Asset-Price Redistribution

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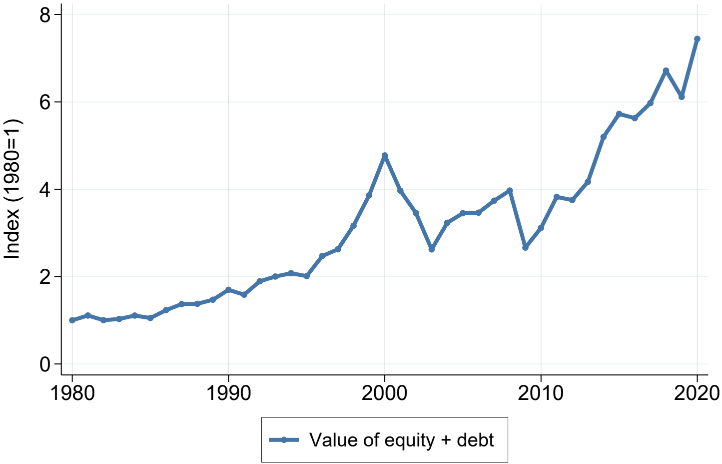
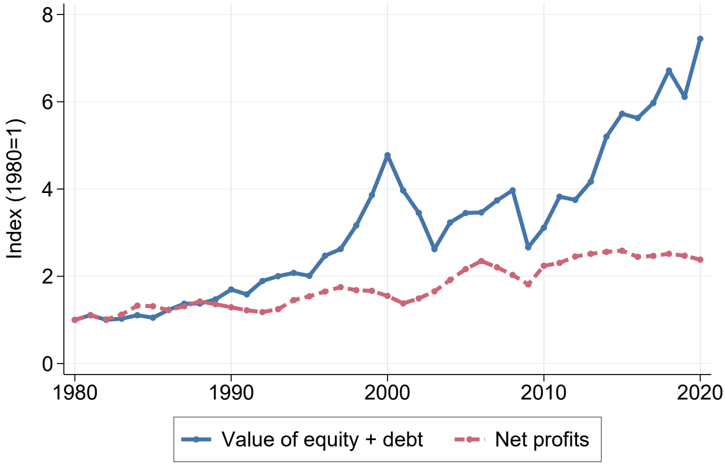
Rising asset prices



U.S. Nonfinancial Corporate Businesses

Rising asset prices ... relative to income = rising valuations



U.S. Nonfinancial Corporate Businesses

Welfare consequences of rising asset valuations?

- Rising asset valuations had large effects on distribution of wealth

Q: But what are welfare consequences of rising valuations?

- Answer is not obvious. Two polar views regarding effect of $P \uparrow$:

  1. Shift of real resources towards wealthy (Piketty-Zucman, Saez-Yagan-Zucman)
  2. Welfare-irrelevant paper gains (Cochrane, Krugman)

What We Do: Theory

- Formula for money-metric welfare gains/losses (= compensating variation) from asset price changes here for case of one asset and no borrowing

$$\text{Welfare Gain}_i = \sum_{t=0}^{\infty} \text{Discounting}_t \times \Big(\text{Asset sales}_{it} \times \text{Price deviation}_t\Big) + \ldots$$

  - price deviations holding cashflows constant ⇒ pure valuation effects
  - envelope theorem ⇒ first-order approximation
  - +... captures other effects (collateral,GE,..) but 1st term is always there

- **Two main lessons:** higher valuations ...

  1. benefit sellers, not holders
  2. are purely redistributive in terms of welfare (for every seller there is a buyer)

- Implication: both polar positions from previous slide are wrong

What We Do: Empirics

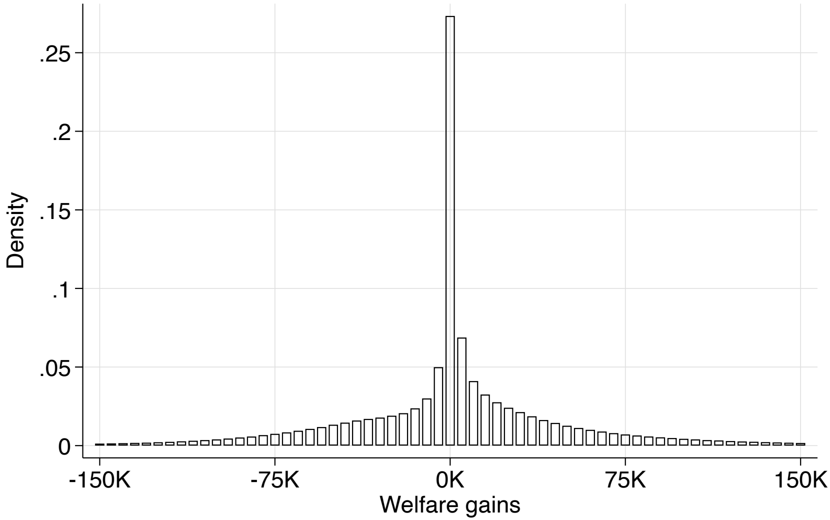
- Implement as sufficient statistic using Norwegian admin data (1994–2019)

$$\text{Welfare Gain}_i = \sum_{t=0}^{T} \text{Discounting}_t \left(\sum_{k=1}^{K} \left(\text{Asset sales}_{ikt} \times \text{Price deviation}_{kt} \right) + \text{Borrowing}_{it} \times \text{Rate deviation}_t \right)$$
$$+ \text{Terms from generalizations}$$

