Inflation and the Price of Real Assets

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Motivation

- Household wealth and its components in the 1970s.

1. Wealth/GDP dipped by 25%.

![Graph showing Net Worth/GDP over time. The graph shows a significant dip in 1970 followed by a recovery.](image-url)
Motivation

• Household wealth and its components in the 1970s.

1. Wealth/GDP dipped by 25%.
   2a. Portfolio shift out of equity into housing.
Motivation

- Household wealth and its components in the 1970s.

1. Wealth/GDP dipped by 25%.

2b. Price dividend ratios comove negatively.
This paper

• Challenge for asset pricing: low frequency volatility & "unique" events
  Examples: Inflation, demographics, credit market developments

• Model of asset prices and household behavior
  – focus on historical trading period.
  – asset demand derived from household sector portfolio choice, given
    1. asset endowments & income (from micro data).
    2. expectations of future prices & income (from historical data, surveys).
  – new asset supply by other sectors to households (from Flow of Funds).
  – prices clear markets to establish temporary equilibrium.

• Main Results
  – Both demographics and surprise inflation lower savings rate ⇒ wealth dip.
  – Inflation makes houses more attractive than stocks ⇒ portfolio shift.
  – Disagreement about inflation ⇒ portfolio shift, increase in credit.
Literature

- **Asset Prices in the 1970s**
  - Demographics: Mankiw-Weil, Abel, Geanakoplos-Magill-Quinzii.

- **Heterogeneous agents & asset prices**
  - incomplete markets: Constantinides-Duffie, Heaton-Lucas, Krusell-Smith.

- **Housing & lifecycle behavior**

- **Temporary equilibrium**: Grandmont.
Outline

1. Model
2. Measurement of model inputs
3. Cross section of household portfolios.
5. Inflation and the portfolio shift.
Model

- **Single trading period** $t$

- **Asset demand:**
  - households solve savings & portfolio choice problems, given
    1. period $t$ prices (endogenous)
    2. expectations of future prices (exogenous).
    3. asset endowments (exogenous, but value endogenous!).
  - aggregation over households who differ by age, endowments, possibly beliefs.

- **Asset supply**
  - exogenous
  - new supply measured as net household sector purchases.

- **Equilibrium prices**
  - clear markets in period $t$. 
Model

- **Goods:**
  - housing services $s$, “other consumption” $c$.
  - frictionless markets for both goods.

- **Assets**
  - equity = trees that pay off $c$.
  - housing = trees that pay off $s$.
  - bonds = one-period nominal promises; random payoff $1/\pi_{t+1}$.
  - frictions:
    - no short sales of equity, houses.
    - borrowing limit $\propto$ value of house.
    - spread between borrowing and lending rate.

- **Housing vs. Equity**
  - payoffs; housing is collateral; housing has tax advantage.
Household Problem

- **Preferences:** Epstein-Zin utility over streams \( \{C_\tau\} \) of bundles \( C_\tau = c_\tau^\delta s_\tau^{1-\delta} \).

- **Endowments:** labor income \( y_t \), long-lived assets \( \bar{\theta}_t^h, \bar{\theta}_t^e \), and nominal assets \( \bar{b}_t \).

\[ \Rightarrow \text{initial wealth } \bar{w}_t = (p_t^h + d_t^h) \bar{\theta}_t^h + (p_t^e + d_t^e) \bar{\theta}_t^e + \bar{b}_t + y_t. \]

- **Budget constraint**

  In trading period \( t \):

  \[
  \underbrace{c_t + p_t^s s_t}_{\text{consumption}} + \underbrace{p_t^h \theta_t^h + p_t^e \theta_t^e + q_t b_t}_{\text{terminal wealth (savings)}} = \text{initial wealth } \bar{w}_t.
  \]

  For \( \tau > t \)

  \[
  \bar{w}_{\tau+1} = \alpha_{\tau}^\top R_{\tau+1} (\bar{w}_\tau - c_\tau - p_\tau^s s_\tau) + y_{\tau+1}
  \]

- **Short sale constraints & collateral constraint.**

- **Expectations about income, returns, inflation; bond return \( = 1/q_t \pi_{t+1}. \)**
Asset demand and supply

- Asset demand derived from household optimization.
  - sum over households who differ by age, endowments, possibly beliefs.

