"Subjective Return Expectations, Information and Portfolio Choice"

(Work in Progress)

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- *Subjective Belief Elicitation*: Does what they believe in explain their financial decisions?

- (combined with) *Information Elicitation*: **Does what they believe in explain their financial decisions, given what they know?**

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  3. Subjective Belief Elicitation and Household Finance: Dominitz and Manski (2007); Dominitz and Manski (2011); Hurd (2009); Hurd, van Rooij and Winter (2011), Kezdi and Willis (2009, 2011)

Outline of the Presentation

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5. Conclusions and Extensions

Why Should (Subjective) Expectations Matter?
Main Point

- Households' rationality benchmark: standard two-asset portfolio choice model (Arrow, 1965),

$$\max_{\alpha \in [0, w_0]} E \left\{ u[(1 + R)W_0 + (\widetilde{R} - R)\alpha] \right\}$$

Participation Condition: $\qquad E\widetilde{R} - R > 0$

Conditional Demand Equation: $\qquad \alpha^* \cong \dfrac{E\widetilde{R} - R}{A_u(W_0)\sigma_R^2}$

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- *Main Point*: Replace $E\{.\}$ by $E^i\{.\} \equiv E_{P^i}\{.\,|\,I^i\}$ everywhere above
- **N.B.** Samuelson (1969) (Merton, 1969): similar conditional demand with i.i.d. normality of $\ln(1 + \widetilde{R})$ and CRRA preferences in a dynamic (continuous-t) infinite horizon setup ($R_u(W_0)$ replaces $A_u(W_0)$ and α^* denotes instead the share of W_0)

- A professional Survey Agency (TNS) was paid (ANR research funds) to administer a survey with questions on attitudes, preferences, expectations and socio-economic and demographic characteristics to a representative sample of 4,000 households. Respondents had to fill the questionnaire, and return it by the post in exchange of around €25 (*bons-d'achat*).

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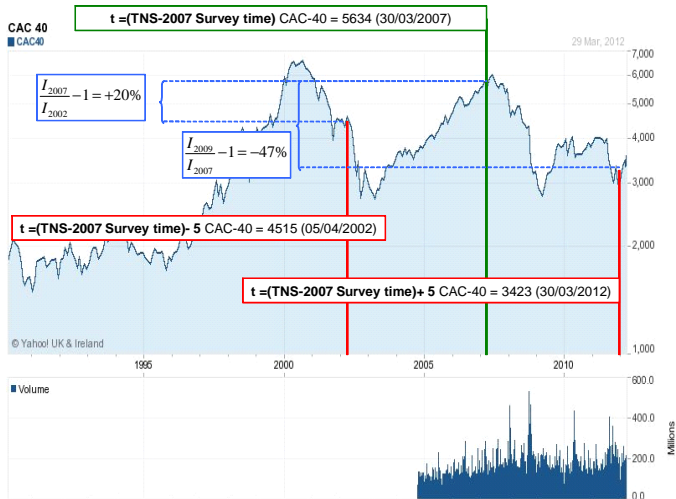
- *We elicit households' subjective beliefs regarding the **recent past** evolution of the French stock market index (CAC-40) over the 5 years, I_{t-5}, prior to the time of the survey, I_t.*

French Stock Market Index CAC-40 between Mar1980 and Apr2012

CAC 40
■ CAC40

t =(TNS-2007 Survey time) CAC-40 = 5634 (30/03/2007)

29 Mar, 2012

$$\frac{I_{2007}}{I_{2002}} - 1 = +20\%$$

$$\frac{I_{2009}}{I_{2007}} - 1 = -47\%$$

t =(TNS-2007 Survey time)- 5 CAC-40 = 4515 (05/04/2002)

t =(TNS-2007 Survey time)+ 5 CAC-40 = 3423 (30/03/2012)

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■ Volume

Millions

How do We do It (I)
Probabilistic Questions about Expected Stock Market Performance 5 years ahead:
(Translated) Wording

C6. 'Five years from now, do you think that the stock market... -For each category write down the likelihood of occurrence assigning a value between 0 and 100 ($p^i_{t+1,k}$). The sum of all your answers must be equal to 100 ($\sum_k p^i_{t+1,k} = 100$)-:

