Depression Babies: Do Macroeconomic Experiences Affect Risk-Taking?

October 19, 2009

Ulrike Malmendier, UC Berkeley

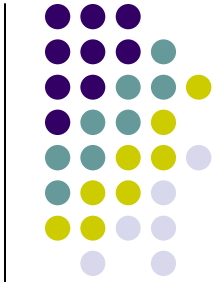
(joint work with Stefan Nagel, Stanford)

The Tale of Depression Babies

"I don't know about you, but my parents were depression babies, and as a result, avoided the stock market and all things risky like the plague." Source: moneytalks.org ("Investing: The Basics")

- Is it true?
- And: Will it be true again?
  - *Does the personal experience of a large stock-market and macro-economic shock have a lasting impact on individuals' risk attitudes?*
  - *If so, does it affect tangible finance and macro variables such as stock market valuation?*

Non-standard approach

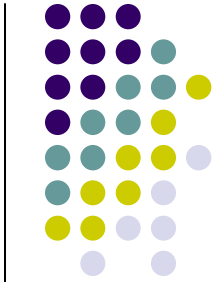


- **Traditional finance models:**
  - Investors have stable risk-attitudes.
  - Investors rationally update beliefs.

    ➔ Effect of "personally experienced outcomes" no different from information about these outcomes.

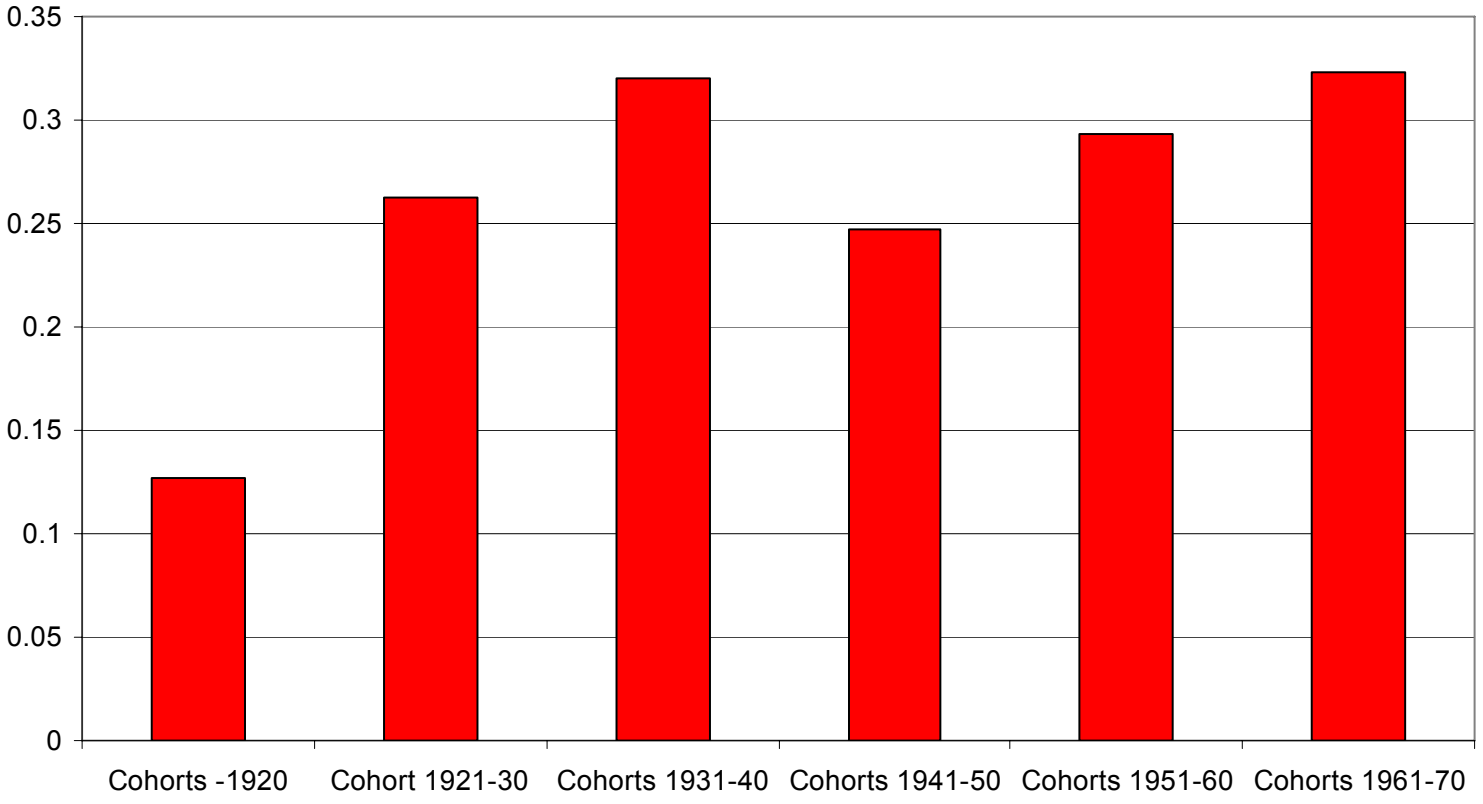
    ➔ *Or:* Effect of "living through a depression" on financial investment no different than effect of reading about it (controlling for wealth, income).
- **Non-traditional models** (behavioral and experimental economics):
  - Experimental games: Personal interaction (with other players) affects behavior more stronger than observing other players' behavior

Research Questions

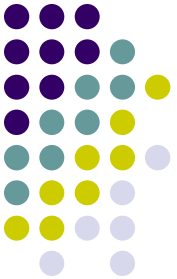


- Do individuals' "macroeconomic/finance histories" systematically affect their risky choices – differently than information about the historical outcomes?
- Illustration: stock-market participation at age 36-45

Suggestive Evidence: Stock Market Participation

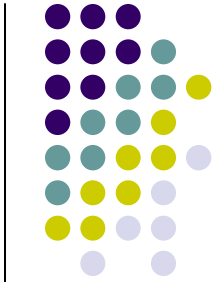


Application and Formal Test



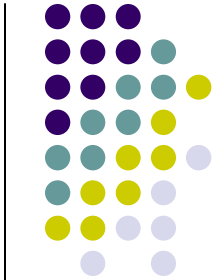
- Do past experiences of risk affect long-term risk attitudes as measured by
  1. Stock Market Participation
  2. Bond Market Participation
  3. Percentage of Liquid Assets Invested in Stock (conditional on stock-market participation)
- Methodology:
  - Measure individual investors' "stock market experience" over their lives so far and relate it to stock market investment (and to risky asset share)
  - Measure individual investors' "bond market experience" over their lives so far and relate it to bond investment

Data



- Survey of Consumer Finances
  - 1983-2004: Triennial, cross-sectional, household-level
  - Over-sampling of high-income households
  - Detailed data on asset holdings and demographics
- Precursor of Survey of Consumer Finances
  - 1964-1977: 1964, 1968, 1969, 1970, 1971, 1977
  - We use data on stock-market participation since 1964 and on bond-market participation since 1968.

