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MEASURES OF INDIVIDUAL
RISK ATTITUDES AND
PORTFOLIO CHOICE :
EVIDENCE FROM PENSION
PARTICIPANTS

ADVANCES IN BEHAVIORAL FINANCE Annual Conference
of the Center for Economics and Econometrics (CEE)

Motivation

- Individual liabilities for the management of retirement savings (allocations to pension funds) have been increasing.
- This is mainly due to establishment of **defined contribution systems** where participants make active investment decisions (the alternative is **defined benefit system**)
- It is crucial to understand the main factors determining the financial decisions of individuals regarding their retirement savings.

Pension Funds in Turkey

- Private pension system in Turkey has been established in 2001 and the majority of the participants have individual contracts.
- **Private pension funds assets to GDP ratio** is around 5%, which is significantly lower than the OECD average 84.2 % as of 2014.
- Elapsed time for pension fund contracts are usually **less than 5 years** and average contribution of investors in the system is **230 TL** as of 2014.

Pension Funds in Turkey

Participants can:

- modify the amount of contribution and payment period during the course of the contract.
- switch between pension fund companies after a period of two years.
- change the allocation of funds in the contract at most 6 times in a year.
- hold more than one contract (no limit on the total number) and all contracts must be consolidated in retirement.

Descriptive Statistics – Turkish Pension Fund System

Table 1: Summary Statistics on the Turkish Pension Fund System

Gender	%
Women	39.6
Men	60.4
Age Distribution	%
Under 25 years old	6.32
25-34 years old	34.81
35-44 years old	33.91
45-55 years old	19.79
over 56 years old	5.16
Allocation in Stocks	%
2008	9.1
2009	7.8
2010	11.3
2011	13.4
2012	16.2
2013	15.3
2014	14.1
Amount of Funds	Average 5880 TL
Contribution (Month)	230 TL

Our Study



- We study the relationship between survey-based and experimental measures of risk attitudes and the amount of their retirement savings invested in equities.
- Participants are employees in a large group of companies involving a private pension branch.
- Participants completed an experimental task and an online survey.
- The experiment involved (potentially) real rewards.

Literature Review

- Determinants of asset allocation decisions in retirement savings:
 - Agnew et.al (2003) Ameriks and Zeldes (2004 (2001), Huberman and Jiang (2006), Iyengar and Kamenica (2010)
- The validity of survey and experimental measures in predicting actual decisions:
 - Barsky et. al (1997), Dohmen et. al. (2011), Nosis and Weber (2010), Nousair et.al. (2014), Dimmock and Kouwenberg (2010), Dimmock et.al. (2014)

Our Contribution



- Compare a larger set of risk attitude measures
- Applies the methodology to a different set of individuals, i.e. pension participants with potentially different characteristics
- Track individual choices over time to control for the effects of market conditions



Design

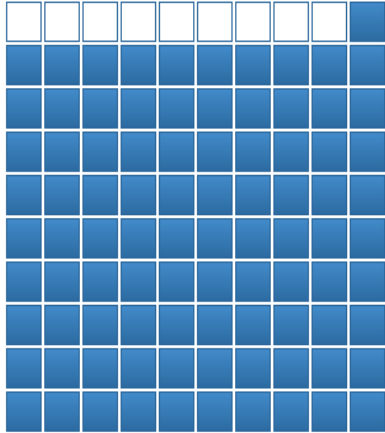
Attitudes towards Risk

- The design yields 4 separate measures of risk attitude.
 - ▣ **Self Reported Risk Attitude:** *How willing are you to take risks, in general?* (Scale 0-10, from German SOEP)
 - ▣ **Hypothetical Lottery:** *Suppose that you inherited 100.000 TL from a distant relative. There's an investment option. In two years, the invested amount will double with 50% probability and will shrink to half with 50% probability. How much of the inherited amount would you invest? (The possible choices were 0, 20000, 40000, 60000, 80000 and 100000)*

Attitudes towards Risk

Deneme Oyunu

Deneme Oyunu



Para (TL)	90
Toplanan Kutu	9
Kalan Kutu	91

Bitir

- **BRET** - Bomb Risk Elicitation Task (Crosetto & Flippin (2013))

Attitudes towards Risk

- 24 survey items related to risk-taking behavior in 5 domains (ethical, financial, health/safety, recreational, social).
- The items used in our study were adopted from the Revised and Improved 30-Item Domain-Specific Risk-Taking (**DOSPERT**) Scale (Blais & Weber, 2006) - Examples:
 - ▣ I can try skydiving.
 - ▣ I will invest 5% of my wealth to a speculative stock.