- Asset supply
  1. Household endowments
     \[ \left\{ \overline{\theta}_t^h (i), \overline{\theta}_t^e (i), \overline{b} (i) \right\}; \quad \sum_i \overline{\theta}_t^h (i) = \sum_i \overline{\theta}_t^e (i) = 1. \]
  2. Rest of the Economy (\(=\) government, corporate & foreign sectors)
     - sells new assets to households (accommodates nonzero savings)
       “house” trees \( f_t^h \), “equity” trees \( f_t^e \), bond supply \( D_t \).
     - redeems outstanding bonds
       \[ \sum_i \overline{b} (i) = \overline{B}. \]
     - consumes proceeds:
       \[ C_t^{ROE} = p_t^h f_t^h + p_t^e f_t^e + D_t - \overline{B}_t. \]
Equilibrium

• Definition

Prices for period \( t \), \( (p_t^h, p_t^e, q_t, p_t^s) \), collection of household choices such that
  - consumers optimize, given prices and expectations.
  - goods markets clear.
  - asset markets clear:

\[
\sum_i \theta_t^h (i) = 1 + f_t^h, \quad \sum_i \theta_t^e (i) = 1 + f_t^e, \quad q_t \sum_i b_t (i) = D_t
\]

• Properties

  - Trade with ROE sector accommodates nonzero personal savings.
  - Exogenous expectations.
    - “baseline beliefs” based on empirical moments.
    - inflation expectations in 1970s: Michigan survey; controlled experiments.
Outline

1. Model

2. Measurement of model inputs

3. Cross section of household portfolios.


5. Inflation and the portfolio shift.
Model Inputs: Data & Definitions

• Implement for three 6-year periods

• Data
  – household positions: Survey of Consumer Finances.

• Definitions
  – equity: all corporate (publicly traded + closely held).
  – real estate: owner-occupied + other residential, held directly or thru business.
  – bonds: all dollar-denominated instruments.
  – indirect holdings: included if controlled by household.
  – non-asset income: included if disposable.
Model Inputs & Calibration

1. New Asset Supply
   - household sector net purchases from FFA.
Model Inputs & Calibration

1. New Asset Supply
   - household sector net purchases from FFA.

2. Distribution of Asset Endowments & Income
   - constructed using SCF positions 6 years earlier.
2. Distribution of Asset Endowments & Income

- approximate distribution by finite number of cells.

- equity & real estate:
  
  market shares from SCF six years prior to benchmark year.

- bonds: prior SCF holdings $\times$ interest factor / realized inflation.

- income $y_T^i = G_T A_T P_T^i u_T^i$
  
  $A_T = \text{age profile, deterministic}$
  
  $P_T^i = \text{permanent idiosyncratic component}$
  
  random walk driven by iid lognormal
  
  $u_T^i = \text{transitory idiosyncratic component}$
  
  iid lognormal

prior SCF income, simulate forward
Model Inputs & Calibration

1. New Asset Supply
   - household sector net purchases from FFA.

2. Distribution of Asset Endowments & Income
   - constructed using SCF positions 6 years earlier.

3. Expectations & preferences
   - stochastic processes for income and returns
   - preference parameters
   - credit market parameters
3. Expectations & Preferences

- aggregate growth $G_T$ iid lognormal

- income $y^i_T = G_T A_T P^i_T u^i_T$
  
  with $P^i_T, u^i_T$ lognormal idiosyncratic shocks

- returns $R_T = \begin{bmatrix} R^b_T, R^h_T, R^s_T \end{bmatrix}$ and inflation $\pi_T$ iid lognormal

- real returns on individual house $R_{h,i}^h = R_T^h \varepsilon^i_T$
  
  with $\varepsilon^i_T$ iid lognormal idiosyncratic shock

- volatilities and correlations for aggregate shocks from historical aggregate data
  
  volatilities for idiosyncratic shocks from literature
3. Expectations & Preferences

- CRRA 5, IES $\frac{1}{2}$
  
  perceived volatility on risky assets is $1.5 \times$ measured

- discount factor $\beta = .975$ to match 1995 wealth/GDP ratio

- capital gains tax on stocks 20%, on housing 0%

- 2% spread between borrowing & lending rate

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<thead>
<tr>
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<th>portfolio weights</th>
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</table>
Outline

1. Model

2. Measurement of model inputs

3. Cross section of household portfolios (1995; baseline beliefs).


5. Inflation and the portfolio shift.
Asset Demand

Key state variable

\[ \frac{\bar{w}}{\hat{y}} = \text{initial wealth} \quad \text{permanent component of income} \]

1. Savings decision: smoothe consumption.
   - lower saving rate if lower \( \bar{w}/\hat{y} \):
   - by collateral constraint, savings must be nonnegative.

\[ \Rightarrow \] younger, poorer households save less; middle-aged households save most.