Measures of Risk-Taking



- **Elicited risk aversion** (1983-2004): survey
  - 1 = “willing to take substantial financial risks expecting to earn substantial returns”
  - 2 = “… above average financial risks .. above av. ret.”
  - 3 = “…average financial risks … average returns”
  - 4 = “not willing to take any financial risk”
- **Stock investment** (1964-2004)
  - Stock-market participation (stock holdings > $0)
- **Bond investment** (1968-2004)
  - Bond-market participation (bond holdings > $0)
- **Stock investment** II (1983-2004)
  - Stock asset share of stock-market participants (= % of liquid assets invested in stocks)

Measures of Experienced Returns

- $R_{i,t-k}$: Annual real returns on S&P500 index from Shiller (2005)
- Calculate since birth of household head
- Life-time (weighted) average returns of household *i* at *t*:

$$A_{it}(\lambda) = \frac{\sum_{k=1}^{age_{it}-1} w_{it}(k,\lambda) R_{t-k}}{\sum_{k=1}^{age_{it}-1} w_{it}(k,\lambda)}, \text{ where } w_{it}(k,\lambda) = \left(\frac{age_{it}-k}{age_{it}}\right)^{\lambda}$$

Weighting Function

- Chosen to allow increasing, decreasing, constant weights over time with one parameter.
  - Have also used U-shaped and inverse U-shaped functions; same results.
- Illustration for 50-year old household:

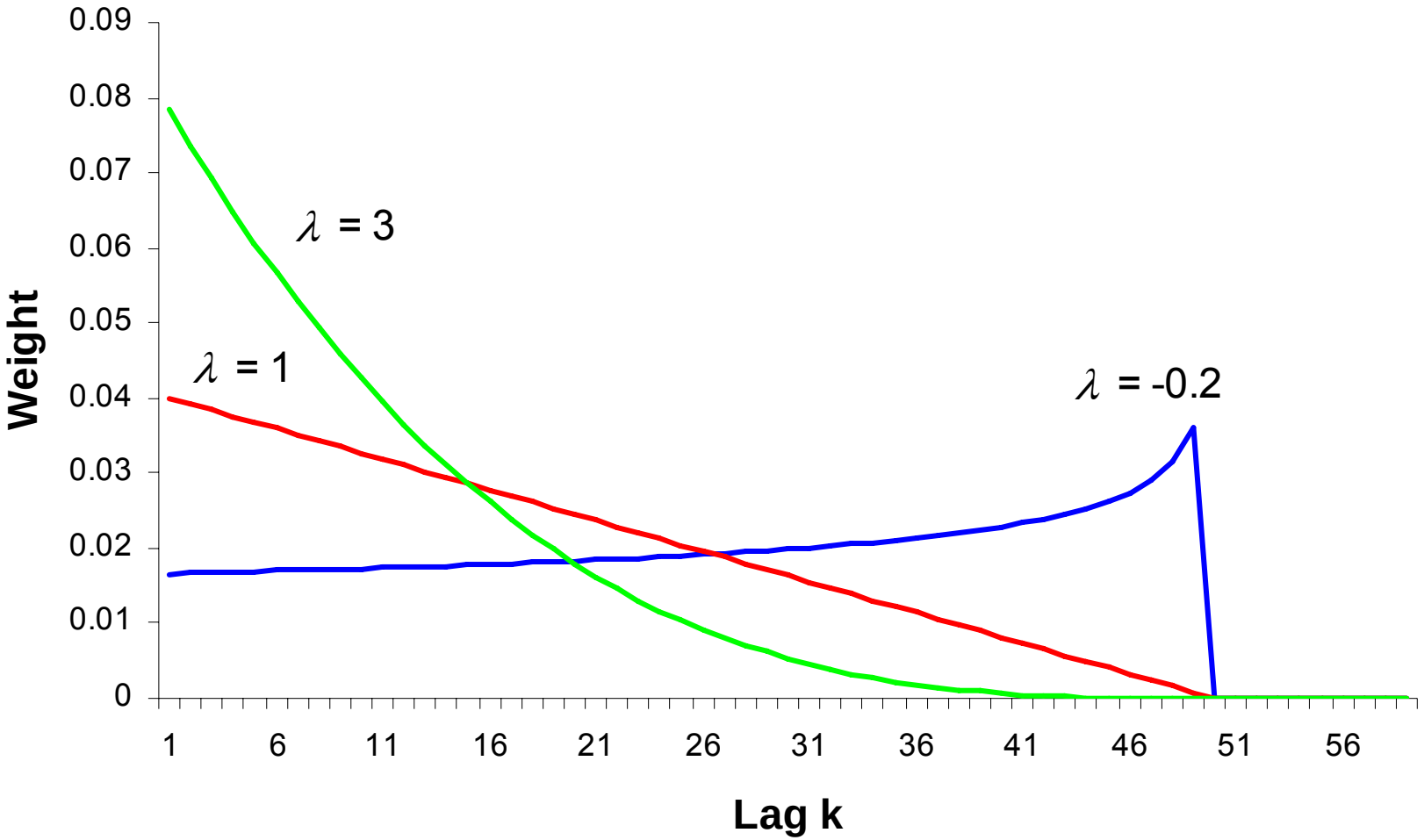


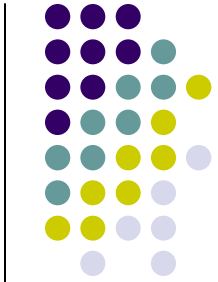
Table I: Summary Statistics

	10^{th} pctile	Median	90^{th} pctile	Mean	Stddev	#Obs.
Panel A: All households 1964 – 2004						
Liquid assets	696	9,820	205,590	119.858	721,755	33,600
Income	16,819	48,849	109,957	65,679	178,229	33,600
Experienced real stock return (λ = 1.25)	0.059	0.086	0.110	0.085	0.021	33,600
Experienced real bond return (λ = 0.75)	-0.002	0.012	0.046	0.018	0.019	33,600
Stock market participation	0	0	1	0.285	0.451	33,591
Bond market participation	0	0	1	0.322	0.467	32,269
Elicited risk aversion (1983-2004)	2	3	4	3.120	0.834	22,316

Table I: Summary Statistics (*continued*)