$\{k = 1 : R_{t+1} \in (0.25, R^i_{max}]\}$ -... will have increased by more than 25%

$\{k = 2 : R_{t+1} \in [0.10, 0.25]\}$-... will have increased by 10 to 25%

$\{k = 3 : R_{t+1} \in (0, 0.10)\}$-... will have increased by less than 10%

$\{k = 4 : R_{t+1} = 0\}$-... will be the same

$\{k = 5 : R_{t+1} \in (0, -0.10)\}$-... will have decreased by less than 10%

$\{k = 6 : R_{t+1} \in [-0.10, -0.25]\}$-... will have decreased by 10 to 25%

$\{k = 7 : R_{t+1} \in (-0.25, -R^i_{min}]\}$-... will have decreased by more than 25%

C7b. 'If you expect the stock market to increase within the next 5 years, which is the highest possible increase (as a percentage)?' (R^i_{max})

C8b. 'In your opinion, if you expect the stock market to decrease within the next 5 years, which is the lowest possible decrease (as a percentage)?' (R^i_{min})

How do We do It (II)
Probabilistic Questions about Expected (and Past) Stock Market Performance (over the past) 5 years ahead:

$I_t \equiv$ Value of the CAC-40 Index by the time of the survey (March 2007, approx.)

$I_{t+5} \equiv$ Value of the CAC-40 Index 5 years ahead of the time of the survey (March 2012, approx.)

We are inquiring about the subjective likelihood $(p_{t+1,k}^i)$ of different ranges (k) for the index percentage change $(R_{t+1}(5) \equiv \frac{I_{t+5}}{I_t} - 1)$,
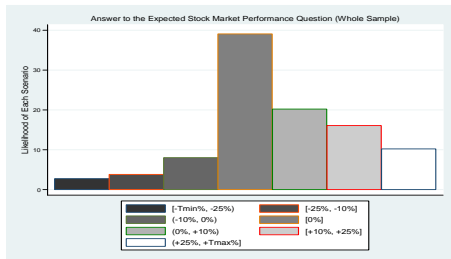
$$\forall i : p_{t+1,k}^i \equiv \Pr{}^i \left[R_{t+1} \in k \right] = \Pr{}^i \left[\frac{I_{t+5}}{I_t} - 1 \in k \right]$$

Similarly, if $I_{t-5} \equiv$ Value of the CAC-40 Index 5 years prior to the time of the survey (March 2002, approx.),
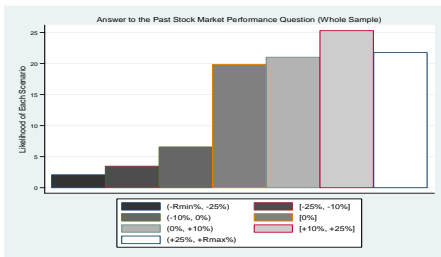
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How do They answer (I)
Average Expected (Past) Stock Market Performance (over the past) 5 years ahead:

Histogram of average individual answers to the likelihood of the different scenarios regarding 5-year ahead stock market performance. Source: TNS 2007.

Histogram of average individual answers to the relative likelihood of the different scenarios regarding the stock market performance over the last 5 years. Source: TNS 2007.

- Pessimistic regarding the future, but on average well informed regarding the recent past

How do They answer (II)
Descriptive Statistics: Probabilistic Questions about Stock Market Performance

Descriptive Statistics

Variable	No. Obs.	Mean	Std. Dev.	Min	Max
Expected Return (ER)	2460	0.055311	0.112602	-0.625	1.125
Std. Dev. of ER	2460	0.068028	0.07347	0	0.43056
Past ER (pER)	2231	0.11938	0.139876	-0.375	0.375
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2. They tend to be more pessimistic about the mean stock market performance 5 years ahead, and
3. The average standard deviation for the 5 years ahead seems too low, but larger than that for the last 5 years

1. Different Horizon (5 versus 1 year ahead) intended to reduce the sensibility of answers to: (i) *Bussiness cycle* conditions by the time of the survey (capture better historic trend in returns), and to (ii) *Inertia* in portfolio management (with *which* horizon do households invest in equity?): Less 50-50 type of answers.

