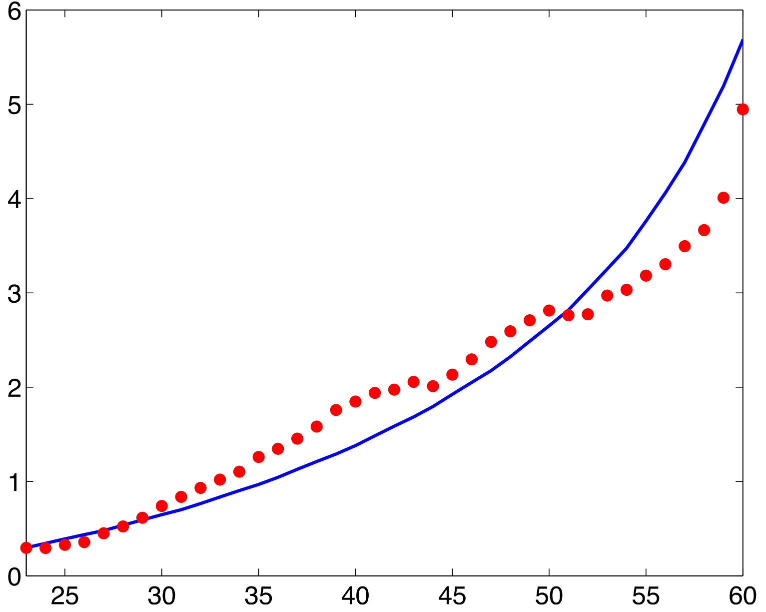
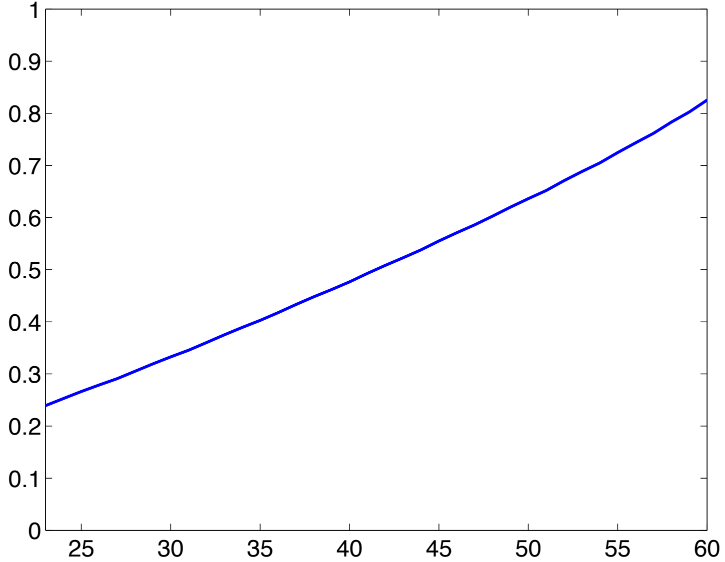
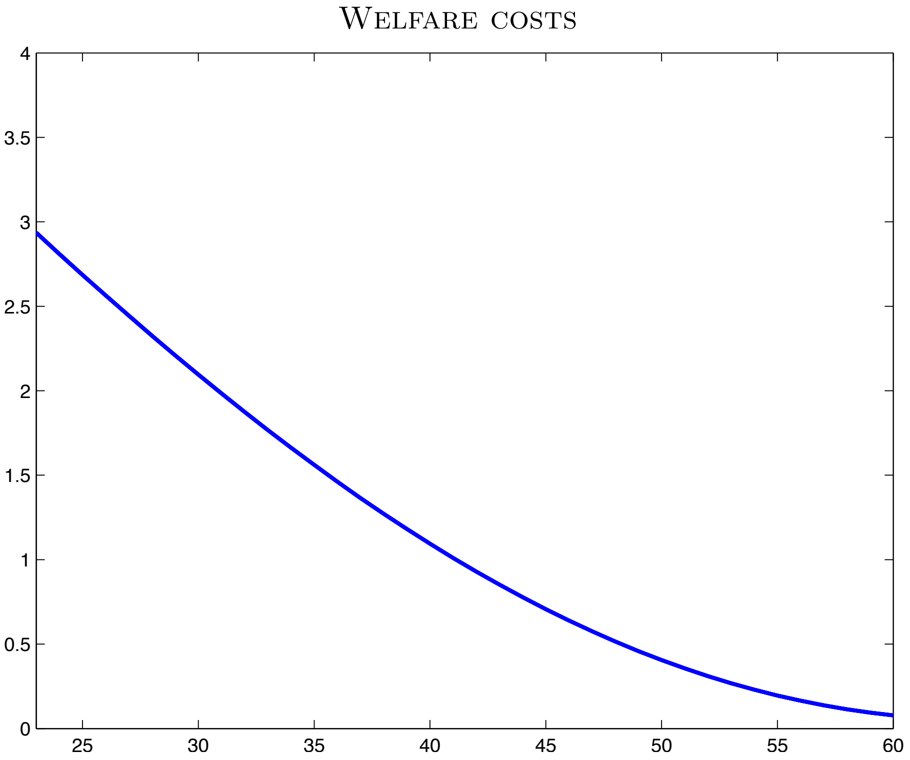


Figure 10: Consumption insurance




Welfare costs
4
3.5
3
2.5
2
1.5
1
0.5
0
25
30
35
40
45
50
55
60