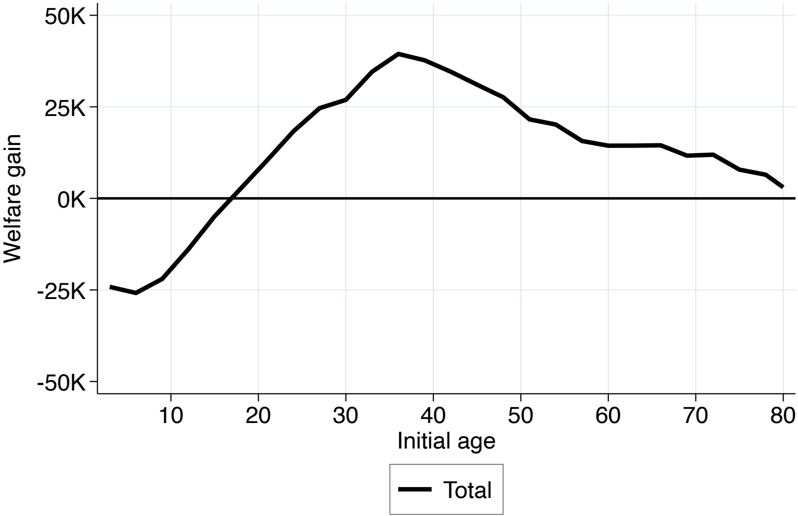
  - measure net asset sales, borrowing (housing, stocks, debt, deposits)
  - measure price deviations = deviations from constant price-dividend ratios (Gordon growth model) to isolate valuation effect

- Document large redistributive effects of rising asset valuations
  - in cross section
  - from young towards old
  - from poor towards wealthy

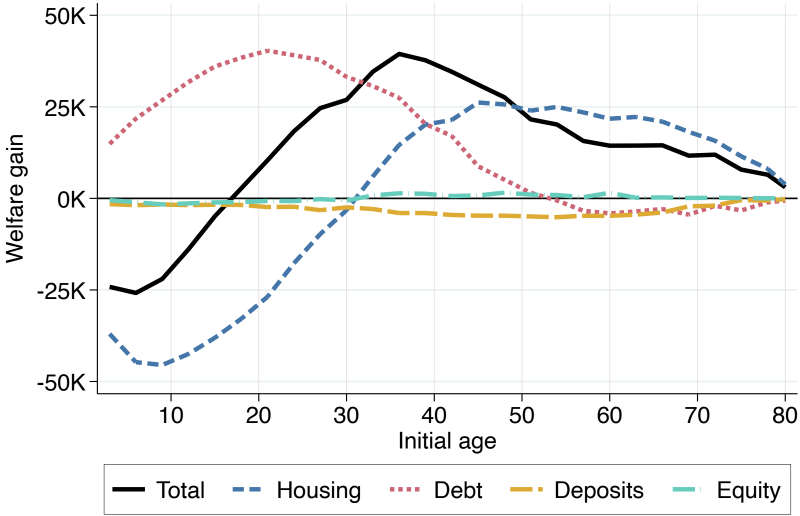
Rising asset valuations generate large welfare gains & losses



Example: large redistribution from young to old ...



... mostly due to house price changes



Plan

1. Theory: Intuition in two-period model

2. Theory: Sufficient statistic in full dynamic model with multiple assets

3. Empirics: implementation using Norwegian administrative data

4. Empirics: redistribution across households

5. Empirics: generalizations of baseline sufficient statistics approach

Intuition in two-period model

- Periods $t = 0$ and $t = 1$, endowments Y_0 and Y_1
- Can trade shares N at time $t = 0$ that pay dividend D at time $t = 1$

$$V = \max_{\{C_0, C_1\}} U(C_0) + \beta U(C_1)$$

$$C_0 + (N_0 - N_{-1}) P_0 = Y_0, \qquad C_1 = Y_1 + N_0 D_1$$

- Comparative static: effect of P_0 on welfare V?

$$dV = \underbrace{U'(C_0)}_{\text{marginal utility}} \times \underbrace{(N_{-1} - N_0)}_{\text{asset sales}} \times \underbrace{dP_0}_{\text{price deviation}}$$

- Rising asset prices benefit sellers ($N_{-1} - N_0 > 0$), not holders ($N_{-1} > 0$)
- Note: D_1 held constant, else additional term $+\frac{\beta U'(C_1)}{U'(C_0)} N_0 \, dD_1$

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- Comparative static: effect of P_0 on welfare V?

$$\underbrace{\frac{\mathrm{d}V}{U'(C_0)}}_{\text{welfare gain (in \$)}} = \underbrace{(N_{-1} - N_0)}_{\text{asset sales}} \times \underbrace{\mathrm{d}P_0}_{\text{price deviation}}$$

- Rising asset prices benefit sellers ($N_{-1} - N_0 > 0$), not holders ($N_{-1} > 0$)
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Intuition in two-period model

- Rising asset prices benefit sellers ($N_{-1} - N_0 > 0$), not holders ($N_{-1} > 0$)

- How can initial holders not benefit from $P_0 \uparrow$? Two counteracting effects:

  $(t = 0)$ High initial return $R_0 = P_0/P_{-1} \uparrow$

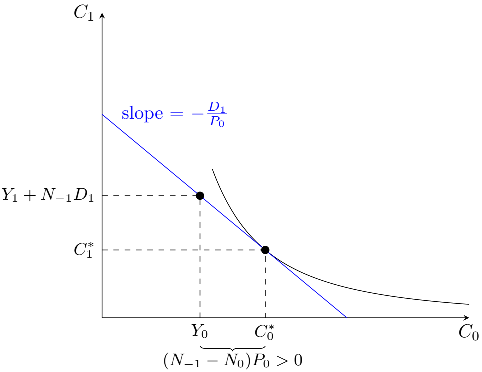
  $(t = 1)$ Low future returns $R_1 = D_1/P_0 \downarrow$

- For sellers, high initial returns dominate ...