2. Different Elicitation Methodology: we elicit *pdf*s. (à la Guiso *et al.*, 1996) as opposed to *cdf*s. (à la Dominitz and Manski, 2007): Less above 100 points, less 50-50 type of answers.

3. Representative sample by age: [Why is it that the young do not invest in stocks?]

4. Representative sample by wealth: [Why is it that the rich do not invest in stocks?]

5. We *elicit individual information about past stock performance probabilistically* (Stock Market Performance over the last 5 years) to capture: (i) Differences in information across households, and (ii) The relationship between information and expectations.

Stock Market Participation and Conditional Shares (TNS-2007) by Age (Gender)
Main Facts
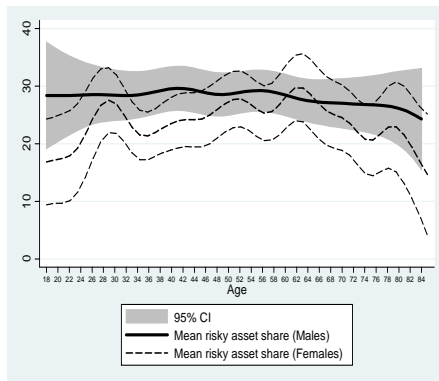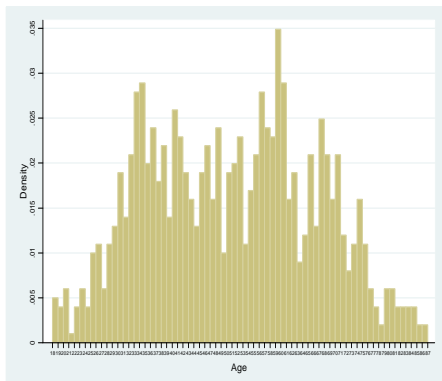
- The age-participation portfolio profile is hump-shaped, with no clear pattern at the intensive margin

Mean Expectations and Information by Age
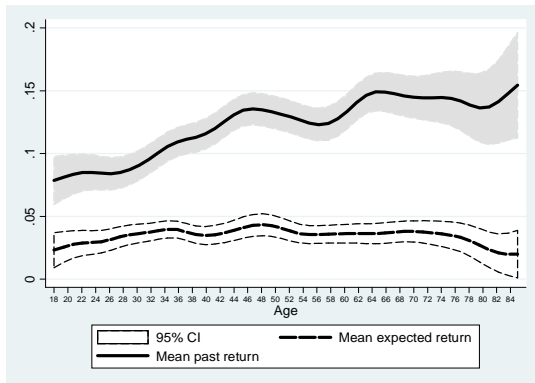
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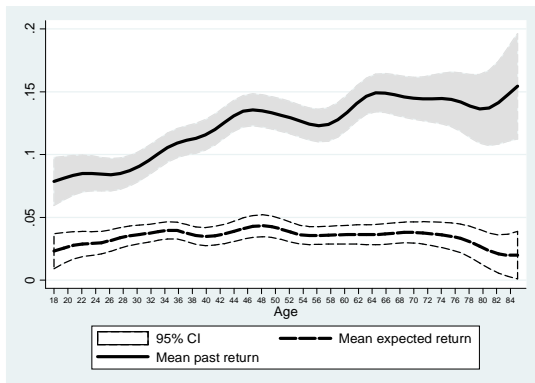
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- The young appear worse informed than the elderly [King and Leape (1987), Hurd (2009)] (against financial literacy fidings)...
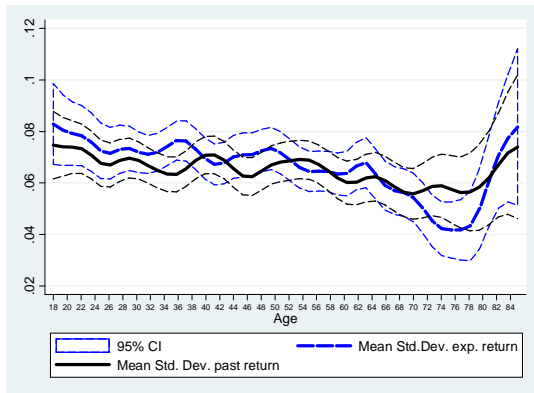
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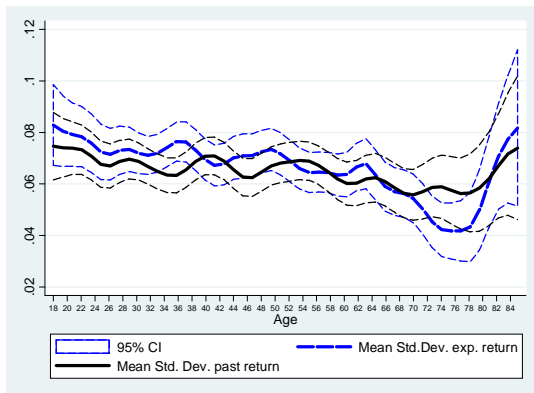
- There is (mildly) more uncertainty regarding the future than the past,
- And both follow a U-pattern with age (consistent with financial literacy)...