	10th pctile	Median	90th pctile	Mean	Stddev	#Obs.
Panel B: Stock market participants 1964-2004						
Liquid assets	5,375	47,676	431,419	224,766	1,258,931	12,977
Income	29,382	69,828	171,645	104,040	313,501	12,977
Bond market participation	0	0	1	0.496	0.498	12,736
% Liquid assets in stocks	0.059	0.427	0.903	0.473	0.439	12,117
Elicited risk aversion (1983-2004)	2	3	4	2.787	0.776	9,531
Panel C: Bond market participants 1968-2004						
Liquid assets	1,950	22,191	302,054	166,977	1,139,639	12,226
Income	26,939	62,690	140,487	89,377	263,974	12,226
Stock market participation	0	0	1	0.454	0.497	11,225
% Liquid assets in stocks	0.000	0.000	0.649	0.179	0.272	11,542
Elicited risk aversion (1983-2004)	2	3	4	2.977	0.796	8,749

Estimation

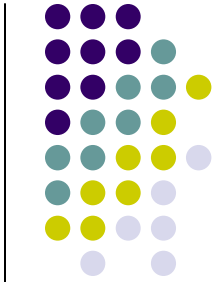


- General approach:

$$y_{it} = \alpha + \beta A_{it}(\lambda) + \gamma' x_{it} + \varepsilon_{it}$$

  - $A_{it}(\lambda)$: Life-time (weighted) average stock or bond returns of household *i* at time *t*, given weighting parameter λ
  - x_{it}: Control variables
  - β: Partial effect of life-time average stock or bond returns on dependent variable (coefficient of main interest)
- We estimate β and λ simultaneously.
- Non-linear estimation

Questions



1. **True "experience" of returns**
   - Depends on investment
   - Depends on interest in economic matters
   - Depends on other personal circumstances

   Bias?
   - Only if such idiosyncratic factors are correlated with the aggregate return measures. Else noise.

Questions

2. **Unobserved <u>aggregate effects</u>** explaining both stock returns and (aggregate) investment

   E.g. time effects

   E.g. time-varying aggregate risk aversion

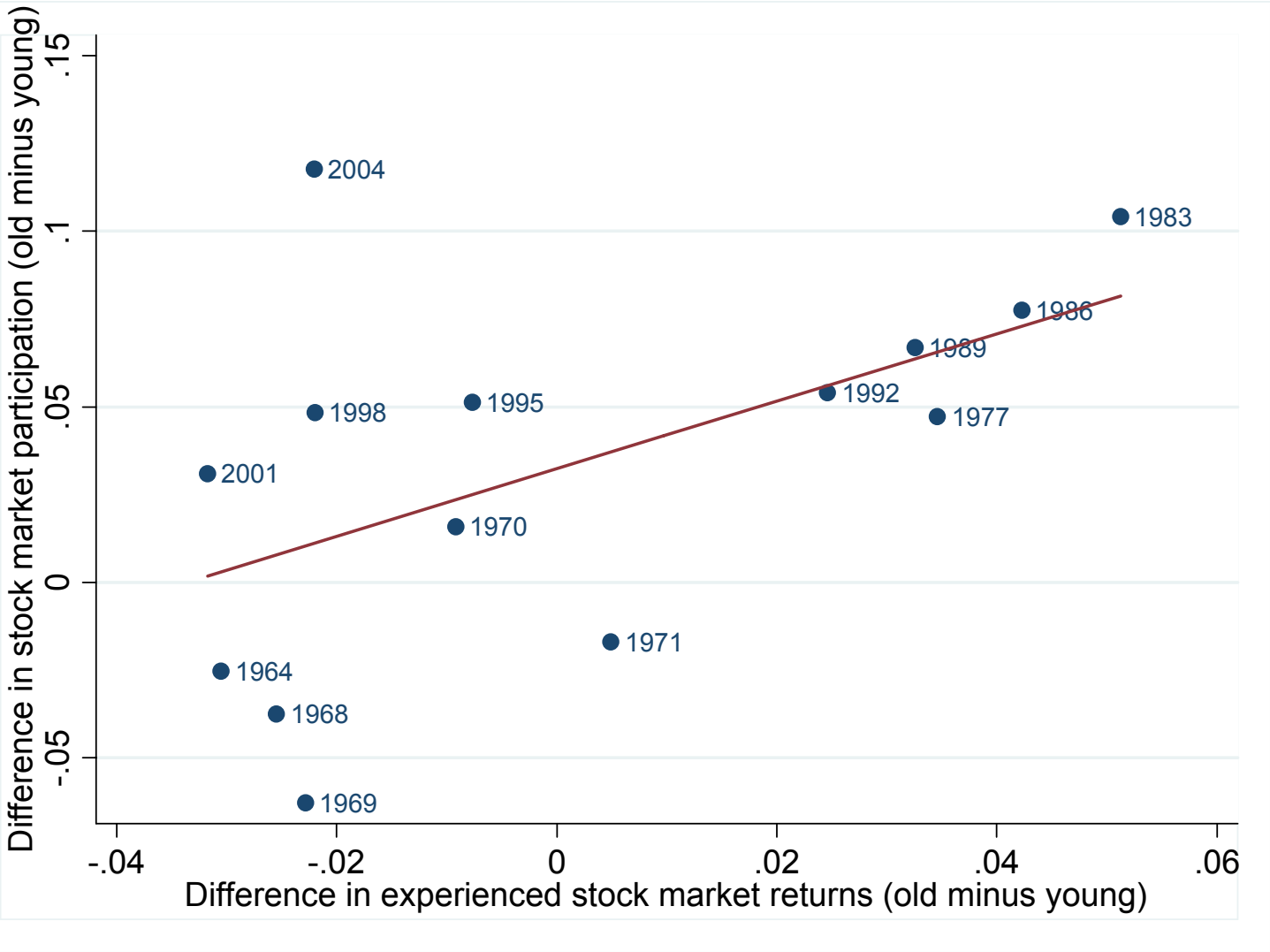
   ➔ Include year dummies

   ➔ The identification from cross-sectional *differences* in risk-taking and in macroeconomic histories **<u>and</u>** from changes of those cross-sectional differences over time, not from *common* variation over time.

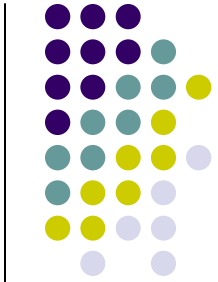
Example

- Early 1980s: young households had lower stock-market participation, lower allocation to stocks, and reported higher risk aversion than older households.
  - Young households experienced the low 1970s stock returns.
  - Older households experienced the low 1970s stock returns, but also the high 1950s and 1960s returns.
- 1990s: pattern flipped: (then) young households had higher rates of stock-market participation, higher allocation to stocks, and lower reported risk aversion than older households.
  - Young households experienced the 1990s boom years and, hence, had higher life-time average returns than old households.
- Our identification: from correlated changes in the age profile of life-time weighted average returns and risk-taking.