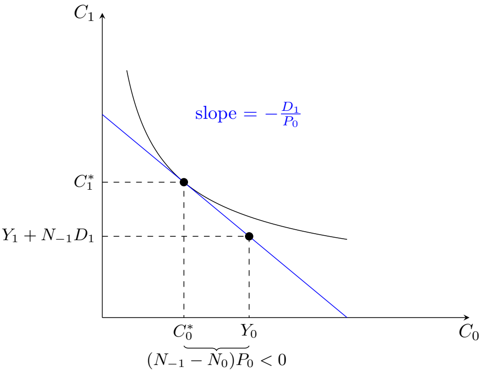
- For buyers, low future returns dominate

Graphical intuition: welfare effect of $P_0 \uparrow$

A seller's investment decision

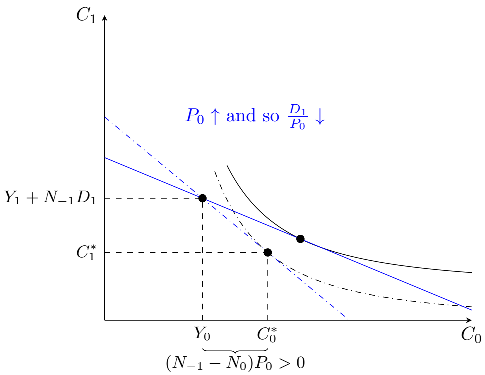


A buyer's investment decision

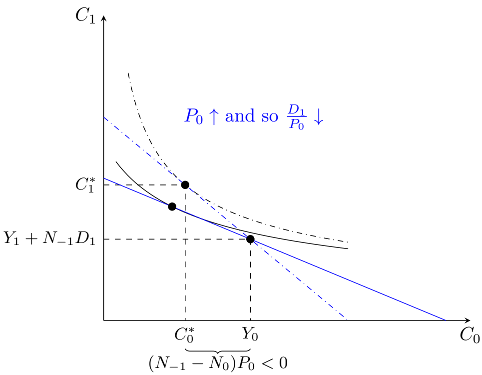


Graphical intuition: welfare effect of $P_0 \uparrow$

Effect of $P_0 \uparrow$ on seller



Effect of $P_0 \uparrow$ on buyer



Full dynamic model with multiple assets

- Infinite horizon, no risk
- One-period bond $\{B_{i,t}\}_{t=0}^{\infty}$ with prices $\{Q_t\}_{t=0}^{\infty}$ (deposits)
  - one-period return: $R_{t+1} = 1/Q_t$
  - return from 0 to t: $R_{0\to t} \equiv R_1 \cdot R_2 \cdots R_t$
- K long-duration assets $\{N_{ik,t}\}_{t=0}^{\infty}$, prices $\{P_{k,t}\}_{t=0}^{\infty}$ & dividends $\{D_{k,t}\}_{t=0}^{\infty}$
  - adjustment cost $\chi_{ik}\left(N_{ik,t} - N_{ik,t-1}\right)$, potentially kinked (inaction)
  - asset returns: $R_{k,t+1} \equiv \frac{D_{k,t+1}+P_{k,t+1}}{P_{k,t}}$

Extensions: see paper, show you two of these today

1. Borrowing and collateral constraints
2. Incomplete markets
3. Bequests
4. Consolidating businesses with their owners.
5. Government sector
6. Taxes on assets
7. Housing and wealth in the utility function
8. General equilibrium

Welfare gains/losses in full dynamic model

- Households solve

$$V_i = \max_{\{C_{i,t}, B_{i,t}, \{N_{ik,t}\}_{k=1}^{K}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t U(C_{i,t}) \quad \text{s.t.}$$

$$C_{i,t} + \sum_{k=1}^{K} (N_{ik,t} - N_{ik,t-1}) P_{k,t} + B_{i,t} Q_t + \sum_{k=1}^{K} \chi_{ik} = \sum_{k=1}^{K} N_{ik,t-1} D_{k,t} + B_{i,t-1} + Y_{i,t}$$

- **Proposition:** welfare effect of perturbation $\{\mathrm{d}P_{1,t}, \ldots, \mathrm{d}P_{K,t}, \mathrm{d}Q_t\}_{t=0}^{\infty}$ is

$$\mathrm{d}V_i = U'(C_{i,0}) \times \underbrace{\sum_{t=0}^{\infty} R_{0\to t}^{-1} \left(\sum_{k=1}^{K} (N_{ik,t-1} - N_{ik,t}) \, \mathrm{d}P_{k,t} - B_{i,t} \, \mathrm{d}Q_t \right)}_{\text{Welfare Gain}_i}$$