Mean Expectations and Information by Wealth

- The wealthier are better informed regarding the past, and more optimistic regarding the future

- The wealthier are less uncertain about the recent past, and mildly so regarding the future

$\widetilde{R}_{t+1}^i(5) \equiv \frac{\widetilde{I}_{t+5}}{I_t} - 1$ denotes household i's perception of the 5-year-ahead Stock Market return:

$$\left. \begin{array}{c} \ln \underbrace{\frac{I_{t+5}}{I_t}}_{\equiv 1+R_{t+1}(5)} = 5\mu^i + \sum_{f=1}^5 \eta_{t+f}^i \\ \eta_{t+f}^i \sim i.i.d.\,N(0, \sigma_i^2) \\ p_{t+1,k}^{*i} = \Pr(r_{t+1}^i > \ln(1+R_k) \,|\, \mu^i) = \Phi\left(\frac{5\mu^i - \ln(1+R_k)}{\sqrt{5}\sigma_i}\right) \\ R_k = \{-R_{\min}^i, -0.25, -0.1, 0, 0.1, 0.25, R_{\max}^i\} \end{array} \right\} \xrightarrow{\text{CRRA}}$$

Econometric Specification

- Assumptions: (i) $u_p \sim N(0,1)$ (Probit), (ii) $E(u_s | u_p) = \eta u_p$ (Linearity),

$$\underset{\text{CRRA}}{\Longrightarrow} \begin{cases} Stocks = & 1\{\beta_{p\mu}\mu_{t+1} + \beta_{p\sigma}\sigma_{t+1} + \beta'_p \mathbf{x} + u_p > 0\} \\ \frac{Stocks}{F} = & \beta_{s\mu}\mu_{t+1} + \beta_{s\sigma}\sigma_{t+1} + \beta'_s \mathbf{x}_1 + u_s \\ IV & \begin{cases} \mu_{t+1} = & \beta'_\mu \mathbf{x} + \delta'_\mu \mathbf{z} + u_\mu \\ \sigma_{t+1} = & \beta'_\sigma \mathbf{x} + \delta'_\sigma \mathbf{z} + u_\sigma \end{cases} \end{cases}$$

$$\mathbf{x}_1 = \{\text{CARA,Temp. Pref.; Total Wealth, Income; Education, Age; Liq. Constr.}\}$$
$$\mathbf{x} = \{\mathbf{x}_1; \text{ Shares in Remuneration, Transfers, Parents' own stocks}\}$$
$$\mathbf{z} = \{\underbrace{\mu_t, \sigma_t}_{\text{Information}}; \underbrace{\text{qc3}}_{\text{'Unconstrained'}}\}$$

IV Heckman (Information affects Stock Ownership ONLY through Expectations)

- Genotte's (1986, JF) **Separation Theorem**: [Optimal Portfolio Choice under Incomplete Information]

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  - Exclusion restriction 1: Information (μ_t, σ_t) does not determine stockownership directly, only through expectations $(\mu_{t+1}, \sigma_{t+1})$
  - Exclusion restriction 2: Inertia determines stockownership, but not the proportion of financial wealth invested in stocks (conditional demands)