Example


Difference in stock market participation (old minus young)
.15
.1
.05
0
-.05
2004
1983
1986
1989
1992
1977
1998
1995
2001
1970
1971
1964
1968
1969
-.04
-.02
0
.02
.04
.06
Difference in experienced stock market returns (old minus young)

Measure 1: Elicited Risk Aversion



- Ordered Probit Model (ML estimation)

$$\mathrm{P}\left(y_{it} \le j \mid x_{it}, A_{it}\left(\lambda\right)\right) = \Phi\left(\alpha_j - \beta A_{it}\left(\lambda\right) - \gamma' x_{it}\right)$$

- Risk aversion categories j ={1, 2, 3, 4}
  - $A_{it}(\lambda)$: Life-time (weighted) average returns of household i at time t, given weighting parameter λ
  - x_{it}: Control variables

Measure 1: Elicited Risk Aversion

- Ordered Probit Model (ML estimation)

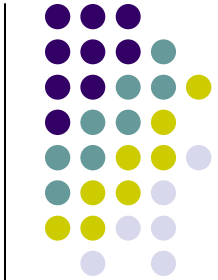
$$\mathrm{P}\left(y_{it} \le j \mid x_{it}, A_{it}(\lambda)\right) = \Phi\left(\alpha_j - \beta A_{it}(\lambda) - \gamma' x_{it}\right)$$

- Risk aversion categories j ={1, 2, 3, 4}
  - Coefficient vector β has no direct economic interpretation.
  - We focus on average partial effects of life-time average return on probabilities of being a certain risk-aversion category.
  - Partial effect $\partial \mathrm{P}\left(y_{it} = j \mid x_{it}, A_{it}(\lambda)\right) / \partial A_{it}(\lambda)$
  - Average partial effect: evaluate the partial effects at each sample observation, given the estimated parameters and observations on x_{it} and $A_{it}(\lambda)$ and average across sample observations

Measure 1: Elicited Risk Aversion

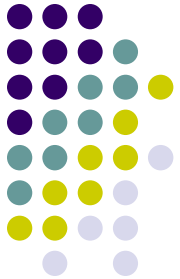
	(i) 1983-2004	(ii) 1983-2004	(iii) 1983-2004 weighted	(iv) 1983-2004 weighted
Ordered Probit coefficient estimates:				
Experienced stock return coefficient β	-4.055	-3.384	-4.735	-3.930
	(1.091)	(1.091)	(1.213)	(1.221)
Weighting parameter λ	1.466	1.422	1.743	1.774
	(0.303)	(0.511)	(0.536)	(0.652)
Income controls	Yes	Yes	Yes	Yes
Liquid assets controls	-	Yes	-	Yes
Demographics controls	Yes	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Average partial effect of experienced stock return on category probability				
Risk aversion = 1 (low)	0.444	0.369	0.628	0.522
	(0.119)	(0.119)	(0.161)	(0.162)
Risk aversion = 2	0.742	0.606	0.707	0.594
	(0.200)	(0.195)	(0.181)	(0.185)
Risk aversion = 3	0.024	0.017	0.085	0.043
	(0.006)	(0.005)	(0.022)	(0.013)
Risk aversion = 4 (high)	-1.210	-0.992	-1.419	-1.159
	(0.325)	(0.320)	(0.364)	(0.360)
#Obs.	22,260	22,260	22,260	22,260
Pseudo R^2	0.08	0.10	0.07	0.08

Interpretation



- Average partial effect:
  - Difference between the 10th and 90th percentile of life-time average stock returns: 5.1%.
  - Implied decrease in the unconditional probability of being in the highest risk-aversion category: -1.210 $\times$ 5.1% $\approx$ -6.2% decrease (compared to unconditional frequency of 28.77%).
- Weighting parameter λ (estimate 1.466 (s.e. 0.303))
  - households' risk aversion most affected by recent returns abut also affected by returns many years in the past.
  - declining weights; significantly different from equal / increasing weights: the memory of these early experiences fades away only very slowly.

Measure 2: Stock-Market Participation



- Probit Model (ML estimation)

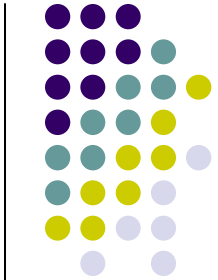
$$\mathrm{P}\left(y_{it}=1 \mid x_{it}, A_{it}(\lambda)\right)=\Phi\left(\alpha+\beta A_{it}(\lambda)+\gamma' x_{it}\right)$$

- Binary indicator y_{it} = 1 if positive stockholdings of household *i* at time *t*
  - As before, coefficient vector β has no direct economic interpretation.
  - We focus on <u>average partial effects</u> of life-time average return on stock market participation:
  - Partial effect: $\partial \mathrm{P}\left(y_{it}=1 \mid x_{it}, A_{it}(\lambda)\right) / \partial A_{it}(\lambda)$
  - Average partial effect: Given the estimated β and λ, evaluate this partial effect at every sample observation and average across all observations.

Measure 2: Stock-Market Participation (Probit)

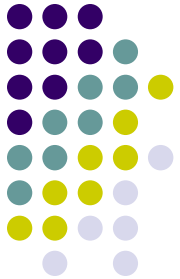
	(i) 1964-2004	(ii) 1964-2004	(iii) 1964-2004 weighted	(iv) 1964-2004 weighted
Probit coefficient estimates:				
Experienced stock return coefficient β	7.230	6.275	7.724	5.834
	(1.157)	(1.270)	(1.287)	(1.447)
Weighting parameter λ	1.300	1.162	1.382	1.117
	(0.188)	(0.266)	(0.237)	(0.313)
Income controls	Yes	Yes	Yes	Yes
Liquid assets controls	-	Yes	-	Yes
Demographics controls	Yes	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Average partial effect of experienced stock return on participation probability	2.086	1.514	2.075	1.440
	(0.334)	(0.306)	(0.346)	(0.357)
#Obs.	33,535	33,535	33,535	33,535
Pseudo R^2	0.24	0.36	0.16	0.26

Interpretation



- Average partial effect:
  - Difference between the 10th and 90th percentile of life-time average stock returns is about 5.1%.
  - Change from the 10th to the 90th percentile implies about $2.086 \times 5.1\% \approx 10.6\ \%$ increase in the probability of stock-market participation.
- Weighting parameter λ very similar (estimate of 1.300 (s.e. 0.188))
  - Remarkable given that based on survey versus asset holdings