- As in two-period model, rising asset prices benefit net sellers

  ... but portfolio choice + timing of purchases also matters

Aggregation

- **Corollary:** Suppose that initial prices clear all asset markets, i.e. asset sales and purchases add up to zero for each asset class. Then

$$\sum_{i=1}^{I} \text{Welfare Gain}_i = 0$$

so that asset price deviations are purely redistributive

Extension: general equilibrium

- Claim: in GE, our formula does not capture full welfare effect but rather welfare effect working through equilibrium asset price changes
- Fundamental drivers of asset prices: vector $z_t = \bar{z}_t + \theta \Delta z_t$
- Equilibrium prices: $\Gamma_t(\theta) = \{\{P_{k,t}(\theta), D_{k,t}(\theta)\}_k, Q_t(\theta), Y_t(\theta)\}$
- Welfare $V(\{\Gamma_t(\theta)\}_{t=0}^{\infty}, \theta)$. Hence

$$dV = \underbrace{\sum_{t=0}^{\infty}\left(\sum_{k=1}^{K}\frac{\partial V}{\partial P_{k,t}}\frac{\partial P_{k,t}}{\partial \theta} + \frac{\partial V}{\partial Q_t}\frac{\partial Q_t}{\partial \theta}\right)d\theta}_{\text{Welfare gain through asset prices = our main formula}}$$

$$+\underbrace{\sum_{t=0}^{\infty}\left(\sum_{k=1}^{K}\frac{\partial V}{\partial D_{k,t}}\frac{\partial D_{k,t}}{\partial \theta} + \frac{\partial V}{\partial Y_t}\frac{\partial Y_t}{\partial \theta}\right)d\theta}_{\text{Welfare gain through dividends, labor income, ...}} + \underbrace{\frac{\partial V}{\partial \theta}d\theta}_{\text{Direct effect}}$$

Extension: collateral constraints $-B_{i,t} \leq \theta N_{i,t} P_t$

- With collateral constraint, money-metric welfare gains are

$$\text{Welfare Gain}_i = \sum_{t=0}^{\infty} \frac{\beta^t U'(C_{i,t})}{U'(C_{i,0})} \Big((N_{i,t-1} - N_{i,t}) \, \mathrm{d}P_t - B_{i,t} \, \mathrm{d}Q_t \Big) + \sum_{t=0}^{\infty} \frac{\beta^t \mu_{i,t}}{U'(C_{i,0})} \theta N_{i,t} \, \mathrm{d}P_t$$

  where $\mu_{i,t}$ is Lagrange multiplier on collateral constraint

- Alternatively, household-specific rate schedule $Q_{i,t} = Q_t F(N_{i,t} P_t, B_{i,t})$:

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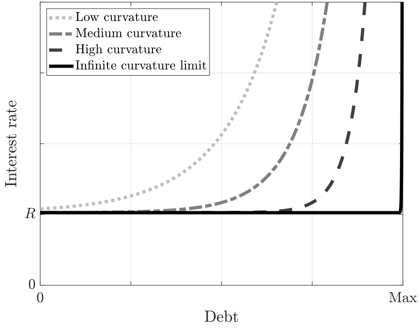

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- Later: implement by taking interest rate schedule from data

Empirics

Implementation

1. Replace infinitesimal changes $\mathrm{d}P_{k,t}$ by discrete changes $\Delta P_{k,t}$
   - robustness: second-order effects
2. Consider deviations in prices away from constant price-dividend ratios

$$\Delta P_{k,t} = P_{kt} - \overline{PD}_k \times D_{k,t} \quad \Leftrightarrow \quad \frac{\Delta P_{k,t}}{P_{k,t}} = \frac{PD_{k,t} - \overline{PD}_k}{PD_{k,t}}$$

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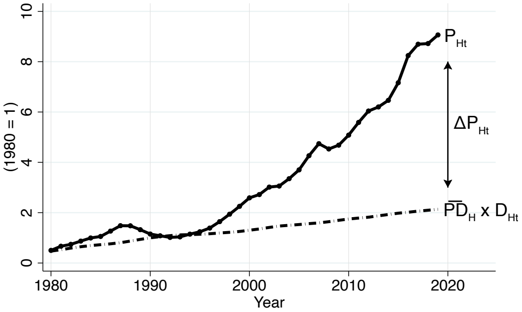

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3. Truncate formula at finite date T (end of sample)
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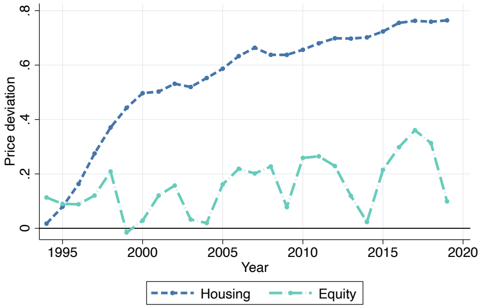
- $\Rightarrow$ Formula we implement empirically

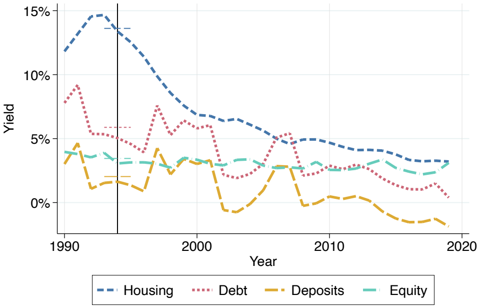
$$\text{Welfare gain}_i \approx \sum_{t=0}^{T} R_{0\to t}^{-1} \left(\sum_{k=1}^{K} (N_{ik,t-1} - N_{ik,t}) P_{k,t} \times \frac{PD_{k,t} - \overline{PD}_k}{PD_{k,t}} - B_{i,t} Q_t \times \frac{Q_t - \overline{Q}}{Q_t} \right)$$