Table 1: The demand for risky assets

Variable	Heckman (w/o Expectations) select (1)	alpha (2)	Heckman select (3)	alpha (4)	IV Heckman (Jacknife s.e.) select (5)	alpha (6)
Expected Return (ER)			1.105***	12.20		
IV-ER					2.712***	48.31**
Std.Dev. ER			1.292***	-33.40***		
IV-Std.Dev. ER					0.783	-52.78***
CARA	-0.0122	-0.415**	-0.00796	-0.420**	-0.00380	-0.313
Temporal preference	0.0554***	-1.240***	0.0543***	-1.215***	0.0549***	-1.243***
Income	20.47***	-21.17	18.78***	-28.75	15.79***	-113.2
Income Sq.	-137.5***	233.9	-122.6**	284.1	-100.7*	1,045
Total wealth	0.834***	1.144	0.798***	1.065	0.791***	0.955
Total wealth Sq.	-0.0355***	-0.0352	-0.0337***	-0.0342	-0.0330	-0.0255
Age	0.192*	4.246	0.169	4.192	0.161	4.407
Age Sq.	-0.0126	-0.404	-0.00970	-0.412	-0.00907	-0.441
Transfers	0.197***		0.195***		0.186***	
High school	0.428***	5.048	0.442***	5.213	0.484***	5.340
Tech./Prof.	0.210	4.234	0.216	4.162	0.262*	4.209
Some college (or+)	0.215	4.463	0.204	4.530	0.229	4.255
Paris	0.0934		0.0673		0.0823	
Parents own stocks	0.433***		0.418***		0.415***	
Firm shares remuneration	0.529***		0.533***		0.531***	
Liquidity constrained	-0.727***		-0.677***		-0.695**	
N	2,636	2,636	2,636	2,636	2,636	2,636
Chi2	3.664	3.664	2.649	2.649	1.247	1.247
Chi2 P-value	0.0556	0.0556	0.104	0.104	0.264	0.264
Log-likelihood	-6696	-6696	-6668	-6668	-6670	-6670

Note: The reference category for education is "less than High School". *** p<0.01, ** p<0.05, * p<0.1. TNS 2007.

Results (I)
Quantitatively important

- A 10 pp. increase in μ_{t+1} (from 5.3% to 15.3%; N.B. over a 5-year horizon, is approx. an average increase of 2% per year):
    1. Increases the ownership rate by 11 pp. ($\frac{.52-.41}{.41} = 26.8\%$) and,
    2. Increases the share invested in risky assets by 4.8 pp. ($\frac{.314-.266}{.266} = 18.1\%$).

- A 10pp. increase in σ_{t+1} :
    1. Does not determine stock ownership, and
    2. Reduces the share invested in risky assets by 5.3 pp. ($\frac{.213-.266}{.266} = -19.9\%$)

- The effects are conditional on demographic, (time and risk) preference, income and wealth controls, as well as on inertial/informational factors; and conform with elementary portfolio choice theory predictions (Arrow, 1965; Merton, 1969; Samuelson, 1969)

Which instruments work? Individual information on past returns (μ_t, σ_t), "being unconstrained" (qc3)

$$\mathbf{z}_\mu = \left\{ \underset{(+)\ (0)\ (+)}{\mu_t, \sigma_t; \text{qc3}} \right\}; \mathbf{z}_\sigma = \left\{ \underset{(+)}{\sigma_t} \right\}$$

Endogeneity: t-test (and F-test of the joint significance of $\widehat{u}_\sigma$ and) $\widehat{u}_\mu$ in the Heckman specification:

$$\underbrace{t = -2.36}_{(P-value=0.018)} ; \underbrace{\chi_2^2(2,039) = 6.75}_{(P-value=0.0342)} \implies \text{Exogeneity}$$

$$\underbrace{}_{\text{Participation } (\mu)} \underbrace{}_{\text{Conditional Demand } (\mu, \sigma)}$$

Test of Overidentifying Restrictions
($nR^2 \sim \chi_q^2 : q = No.\text{Instruments} - No.\text{Endogenous Var.}$):

$$n\overline{R}^2 = 1.425088 \sim \chi_1^2(919), P-value = 0.233 \implies \text{Valid Instruments}$$

What Determines Information
Determinants of information variables (see Appendix 3)

What determines the information proxies?