Measure 3: Bond-Market Participation



- Probit Model (ML estimation)

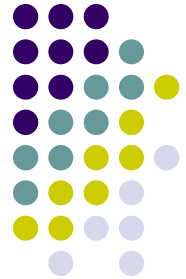
$$\mathrm{P}\left(y_{it}=1 \mid x_{it}, A_{it}(\lambda)\right)=\Phi\left(\alpha+\beta A_{it}(\lambda)+\gamma' x_{it}\right)$$

- Binary indicator y_{it} = 1 if positive bondholdings of household *i* at time *t*
  - As before, coefficient vector β has no direct economic interpretation.
  - We focus on <u>average partial effects</u> of life-time average return on stock market participation:
  - Partial effect:

$$\partial \mathrm{P}\left(y_{it}=1 \mid x_{it}, A_{it}(\lambda)\right) / \partial A_{it}(\lambda)$$

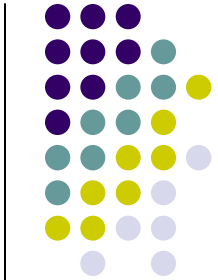
  - Average partial effect: Given the estimated β and λ, evaluate this partial effect at every sample observation and average across all observations.

Measure 3: Bond-Market Participation (Probit)



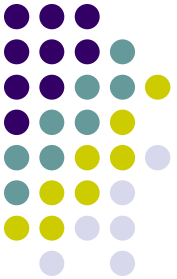
	(i) 1968-2004	(ii) 1968-2004	(iii) 1968-2004 weighted	(iv) 1968-2004 weighted
Probit coefficient estimates:				
Experienced bond return coefficient β	6.819	5.653	7.744	5.151
	(1.443)	(1.342)	(1.830)	(1.709))
Weighting parameter λ	0.597	0.347	0.997	0.825
	(0.328)	(0.288)	(0.452)	(0.540)
Income controls	Yes	Yes	Yes	Yes
Liquid assets controls	-	Yes	-	Yes
Demographics controls	Yes	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Average partial effect of experienced bond return on participation probability	2.289	1.782	2.593	1.660
	(0.484)	(0.423)	(0.613)	(0.551)
#Obs.	32,213	32,213	32,213	32,213
Pseudo R^2	0.11	0.16	0.08	0.12

Interpretation



- Average partial effect:
  - Difference between the 10th and 90th percentile of life-time average bond returns is about 4.8%.
  - Change from the 10th to the 90th percentile implies about $2.289 \times 4.8\% \approx 11.0\%$ increase in the probability of bond-market participation.
- Weighting parameter λ lower (estimate of 0.597) though high s.e. (0.328)
  - Remarkable given that based on survey versus asset holdings

Measure 4: Risky-Asset Portion

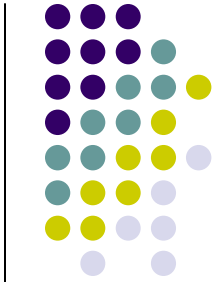


- Non-linear regression:

$$y_{it} = \alpha + \beta A_{it}(\lambda) + \gamma' x_{it} + \varepsilon_{it}$$

  - The model is nonlinear, because the life-time average return $A_{it}(\lambda)$ is a nonlinear function of λ.
- Conditional on stock-market participation.
- Partial effect $A_{it}(\lambda)$ is now = β.

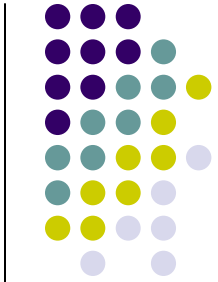
Measure 4: Risky Asset Share



Panel A. Experienced Stock Returns

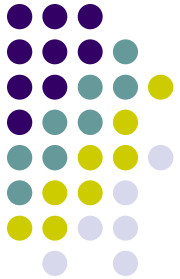
	(i) 1968-2004	(ii) 1968-2004	(iii) 1968-2004 weighted	(iv) 1968-2004 weighted
Experienced stock return coefficient β	1.121	1.120	1.408	1.436
	(0.462)	(0.463)	(0.563)	(0.564)
Weighting parameter λ	1.553	1.549	1.134	1.129
	(0.616)	(0.609)	(0.513)	(0.492)
Income controls	Yes	Yes	Yes	Yes
Liquid assets controls	-	Yes	-	Yes
Demographics controls	Yes	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
#Obs.	11,859	11,859	11,859	11,859
R^2	0.06	0.06	0.08	0.08

Interpretation



- Average partial effect:
  - Difference between the 10th and 90th percentile of life-time average stock returns is about 5.1%.
  - Change from the 10th to the 90th percentile implies about $1.121 \times 5.1\% \approx 5.7$ ppt increase in the proportion allocated to risky assets.
  - Noteworthy: In empirical literature on household portfolio choice, it is hard to find *any* household characteristics *among stock-market participants* that predict the risky asset share.
- Weighting parameter λ very similar (estimate 1.553 (s.e. 0.616))

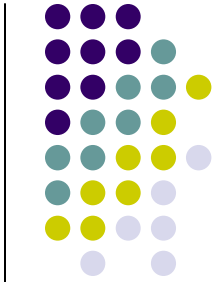
Robustness



- Assume perspective of investor choosing between stocks and bonds
- ➔ Only if performance stocks > bonds, increase investment in stocks relative to bond
- ➔ Repeat analysis with excess returns stocks over bond

  (full sample or sample of stock-and-bond-market participants)

Table VI: Risky Asset Share (NLS)



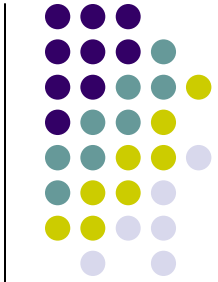
Panel B. Experienced Excess Returns of Stocks Over Bonds

	(i) 1968-2004	(ii) 1968-2004	(iii) 1968-2004 weighted	(iv) 1968-2004 weighted
Experienced excess return coefficient β	1.892	1.899	2.020	2.059
	(0.556)	(0.556)	(0.662)	(0.662)
Weighting parameter λ	1.925	1.923	1.812	1.783
	(0.471)	(0.468)	(0.489)	(0.471)
Income controls	Yes	Yes	Yes	Yes
Liquid assets controls	-	Yes	-	Yes
Demographics controls	Yes	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
#Obs.	11,859	11,859	11,859	11,859
R^2	0.06	0.06	0.08	0.09