Data on Holdings and Transactions

- Administrative data covering the universe of Norwegians over 1993–2019
- Focus on 4 broad asset categories that cover most of household wealth
  1. deposits (15%)
  2. debt (mortgage, student loan, ..., −35%)
  3. equity (individual stocks, mutual funds, private businesses, ..., 10%)
  4. housing (110%)
- For deposits/debt, we only need to measure holdings
- For equities/housing, we use data on individual transactions
- Take into account indirect transactions/holdings through equity ownership

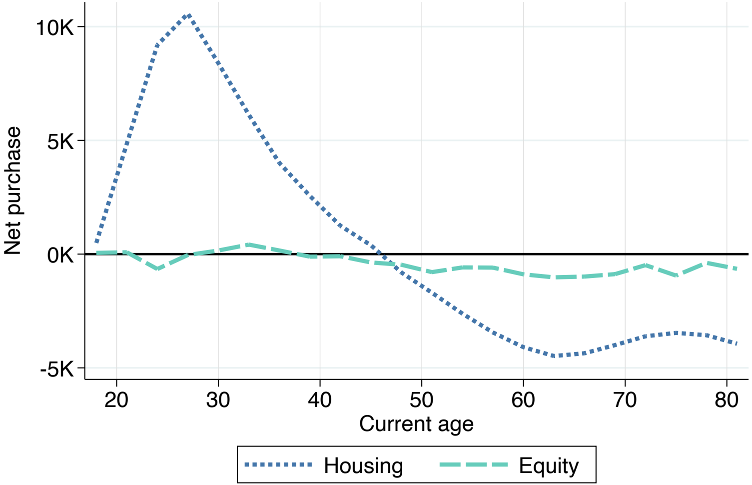
Rising valuations, declining yields in all asset classes



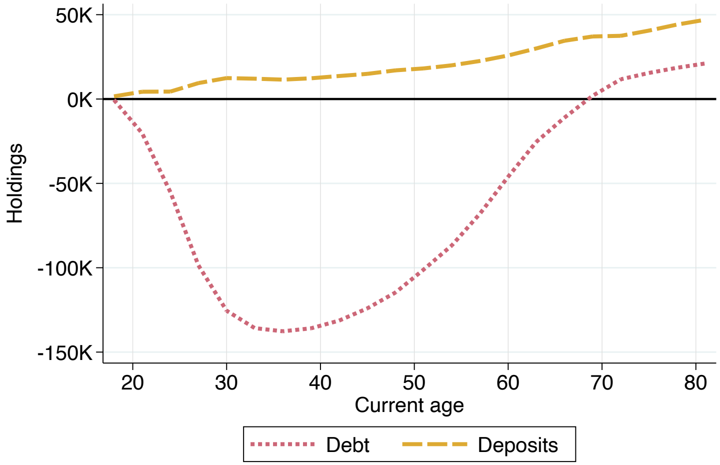


Gross real interest rate (debt/deposits); Rents/Price (housing); Cashflows/EV (equity)