1. μ_t determined by gender, education, age, income, 'being unconstrained' (qc3), CARA;

2. σ_t explained by qi3 (self-confidence), qi28a_5 (friends' advice), qi29_6 (frequency and access to financial media)

	IV Heckman (Jacknife s.e.)		IV Heckman Median Wealth+		IV Heckman Median Wealth-	
	select	alpha	select	alpha	select	alpha
Variables	(1)	(2)	(5)	(6)	(9)	(10)
IV-ER	2.833***	49.57**	3.267***	55.75**	2.255**	35.55
IV-Std.Dev. ER	0.569	-49.33***	0.491	-25.06	0.729	-89.46***
CARA	-0.00449	-0.306	-0.00686	-0.216	-0.000377	-0.565
Temporal preference	0.0579***	-1.258***	0.0716***	-0.873	0.0386**	-1.589***
Income	15.15***	-107.2	7.501	-34.68	16.86*	-257.9
Income Sq.	-95.83*	992.8	-42.64	535.9	30.64	1,205
Total wealth	0.794***	0.996	0.518***	0.459	4.228	-73.36***
Total wealth Sq.	-0.0332	-0.0256	-0.0204**		-9.165	
Age	0.192*	4.351	0.511***	4.694	-0.157	8.893**
Age Sq.	-0.0105	-0.447	-0.0395**	-0.421	0.0215	-0.984**
Transfers	0.183***		0.201***		0.140*	
High school	0.498***	5.355	0.576**	7.920	0.412*	0.232
Tech./Prof.	0.271**	4.275	0.316	5.000	0.190	2.231
Some college (or+)	0.225	4.443	0.268	6.341	0.158	-0.922
Paris	0.0750		0.0250		0.152	
Parents own stocks	0.408***		0.367***		0.455***	
Firm shares in remuneration	0.535***		0.567***		0.516***	
If children>0	-0.0499		-0.214**		0.0357	
Liquidity Constrained	-0.701**		-0.335		-0.894**	
Trust	0.169***	-1.146	0.153*	-1.995	0.165*	0.566
N	2,636	2,636	1,318	1,318	1,318	1,318
Chi2	1.229	1.229	0.0577	0.0577	4.385	4.385
Chi2 P-value	0.268	0.268	0.810	0.810	0.0363	0.0363
Log-likelihood	-6671	-6671	-4047	-4047	-2597	-2597

Note: *** p<0.01, ** p<0.05, * p<0.1. The reference category for education is "less than High School". TNS 2007.

Variable	IV Heckman (Jacknife s.e.)		IV Heckman Non-traders only		IV Heckman Financial Advisor		IV Heckman Self-Management	
	select (5)	alpha (6)	select (7)	alpha (8)	select (9)	alpha (10)	select (11)	alpha (12)
IV-ER	2.712***	48.31**	-0.0914	17.23	2.526*	-11.36	3.933***	87.75***
IV-Std.Dev. ER	0.783	-52.78***	0.763	-44.56*	0.754	-39.83	-0.182	-30.08
CARA	-0.00380	-0.313	-0.00443	0.0597	0.0106	-0.580*	-0.0103	-0.188
Temporal preference	0.0549***	-1.243***	0.0463***	-0.578	0.0552**	-1.107**	0.0520**	-1.578**
Income	15.79***	-113.2	19.10**	-214.4	16.89**	87.08	18.15*	-69.90
Income Sq.	-100.7*	1,045	-276.9*	2,073	-88.03	-172.7	-150.0	623.2
Total wealth	0.791***	0.955	1.513***	-8.264	0.565**	-2.551	0.933	5.993
Total wealth Sq.	-0.0330	-0.0255	-0.583**	7.705	-0.0282	0.223	-0.0384	-0.228
Age	0.161	4.407	0.121	6.967*	0.309	5.246	0.255	2.808
Age Sq.	-0.00907	-0.441	-0.00784	-0.681*	-0.0211	-0.693	-0.0199	-0.0905
Transfers	0.186***		0.189***		0.176**		0.100	
High school	0.484***	5.340	0.512**	0.174	0.323	7.569	0.384	0.0120
Tech./Prof.	0.262*	4.209	0.262	3.794	0.0854	-3.334	0.0824	5.702
Some college (or+)	0.229	4.255	0.264	3.074	0.164	-0.694	0.0105	2.137
Paris	0.0823		0.0443		0.170		-0.147	
Parents own stocks	0.415***		0.229***		0.434***		0.463***	
Firm shares remuneration	0.531***		0.579***		0.547**		0.711***	
If children>0	-0.0340		0.0407		0.103		-0.0705	
Liquidity constrained	-0.695**		-0.506*		-0.270		-0.683	
N	2,636	2,636	1,860	1,860	811	811	1,257	1,257
Chi2	1.247	1.247	2.764	2.764	1.165	1.165	0.00472	0.00472
Chi2 P-value	0.264	0.264	0.0964	0.0964	0.280	0.280	0.945	0.945
Log-likelihood	-6670	-6670	-3012	-3012	-2608	-2608	-3223	-3223