Data from Retirement Savings

- Non-financial info (age, gender marital status, number of children, education etc.)
- Allocations and transactions for each separate contract (individuals can have multiple contracts)
 - For each contract, individuals allocate contributions to available funds (around 20).
 - **Average annual equity share** (fraction invested in stocks) is calculated by consolidating all contracts.
- 1702 participants in the online study. 1349 made some retirement investment during 2008-2014.



Results



Descriptive Statistics

Table 2: Descriptive Statistics on Demographics and Risk Attitudes

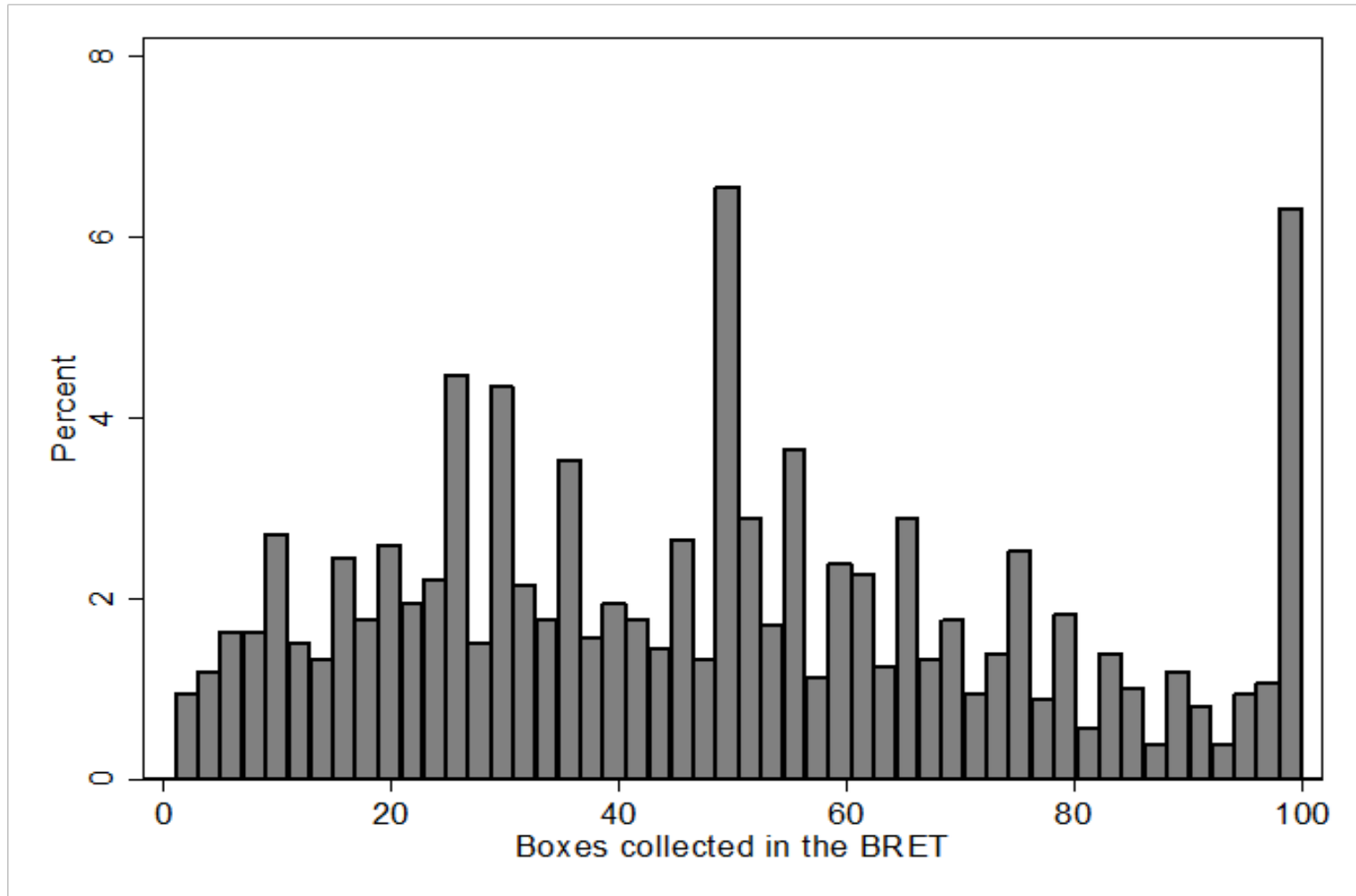
	Obs.	Percent	Mean	Std. Dev.	Min	Max
Male	1585	39				
Age (as of January 1, 2014)	1583		32.53	6.51	20	64
Married	1585	66				
Boxed collected in the BRET	1585		47.90	27.05	1	100
Self-reported willingness to take risks	1585		6.02	2.24	0	10
Investment in the hypothetical Lottery	1585		50.41	22.91	0	100
DOSPERT (F)	1585		12.56	4.33	5	25
Average Monthly Contribution in 2014 (TL)	625		383.36	347.38	11.73	2284.63