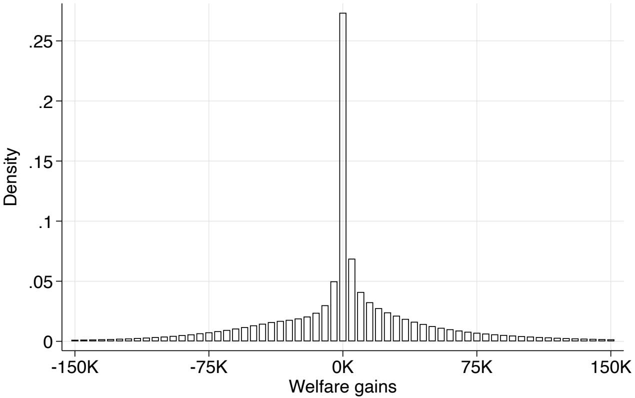
Data on housing and equity transactions



Data on debt and deposits

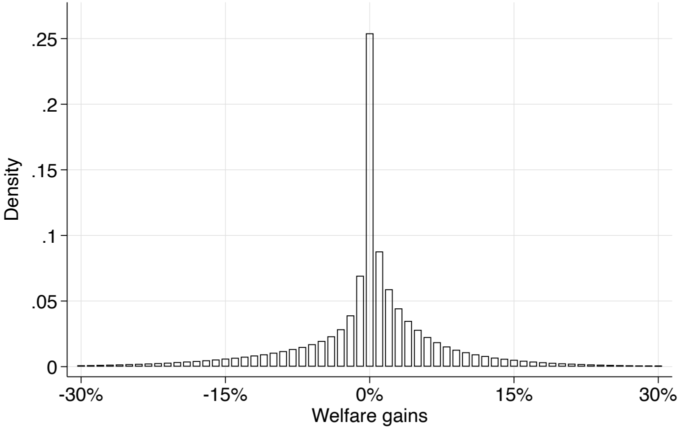


Rising asset valuations generate large welfare gains & losses



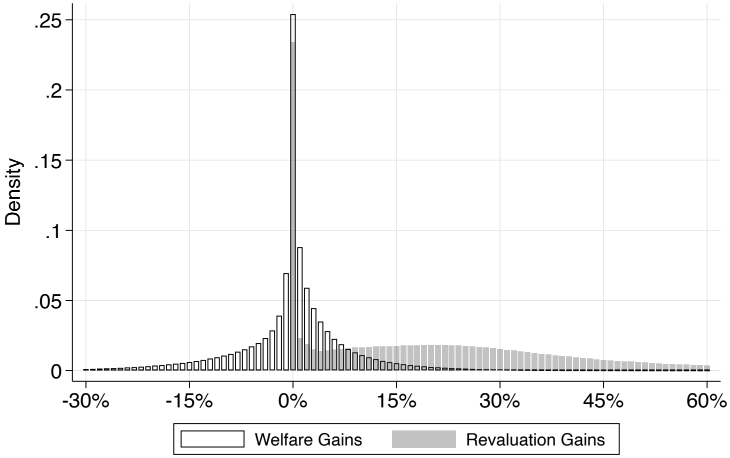
Average	Average by percentile groups of welfare gains					
	p0-1	p1-10	p10-50	p50-90	p90-99	p99-100
10.1	–546.2	–94.5	–13.7	16.7	100.2	701.5

Large gains and losses as % of initial wealth



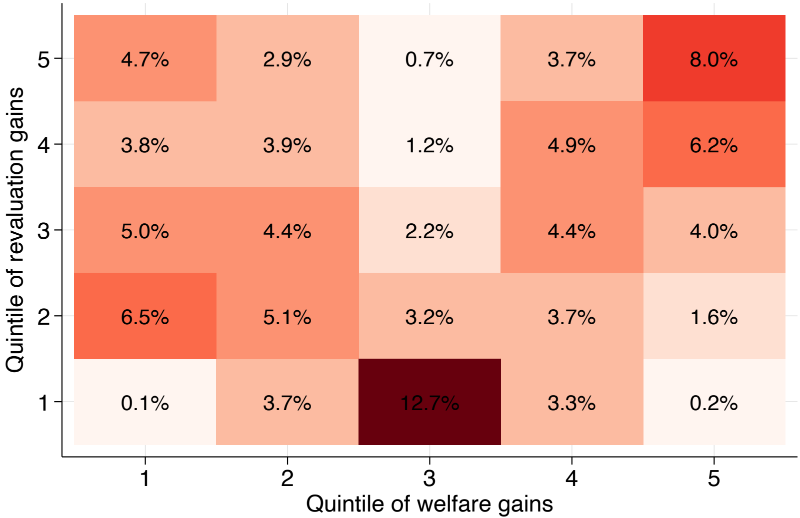
In theory, we have $\frac{\text{Welfare gain}}{\text{Total wealth}} = \frac{\sum_{t=0}^{\infty} R_{0\to t}^{-1}\,\mathrm{d}C_t}{\sum_{t=0}^{\infty} R_{0\to t}^{-1} C_t}$ = welfare gain as a share of lifetime consumption

Welfare vs wealth gains (revaluation gains)

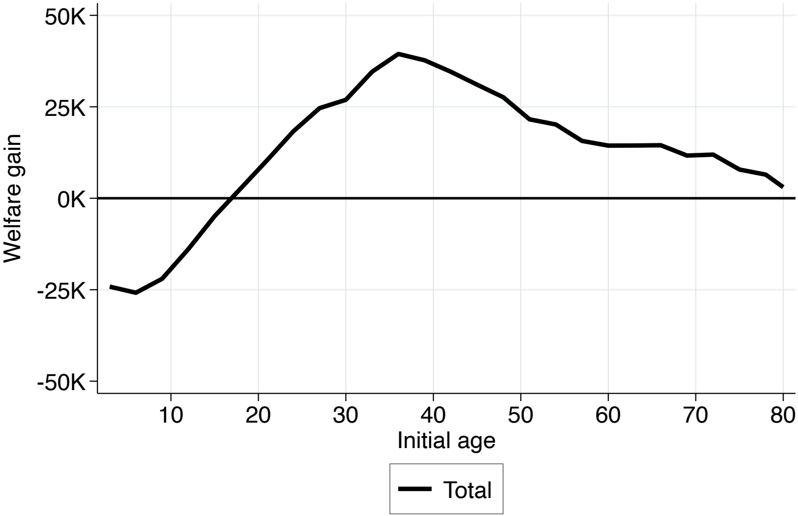


$$\text{Revaluation gain}_i = \sum_{t=0}^{T} R_{0\to t}^{-1} \sum_{k=1}^{K} N_{ik,t-1} P_{ik,t-1}\, \mathrm{d}\left(P_{k,t}/P_{k,t-1}\right) \quad \text{(recall asset returns } \tfrac{D_{k,t}+P_{k,t}}{P_{k,t-1}}\text{)}$$