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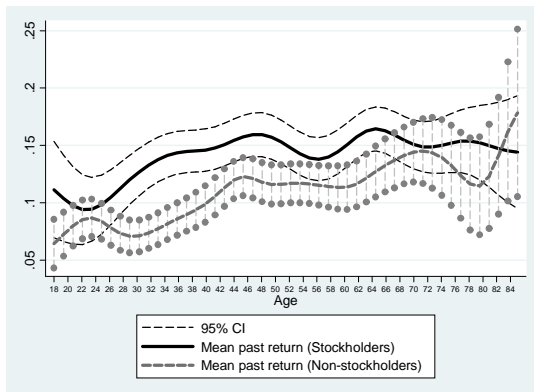
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  - ... but *Inertia*: no panel dimension available...
- Quantitatively determine conditional asset demands (beyond Hurd *et al.*,2011; Kézdi and Willis, 2011), confirming elementary theory.

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  - [So far the median coefficient of relative risk aversion is around 80... for 561 observations!]

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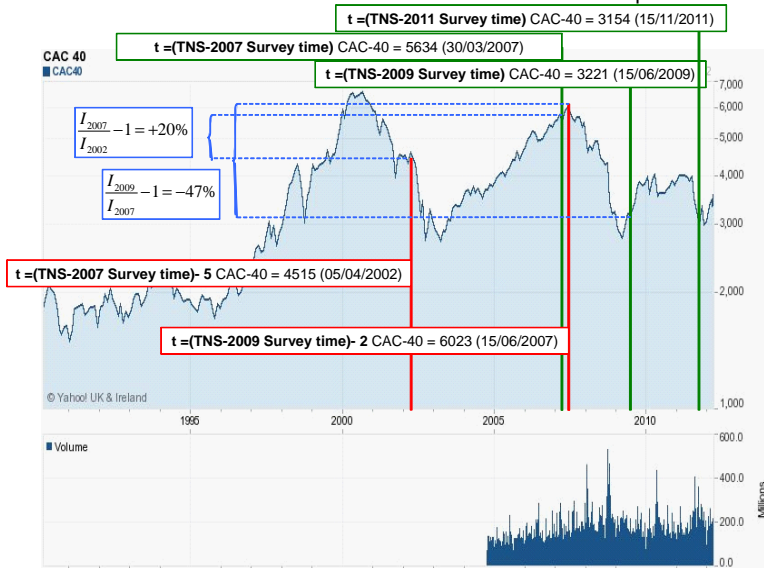
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    3. Does it aggregate up? i.e. Is the sum of individual behaviours in financial markets consistent with strategic substitutes/complements? [e.g. Allen, Morris and Shin (2006)]

French Stock Market Index CAC-40 between Mar1980 and Apr2012

t =(TNS-2011 Survey time) CAC-40 = 3154 (15/11/2011)

t =(TNS-2007 Survey time) CAC-40 = 5634 (30/03/2007)

t =(TNS-2009 Survey time) CAC-40 = 3221 (15/06/2009)

CAC 40
■ CAC40

$$\frac{I_{2007}}{I_{2002}} - 1 = +20\%$$

$$\frac{I_{2009}}{I_{2007}} - 1 = -47\%$$

t =(TNS-2007 Survey time)- 5 CAC-40 = 4515 (05/04/2002)

t =(TNS-2009 Survey time)- 2 CAC-40 = 6023 (15/06/2007)