Placebo: Using stock and bond returns

Dependent variable	Elicited risk aversion	Stock mkt. participation	Bond market participation	% liquid assets in stocks	% liquid assets in stocks
Sample	Full	Full	Full	Stock market participation required	Stock and bond market participation required
Experienced stock return coeff. β_{stock}	-0.941	6.539	-1.727	1.899	2.555
	(1.696)	(1.413)	(1.286)	(0.569)	(0.757)
Weighting parameter for stocks λ_{stock}	1.422	1.162	1.162	1.549	1.549
	[fixed]	[fixed]	[fixed]	[fixed]	[fixed]
Experienced bond return coeff. β_{bond}	-5.162	-0.619	6.564	-1.180	-1.170
	(2.772)	(1.489)	(1.399)	(0.650)	(0.848)
Weighting parameter for bonds λ_{bond}	0.347	0.347	0.347	0.347	0.347
	[fixed]	[fixed]	[fixed]	[fixed]	[fixed]

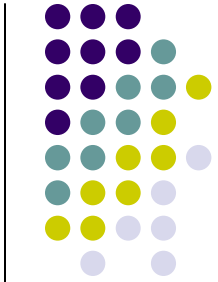
Interpretation



- Addresses unobserved wealth effects
  - Alternative interpretation: correlation of return experiences with unobserved wealth components, coupled with wealth-dependent risk aversion, explains our results.
  - Since both past stock and bond returns should be positively related to wealth, both stock and bond returns should predict each of the risk-taking measures with the same sign.

➔ Not the case.

What about “experienced volatility”?

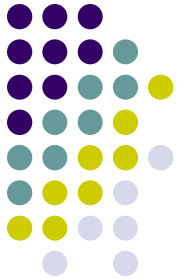


- Do differences in life-time experiences of return volatility also lead to differences in risk-taking?
  - Repeat analysis with “life-time volatility” of returns, measured by the standard deviation of returns since birth
  - Observations weighted as for the life-time average return (with λ = 1.00)

➔ Small, insignificant, negative coefficient.

Unconditional mean of returns is harder to estimate than the second moment (Merton, 1980), hence presumably more scope for investors to disagree and be influenced by life-time experiences of mean returns rather than volatility.

Aggregate Perspective



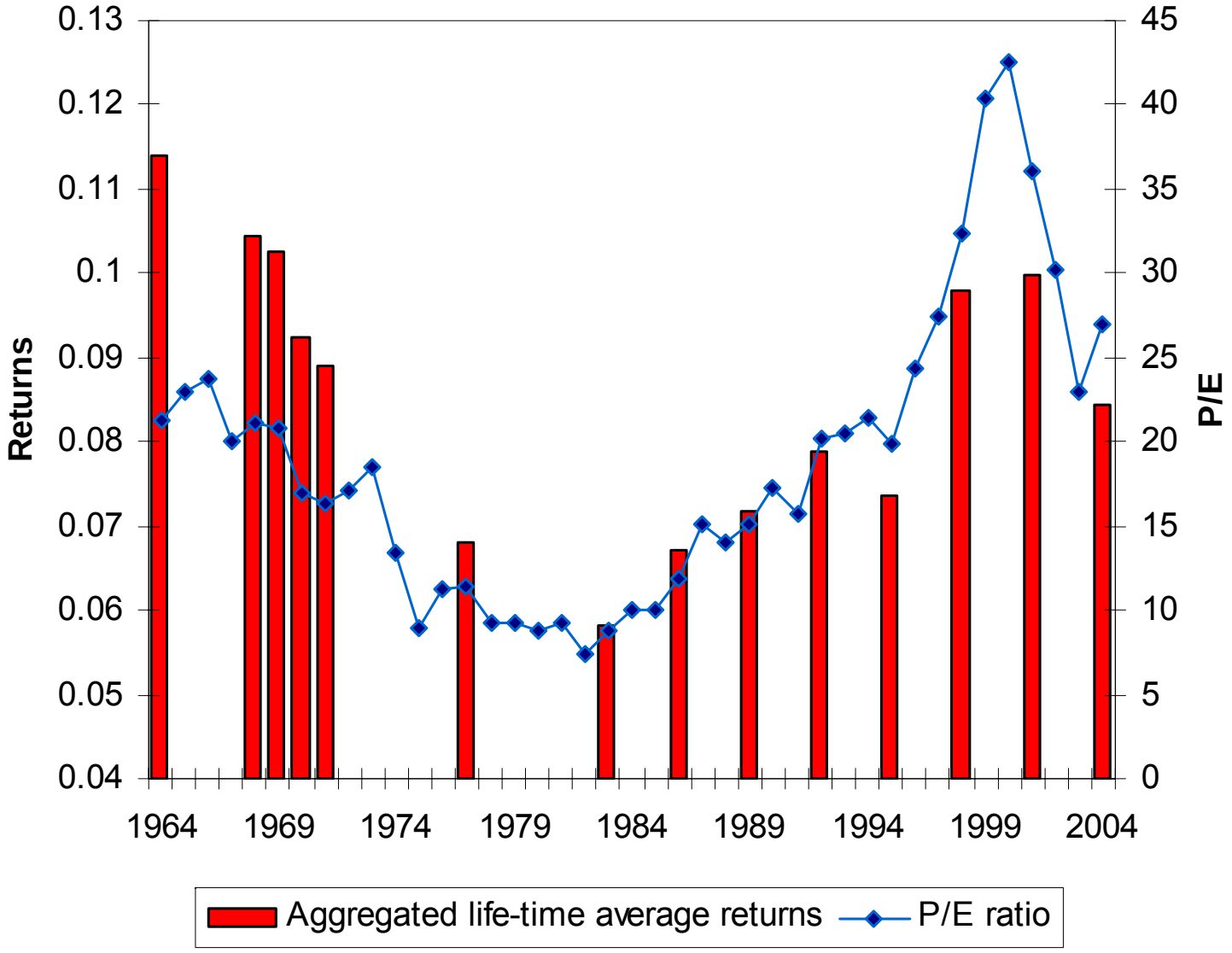
Do the experience-based changes in risky asset demand influence the dynamics of stock prices?