Correlations between Risk Attitudes

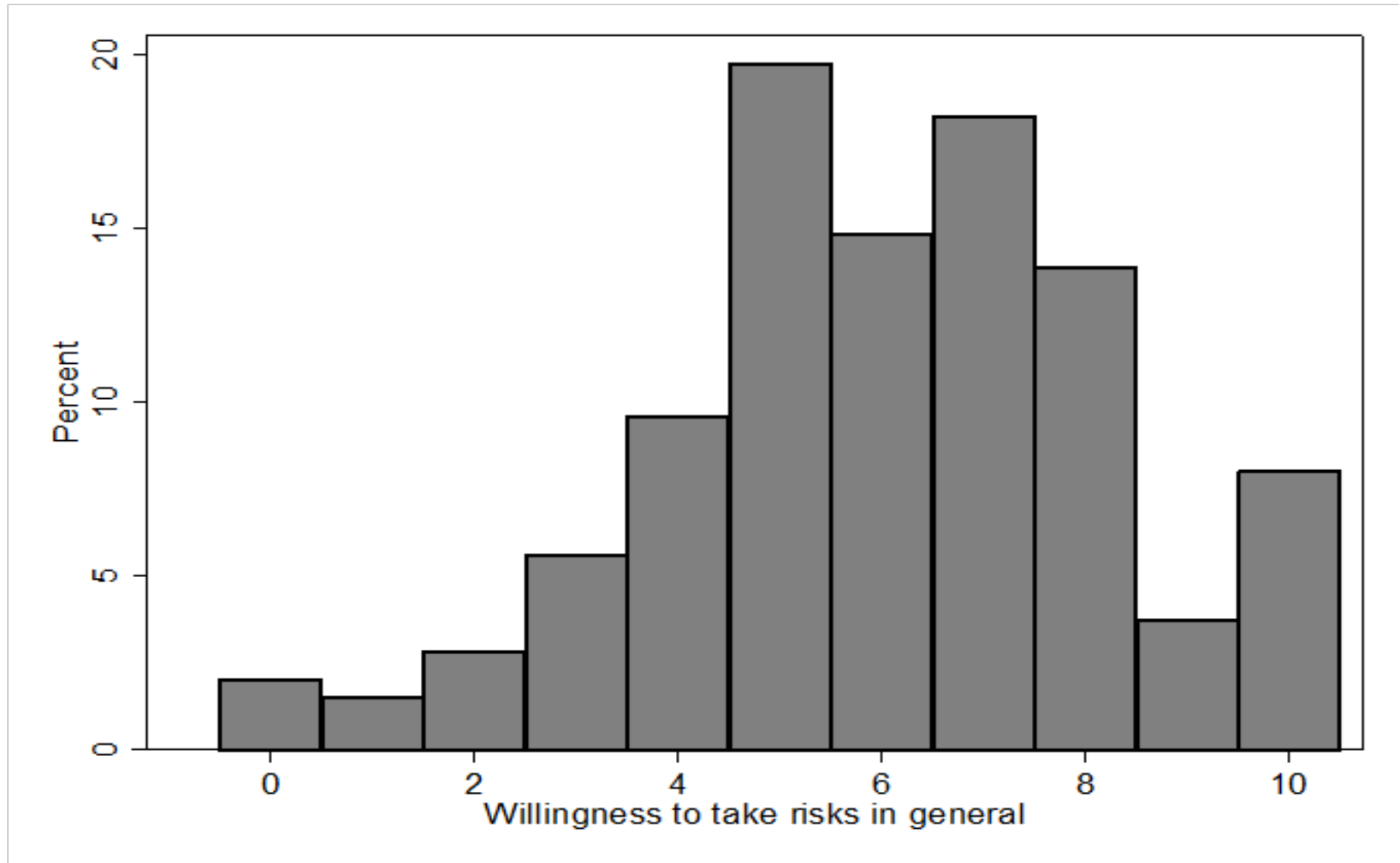
Table 3: Spearman Correlation Matrix

	r_{bret}	r_{soep}	$r_{lottery}$	$r_{dospert}$
r_{bret}	1			
r_{soep}	0.33	1		
$r_{lottery}$	0.2	0.51	1	
$r_{dospert}$	0.15	0.36	0.28	1