2. Portfolio decision: maximize return on wealth.
   - higher leverage if lower \( \bar{w}/y \) (human wealth works like riskless asset!).
   - by collateral constraint, borrowing requires buying real estate.

\[ \Rightarrow \] younger, poorer households borrow more, buy houses.
Asset Holdings by Age

Terminal Wealth (% gdp)

Equity: Market Shares by Age, Wealth

Net Nominal Positions (% gdp)

Houses: Market Shares by Age, Wealth
Cross Section of Household Portfolios: Summary

• Stylized facts

1. Savings decision
   - hump shapes in savings by age
   - rich households save more

2. Portfolio decision
   - hump-shaped market shares of stocks, houses.
   - young households are net borrowers, old are net lenders.
   - rich households borrow less.

• Model generates facts because low $\bar{w}/\bar{y}$ means low savings, high leverage.

• Asset pricing implications

1. savings decision drives Wealth/GDP ratio.

2. portfolio decision drives individual asset prices.
Outline

1. Model

2. Measurement of model inputs


4. Evolution of the Wealth/GDP ratio (baseline beliefs).

5. Inflation and the portfolio shift.
Evolution of the Wealth/GDP Ratio

- At baseline expectations, model predicts wealth dip in 1970s.
Evolution of the Wealth/GDP Ratio

- At baseline expectations, model predicts wealth dip in 1970s.
• Entry of baby boomers into asset markets lowers average savings rate, asset demand.

Net Worth/GDP

Demographics

• Entry of baby boomers into asset markets lowers average savings rate, asset demand.
• Surprise inflation lowers aggregate household wealth, asset demand.
Evolution of the Wealth/GDP Ratio

- Entry of baby boomers into asset markets lowers average savings rate, asset demand.
- Surprise inflation lowers aggregate household wealth, asset demand.
- Reduction of government debt lowers asset supply.
Outline

1. Model

2. Measurement of model inputs


5. Inflation and the portfolio shift.
Portfolios under Baseline Expectations, 1978

- Portfolio weights are the same as in 1995; credit lower due to higher spread.

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- Inflation Expectations Experiments.
  - Expected inflation from surveys
  - Inflation uncertainty
  - Inflation as a predictor of low stock returns.
Survey Inflation Expectations

• Data
  – Michigan Survey of Consumers
  – in late 1970s, old expected lower inflation than young
  – difference by age goes away in 1990s.
  – in the model experiment: assign cohort medians.

• Portfolio shift towards housing

  1. Disagreement & Collateral Constraint
     – young trade at same nominal rate as old, perceive lower real rate.
     – young want to borrow cheaply, demand houses (collateral)

  2. Taxation of nominal returns
     – nominal gains on equity, nominal interest taxed more than gains on housing.
Survey Inflation Expectations

- Portfolio shift from stocks to housing.
- Increase in credit volume, nominal interest rate.

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Survey Inflation Expectations

- Portfolio shift from stocks to housing.
- Increase in credit volume, nominal interest rate.

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Inflation Uncertainty

- Motivation: first peacetime inflation
- Experiment: double volatility of inflation.
- Effects: higher nominal interest rate, less borrowing and lending among households.

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Inflation as a Predictor of Low Stock Returns

- Motivation: inflation & pessimism about profits.
- Experiment: expected real stock returns –1.5% (consistent with Fama-Schwert 1977).
- Effects: portfolio shift, small drops in wealth/GDP, interest rate.

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## Low growth expectations

- **Motivation:** productivity slowdown
- **Experiment:** expected non-asset income growth, stock, house returns $-1\%$.
- **Effects:** lowers interest rate, raises wealth/GDP.

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<td>growth $-1%$</td>
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Combining survey inflation expectations, inflation uncertainty (vol × 4), low expected growth (-.9%) & low expected stock returns (-1.7%)

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Conclusion

- Asset pricing in 1970s
  - Demographics, surprise inflation, bond supply matter for wealth/GDP.
  - Inflation expectations matter for negative commovement of stock, house prices.
    Three effects:
    1. Disagreement about inflation (young expect more inflation than the old)
    2. Inflation uncertainty
    3. Inflation as a predictor of low stock returns
  - Growth expectations matter for interest rate.

Modelling approach.
- micro data on portfolios discipline heterogeneous agent modelling
- changes in supply ensure compatibility with actions of other sectors.
- temporary equilibrium allows use of surveys, controlled experiments with expectations.