Joint distribution of welfare and revaluation gains



Redistribution from the young to the old



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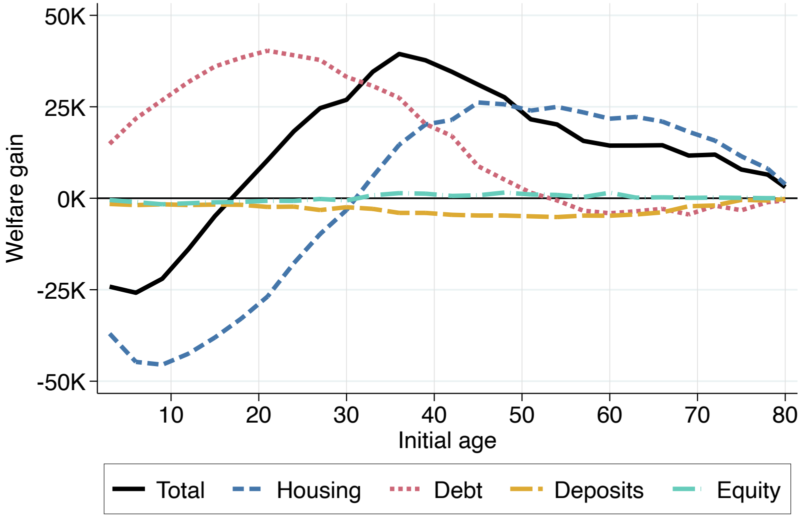
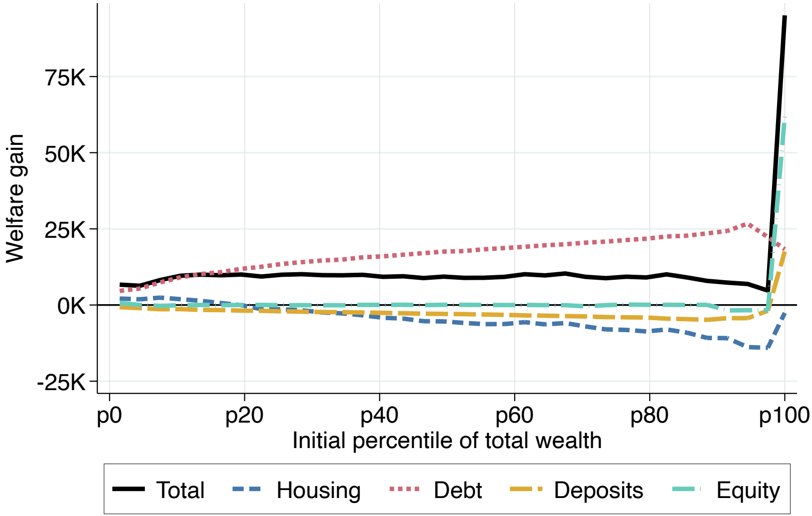
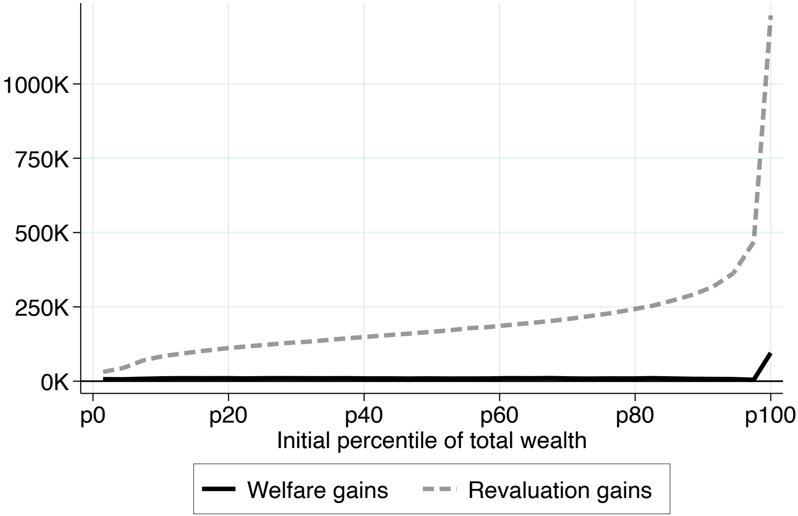


Redistribution from the poor to the rich



Welfare vs revaluation gains across wealth distribution



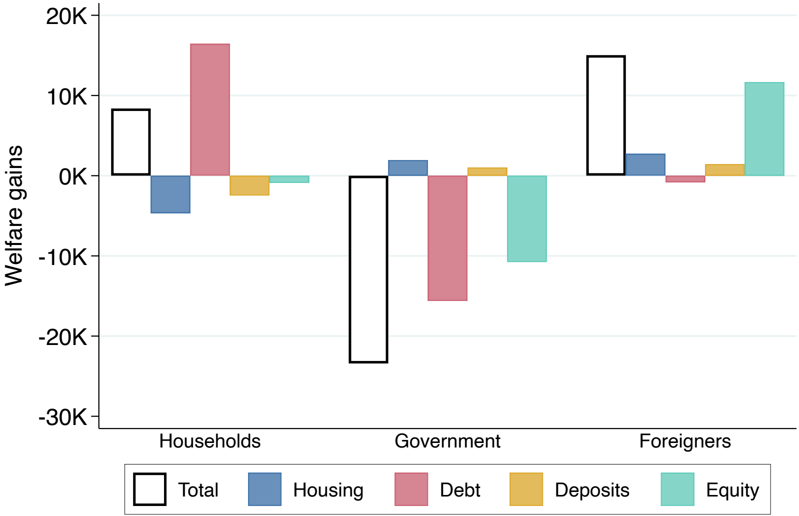
Redistribution across sectors

- Households welfare gains aggregate to $\approx \$10$K per capita

- Who is the losing counterparty?

$$\text{Welfare Gain}_{\text{Households}} = -\text{Welfare Gain}_{\text{Government}} - \text{Welfare Gain}_{\text{Foreigners}}$$