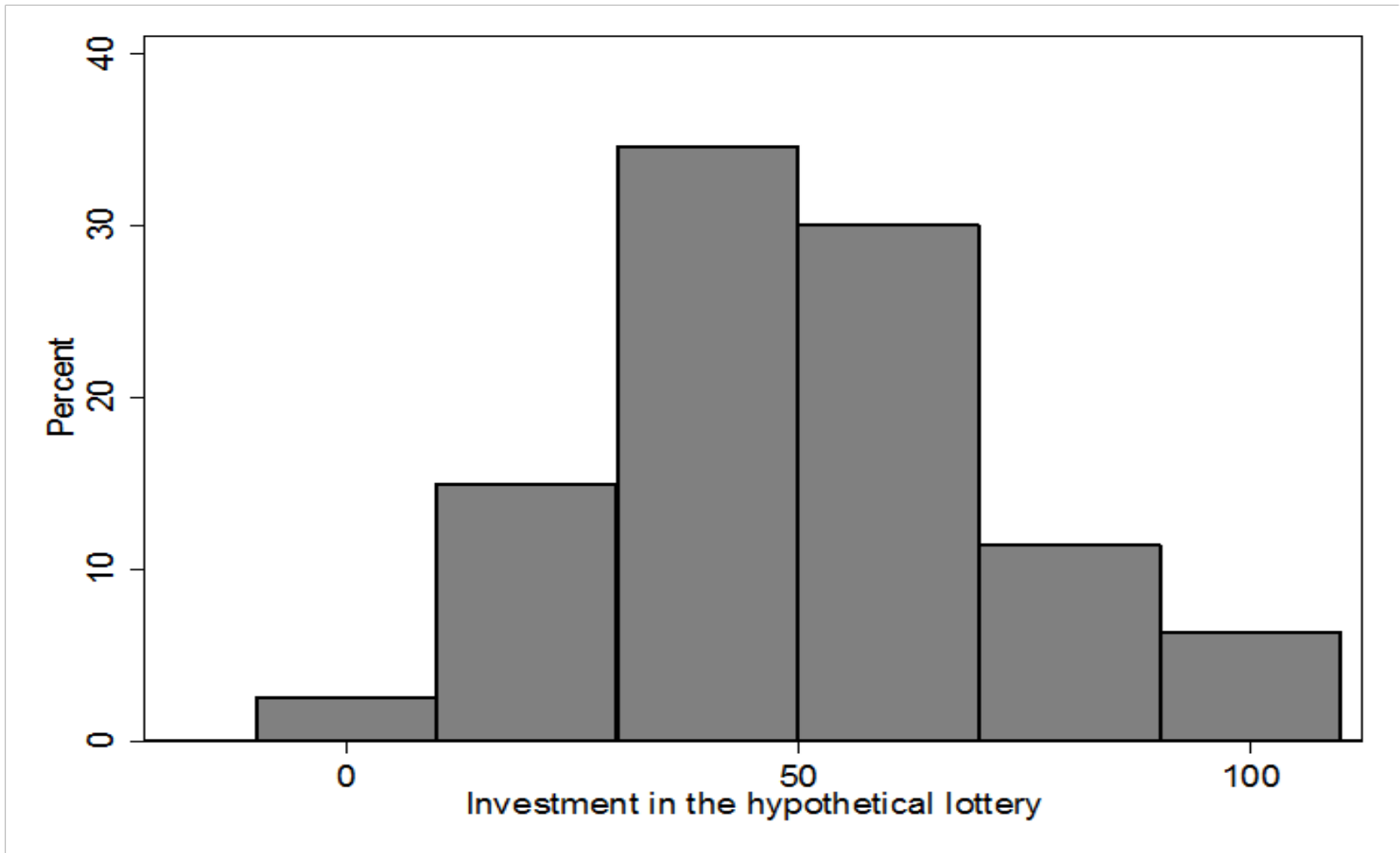
Boxes Collected in BRET



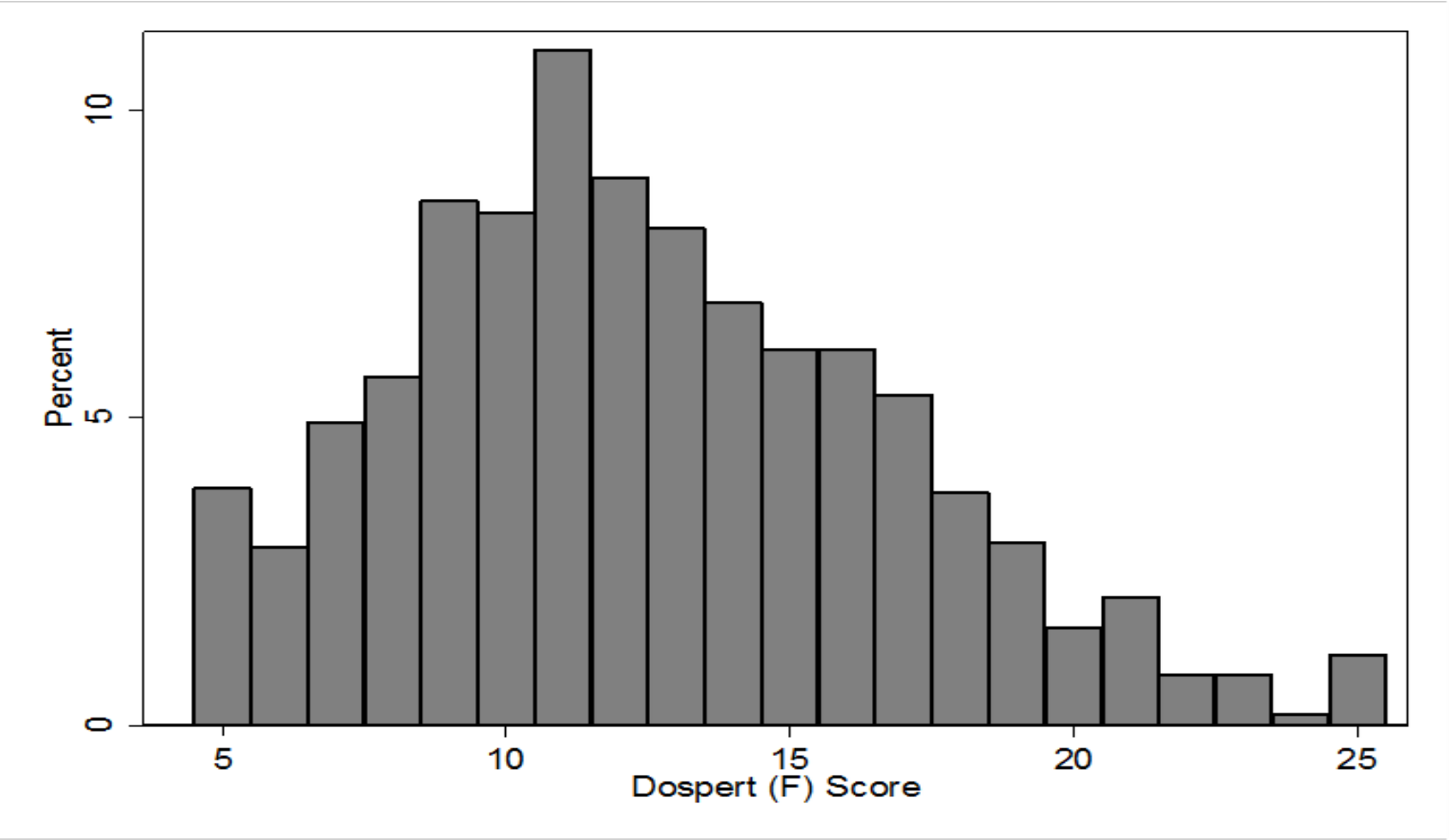
Self Reported Risk Attitude



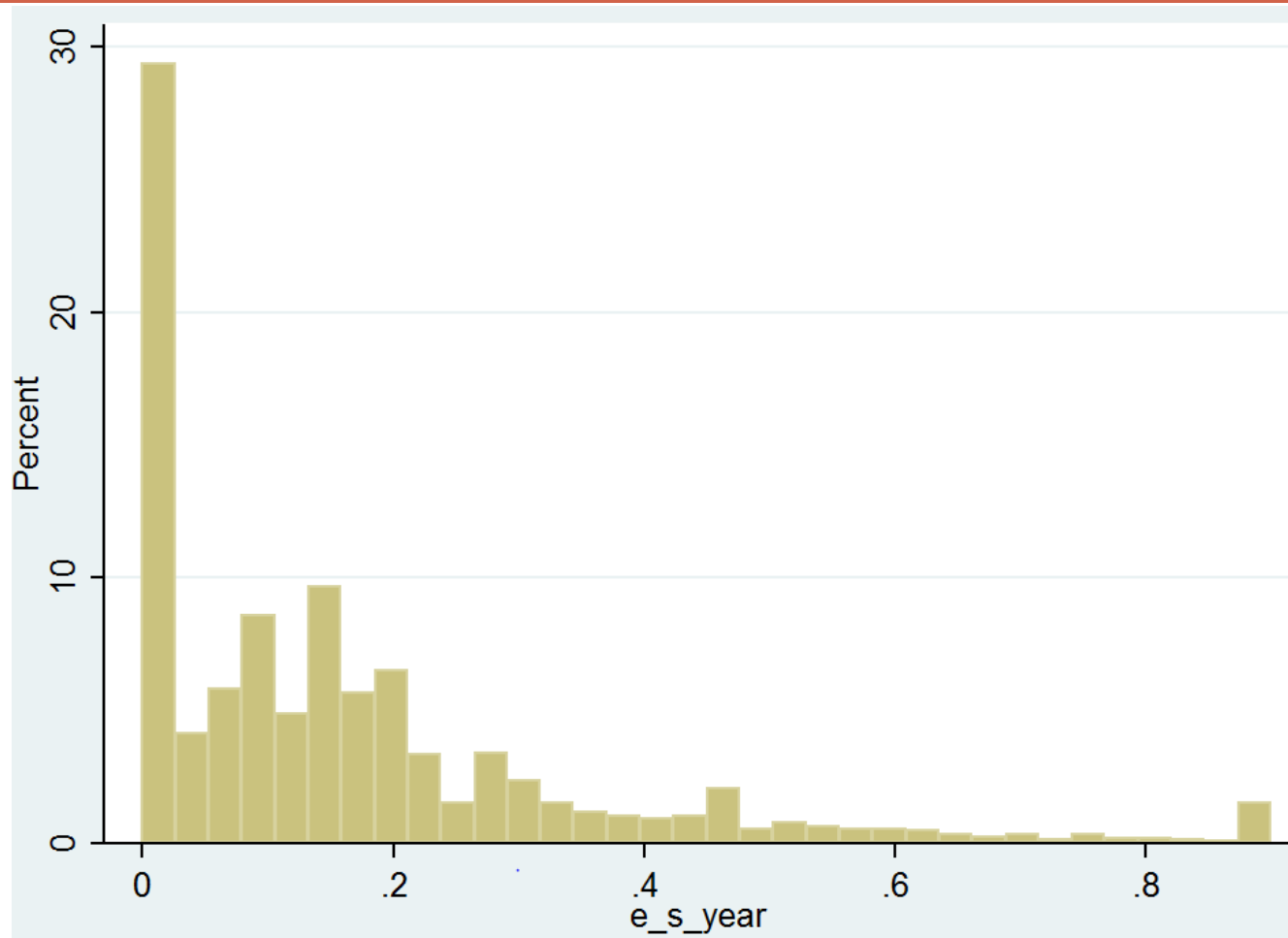
Investment in the Hypothetical Lottery



Score in the Financial Subscale of DOSPERT



Equity Allocations



Equity Allocations

Table 4: Average Annual Equity Allocations

	Observations	Mean	Std. Dev.
Overall	3571	0.164	0.188
Year			
2008	376	0.125	0.132
2009	415	0.088	0.124
2010	450	0.121	0.139
2011	501	0.206	0.201
2012	579	0.191	0.208
2013	625	0.188	0.186
2014	625	0.179	0.194
Gender			
Women	2095	0.142	0.157
Men	1476	0.192	0.207
Marital Status			
Married	2781	0.162	0.183