Exercise:

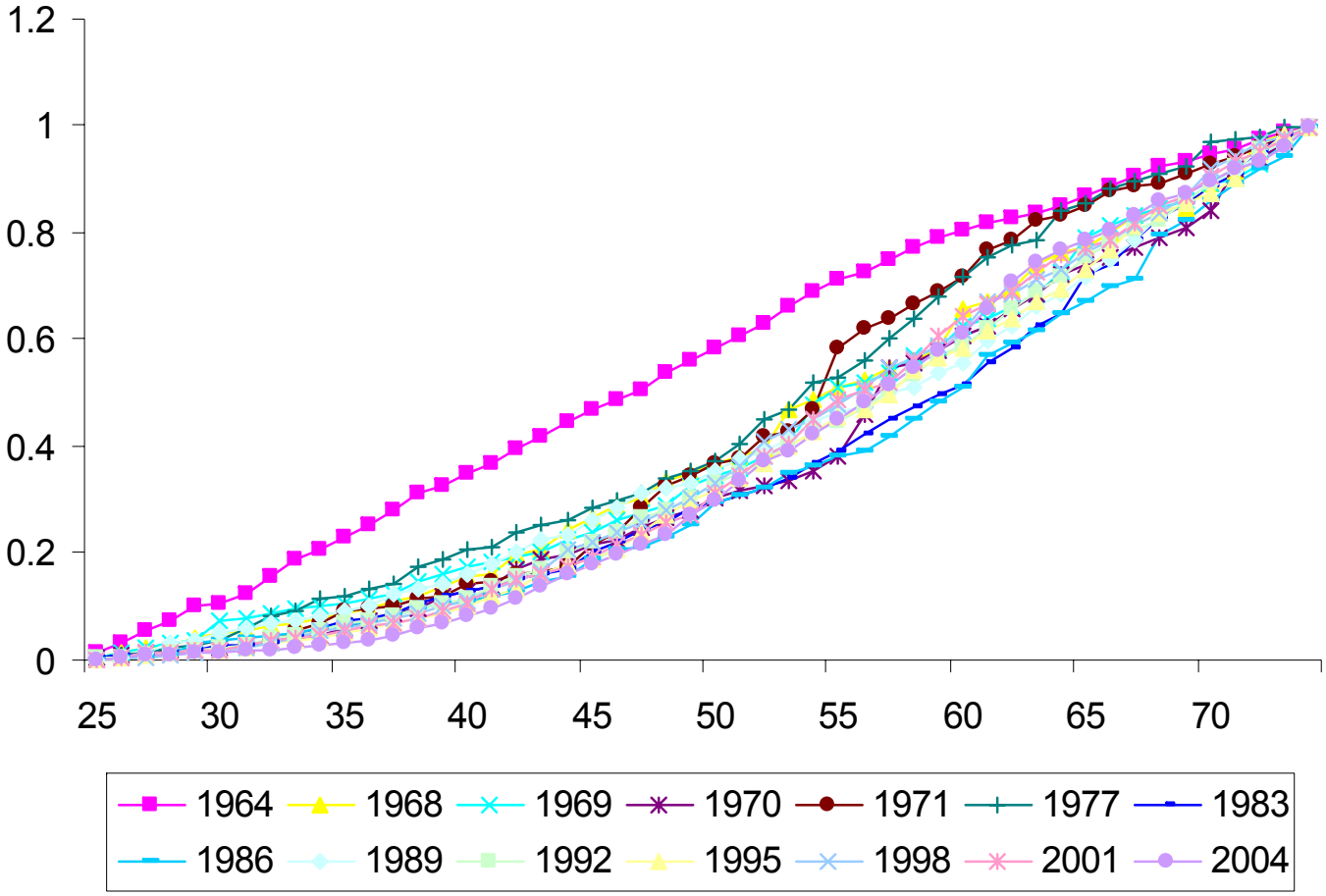
- Set λ=1.25 (in ballpark of prior estimates)
- Compute life-time (weighted) average return for each household and year
- Weight household-year observations with liquid assets of the household × SCF weight
- Relate to measure of stock market valuation:

  P/E ratio from Shiller (2005), which is negatively related to future stock-market returns

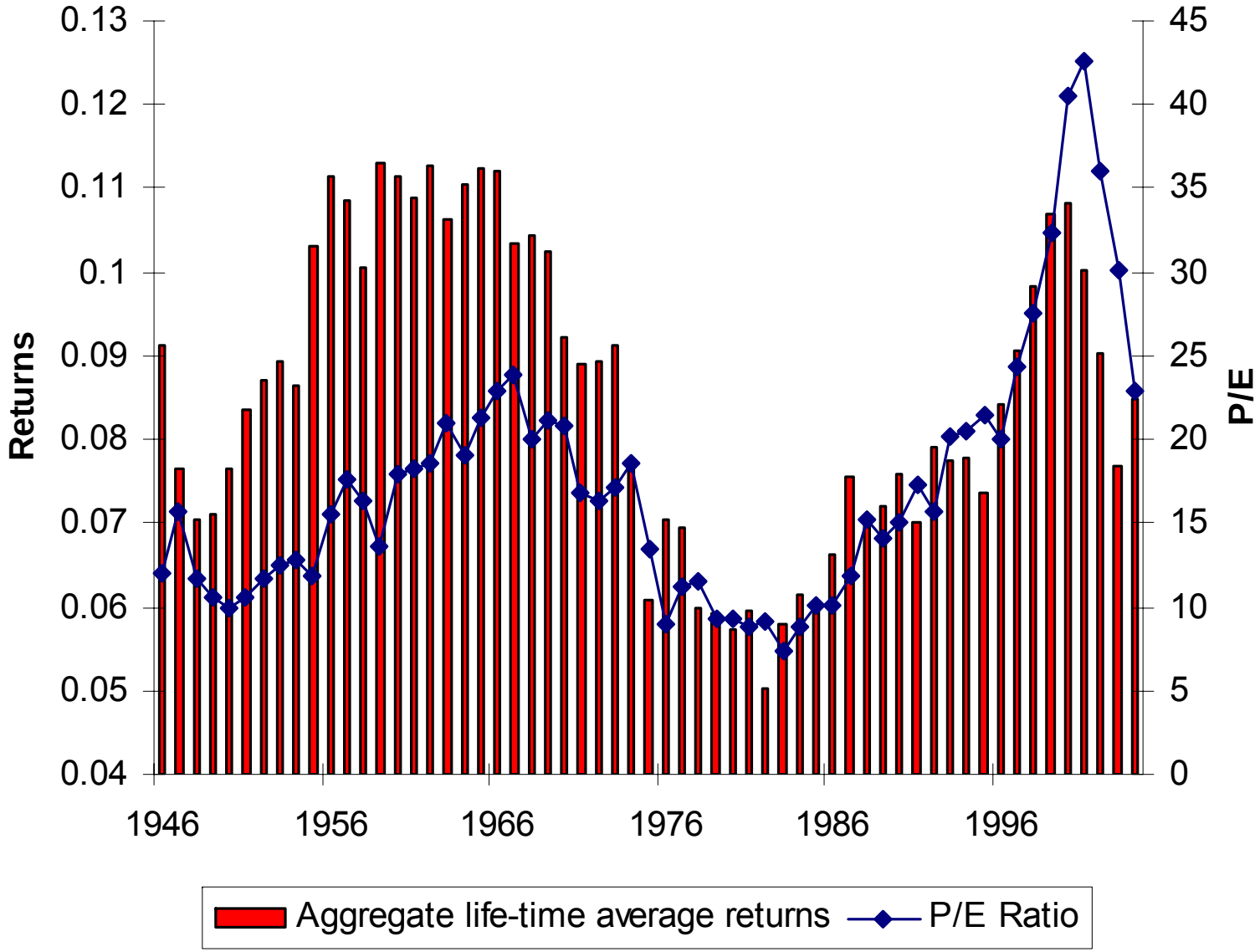
Aggregate experienced stock returns and stock market valuations – survey years