Redistribution across sectors



Generalizations of baseline sufficient statistics approach

Collateral effects

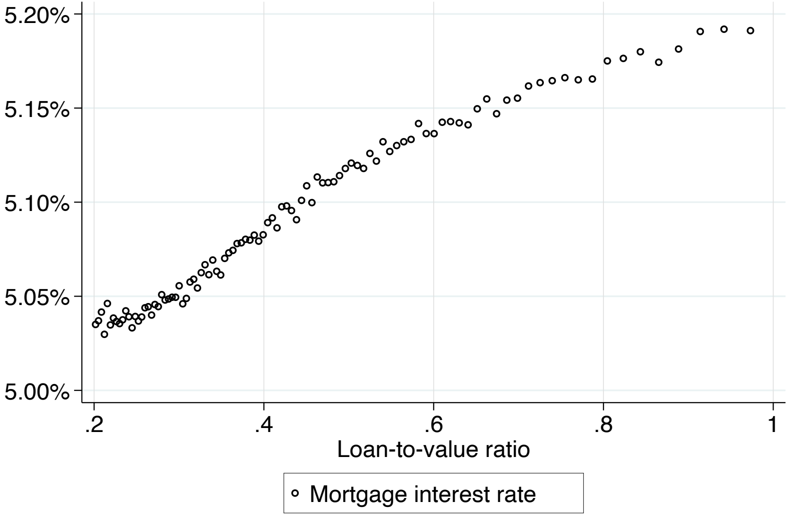
- Recall extension: interest rate schedule $Q_{i,t} = Q_t F(B_{i,t}, N_{i,t} P_t)$

$$\text{Welfare Gain}_i = \sum_{t=0}^{\infty} \frac{\beta^t U'(C_{i,t})}{U'(C_{i,0})} \Big((N_{i,t-1} - N_{i,t})\, \mathrm{d}P_t - B_{i,t} Q_{i,t} \frac{\mathrm{d}Q_t}{Q_t} \Big)$$

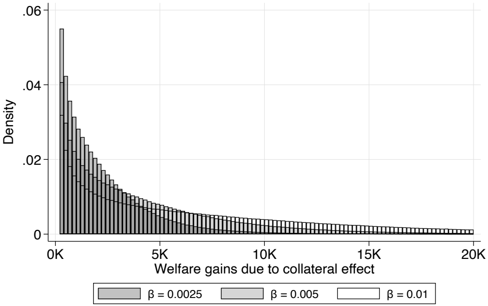
$$+ \sum_{t=0}^{\infty} \frac{\beta^t U'(C_{i,t})}{U'(C_{i,0})} \left(-B_{i,t} \frac{\partial Q_{i,t}}{\partial (N_{i,t} P_t)} N_{i,t}\, \mathrm{d}P_t \right)$$

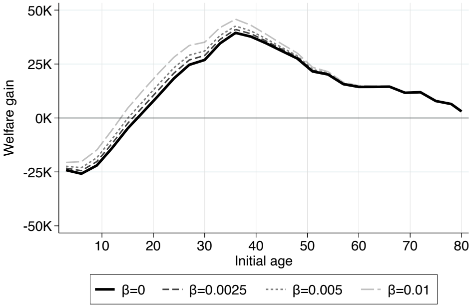
- Estimate second term by measuring effect of LTV on mortgage rates

Mortgage interest rates increase with loan-to-value ratio



Collateral effects





Valuations changes beyond end of our sample period

- We extend our baseline formula to account for future valuation changes:

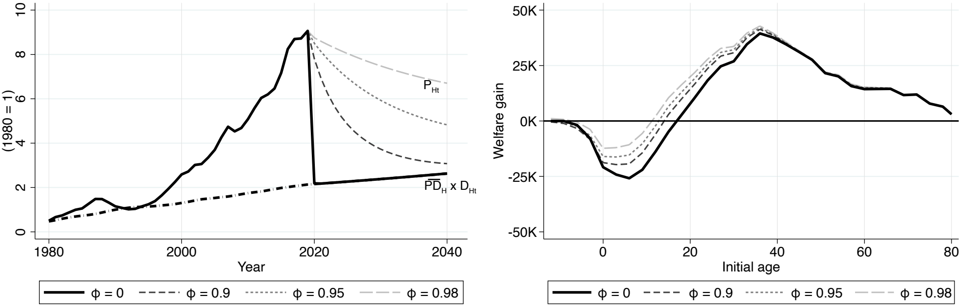
$$\text{Welfare Gain}_i \approx \sum_{t=0}^{T} R_{0\to t}^{-1} \left(N_{i,t-1} - N_{i,t}\right) \Delta P_t + \underbrace{\sum_{t=T+1}^{\infty} R_{0\to t}^{-1} \left(N_{i,t-1} - N_{i,t}\right) \Delta P_t}_{\text{future valuation changes}}$$

- Estimate second term assuming: for $t \geq T$

$$\frac{\Delta P_t}{P_t} = \frac{PD_t - \overline{PD}_t}{PD_t} \quad \text{with} \quad \log\left(\frac{PD_t}{\overline{PD}}\right) = \phi^{t-T} \log\left(\frac{PD_T}{\overline{PD}}\right), \ \phi < 1$$

$$N_{a,t-1} - N_{a,t} = N_{a,T-1} - N_{a,T} \text{ where } a = \text{age}$$

Valuations changes beyond end of our sample period



Conclusion

- Simple framework to quantify welfare effects of asset price deviations
- Framework can be extended to take into account collateral effects, incomplete markets, …
- Application to Norway (1994–2019)
    1. large heterogeneity in welfare gains across households
    2. welfare gains $\neq$ revaluation gains
    3. redistribution from young to old and from poor to rich
    4. negative "welfare gain" for government $\Rightarrow$ future net transfers $\downarrow$
- Could apply in other contexts, e.g. collapsing asset prices in recessions
- Optimal taxation? (Aguiar-Moll-Scheuer)