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7,000
6,000
5,000
4,000
3,000
2,000
1,000

1995   2000   2005   2010

600.0

■ Volume

400.0

Millions

200.0

0.0

Appendix 1: (Adaptive Learning) Rational Expectations

Density of nominal yearly (and 5-year rolling) log returns on the CAC-40 computed from monthly data between July 1987 and July 2011:
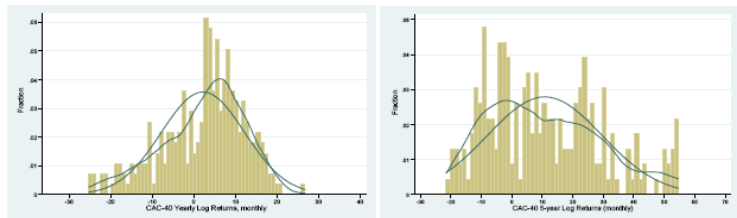
Panel (a): 1-year log-returns.   Panel (b): 5-year log-returns.

Figure: Histogram of CAC-40 index log-returns, computed at 1-year (panel a) and 5-year (panel b) rolling window frequencies. Source: Author's own calculations using monthly data between July 1987 and July 2011, available online from MSN Money.

- Moments for (1-year) 5-year log returns ($\mu = 0.023$) $\mu(5) = 0.108$ and ($\sigma = 0.10$) $\sigma(5) = 0.19$.

Wording: 'If someone suggests that you invest in a security $(\widetilde{S}_i)$ promising one chance out of two to earn 5000 euros and one chance out of two of losing the capital invested, how much (as a maximum) are you willing to invest?'.

$$
\begin{aligned}
u^i(w_i) &= \frac{1}{2}u^i(w_i + 5{,}000) + \frac{1}{2}u^i(w_i - Z_i) = Eu^i(w_i + \widetilde{S}_i) \\
A_i(w_i) &= 2\frac{5000 - Z_i}{5000^2 + Z_i^2}
\end{aligned}
$$

A_i is the absolute risk aversion coefficient (CARA)

Z_i is the amount that the individual declares to be willing to invest.

Risk-averse: $Z_i < 5000$, risk-neutral: $Z_i = 5000$, risk-lovers: $Z_i > 5000$.

Range: $[0, 40]$; Histogram very skewed to the left.

For those who answered it (If CARA>0: 3,343 respondents), mean $=$ 39.11

Table 0: TNS 2007 Descriptive Statistics

Variable	Whole sample Mean	Whole sample Sd	Selected sample Mean	Selected sample Sd
Stockownership (qc14>0)	0.2888	0.4533	0.4181	0.4933
% in shares (if qc14>0)	26.57	25.15	26.63	25.16
Expected Return (ER)	0.05531	0.1126	0.0591	0.1089
(IV) ER	0.0474	0.04134	0.05313	0.04401
Sd. ER	0.06803	0.07347	0.06971	0.07278
(IV) Sd. ER	0.06487	0.03442	0.06719	0.0372
If ER>0	0.643	0.4792	0.7735	0.4186
CARA	34.17	13.42	37.44	8.503
If CARA>0	0.8738	0.3322	0.9594	0.1974
Temporal Preference	6.607	2.514	6.741	2.335
Income (in mill. EUR)	0.01752	0.01205	0.01931	0.01275
Total Wealth (in mill. EUR)	0.1989	0.53	0.2285	0.608
Age	48.28	16.82	46.89	15.95
Intergenerational transfers	0.472	0.5988	0.4928	0.6076
Education				
Less than high school	8.1%		5.0%	
High school	6.7%		5.3%	
Technical/Professional	62.2%		62.7%	
Some college or more	23.0%		27.1%	
Paris	0.1691	0.3749	0.1821	0.386
Parents own stocks	0.2603	0.4389	0.3092	0.4622
Firm shares in remuneration	0.04731	0.2123	0.0569	0.2317
If children>0	0.747	0.4348	0.7344	0.4417
Liquidity constrained	0.02248	0.1483	0.01593	0.1252
Trust	5.629	2.543	5.573	2.446
Financial advisor (yes)	0.241	0.4277	0.3077	0.4616
N	**3826**		**2636**	