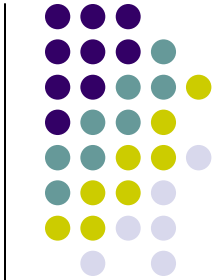
Distribution of liquid assets across ages by year



Aggregate experienced stock returns and stock market valuations – all years 1946-2004

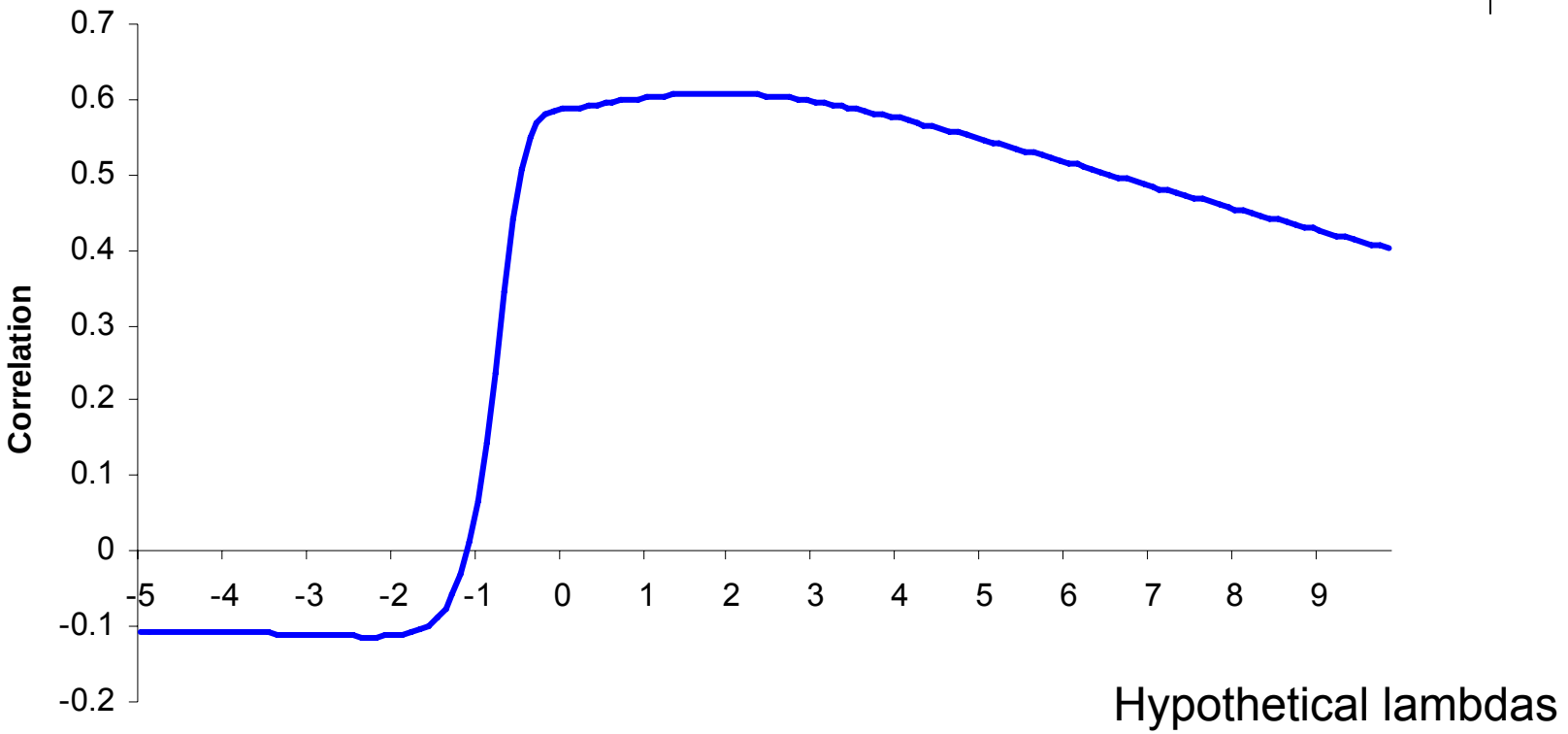


Interpretation



- Highly positive correlation between aggregate life-time average returns and stock-market valuation levels.
- Implies:
  - Our microdata estimates imply plausible time-variation in aggregate demand for risky assets.

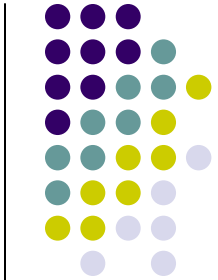
This is not mechanistic:
Correlations for “hypothetical lambdas”



Interpretation

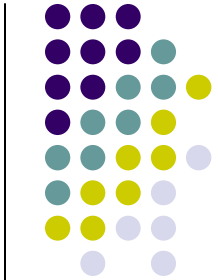
- Highly positive correlation between aggregate life-time average returns and stock-market valuation levels.
- Implies:
  - Our microdata estimates imply plausible time-variation in aggregate demand for risky assets.
  - Personally experienced stock-market returns possibly affect equity valuation via changes in investors' willingness to take risk.

Conclusions



- Stock return experienced over an individuals' life affects risk attitudes and willingness to take stock risk.
- Bond return experience affects willingness to take bond risk.
- Individuals put more weight on relatively recent returns, but even very distant ones still have substantial effects.
- Departure from standard model (stable risk attitudes); source of heterogeneity
- Systematic departure, unified framework for different measures of risk-aversion.
- Potential explanation for variations in stock market valuation levels and expected returns over time.

Open Questions and Next Steps



- **Explanation**
  - Learning?
  - Social learning?
  - Endogenous risk aversion?
- **International Replications**
  - Germany in the 1930s
- **Other Applications**
  - Inflation
  - Earthquakes
  - Managerial decision-making