Single	790	0.167	0.174
Age			
Under 25	48	0.151	0.154
25-34	1523	0.177	0.198
35-44	1692	0.152	0.162
45-55	300	0.158	0.195
56 or older	8	0	0

Equity Allocations

- Gender and age have expected effects.
- Market fluctuations have a significant effect equity shares.
- Equity shares are very low compared to developed countries (average is 40% in Agnew et al., 2003)
- Around 1/3 of the annual averages are 0% , there is almost nobody at 100% (these fractions are 47% vs. 21% in Agnew et al., 2003)



Empirical Strategy



Regressions



- First, we jointly modeled the participation decision and the equity share in new contributions using a Tobit regression, as in Agnew et al. (2003)
- Then we decomposed these decisions by estimating a two part model to model differential impacts of risk attitude measures.
- Two part model provides a better representation of the data generating process.

Variable Definitions

Variable	Description
<i>average annual equity share</i>	Annual averages of monthly equity allocations in year t .
<i>equity ownership</i>	Indicator variable that equals one if average annual equity share is greater than 0 in year t , zero otherwise.
<i>r_{bret}</i>	Boxes collected in the Bomb Risk Elicitation Task (BRET); range is 0-100.
<i>r_{soep}</i>	Self-reported willingness to take risks, range is 0-10.
<i>r_{lottery}</i>	The investment in the hypothetical lottery as percentage of the endowment; range is 0-100.
<i>r_{dospert}</i>	Score in the financial subscale of the Domain-Specific Risk-Taking (DOSPERT) scale; range is 5-25.
<i>Gender</i>	Indicator variable that equals one if the participant is male, zero if female.
<i>Age</i>	Age of the participant in the beginning of year t .
<i>Marital Status</i>	Indicator variable that equals one if the participant is married, zero if single.
<i>Log of contributions</i>	Logarithm of the average of the monthly contributions in year t .
<i>Year dummy (t)</i>	Indicator variable that equals one for year t , and zero otherwise.

Tobit Estimation

Table 6: Equity Allocation: Tobit Estimation Results

Dependent Variable: Average Annual Equity Share

	I	II	III	IV	V	VI
<i>r_{bret}</i>		0.000355 (0.000203)				-0.000195 (0.000216)
<i>r_{soep}</i>			0.0161*** (0.00239)			0.0144*** (0.00308)
<i>r_{lottery}</i>				0.000962*** (0.000245)		0.000274 (0.000280)
<i>r_{dospert}</i>					0.00442*** (0.00115)	0.00190 (0.00128)
marital status	0.00235 (0.0120)	0.00428 (0.0121)	0.00424 (0.0118)	0.00328 (0.0120)	0.00554 (0.0120)	0.00460 (0.0118)
age	-0.00313*** (0.000940)	-0.00317*** (0.000931)	-0.00303*** (0.000907)	-0.00318*** (0.000926)	-0.00310** (0.000941)	-0.00301** (0.000919)
gender	0.0392*** (0.0102)	0.0385*** (0.0102)	0.0236* (0.0101)	0.0340*** (0.00989)	0.0373*** (0.0101)	0.0234* (0.0101)
log of contributions	0.0335*** (0.00722)	0.0330*** (0.00719)	0.0354*** (0.00697)	0.0342*** (0.00708)	0.0315*** (0.00714)	0.0348*** (0.00702)
year dummy(2009)	-0.0597*** (0.00706)	-0.0593*** (0.00704)	-0.0606*** (0.00695)	-0.0611*** (0.00708)	-0.0594*** (0.00704)	-0.0610*** (0.00700)
year dummy(2010)	-0.0251** (0.00844)	-0.0249** (0.00841)	-0.0258** (0.00842)	-0.0264** (0.00842)	-0.0235** (0.00848)	-0.0255** (0.00850)
year dummy(2011)	0.0461*** (0.00951)	0.0465*** (0.00953)	0.0453*** (0.00950)	0.0451*** (0.00953)	0.0483*** (0.00957)	0.0458*** (0.00961)
year dummy(2012)	0.0338*** (0.00977)	0.0340*** (0.00976)	0.0314** (0.00968)	0.0321** (0.00976)	0.0356*** (0.00981)	0.0318** (0.00977)
year dummy(2013)	0.0262* (0.0106)	0.0267* (0.0106)	0.0215* (0.0105)	0.0244* (0.0106)	0.0285** (0.0106)	0.0222* (0.0106)
year dummy(2014)	0.0138 (0.0113)	0.0150 (0.0113)	0.0105 (0.0111)	0.0122 (0.0113)	0.0163 (0.0113)	0.0108 (0.0113)

Participation Decision

Dependent Variable: Equity Ownership (0=No Equity Investment, 1: Equity Investment > 0)

	I	II	III	IV	V	VI
<i>r_{bret}</i>		0.000590 (0.000545)				-0.0004 (0.0005)
<i>r_{soep}</i>			0.0285*** (0.00629)			0.0261* (0.0078)
<i>r_{lottery}</i>				0.00162** (0.000594)		0.00031 (0.0006)
<i>r_{dospert}</i>					0.00880** (0.00313)	0.00448 (0.0032)
marital status	0.0198 (0.0343)	0.0228 (0.0345)	0.0225 (0.0334)	0.0216 (0.0341)	0.0266 (0.0340)	0.0237 (0.0335)
age	-0.00644* (0.00253)	-0.00649** (0.00251)	-0.00615* (0.00249)	-0.00661** (0.00253)	-0.00641* (0.00253)	-0.0061 (0.0025)
gender	0.0112 (0.0267)	0.0100 (0.0267)	-0.0167 (0.0270)	0.00308 (0.0267)	0.00673 (0.0264)	-0.0172 (0.0271)
log of contributions	0.0920*** (0.0197)	0.0911*** (0.0197)	0.0952*** (0.0191)	0.0927*** (0.0195)	0.0872*** (0.0195)	0.0933* (0.0192)
year dummy(2009)	-0.176*** (0.0222)	-0.176*** (0.0223)	-0.177*** (0.0220)	-0.178*** (0.0223)	-0.176*** (0.0222)	-0.178* (0.0221)
year dummy(2010)	-0.115*** (0.0262)	-0.116*** (0.0261)	-0.117*** (0.0261)	-0.117*** (0.0263)	-0.113*** (0.0262)	-0.117* (0.0262)
year dummy(2011)	-0.0354 (0.0275)	-0.0354 (0.0275)	-0.0386 (0.0274)	-0.0374 (0.0276)	-0.0323 (0.0276)	-0.0373 (0.0275)
year dummy(2012)	-0.0433 (0.0276)	-0.0433 (0.0276)	-0.0475 (0.0273)	-0.0462 (0.0276)	-0.0402 (0.0276)	-0.0463 (0.0274)
year dummy(2013)	-0.0214 (0.0309)	-0.0211 (0.0309)	-0.0297 (0.0305)	-0.0244 (0.0309)	-0.0158 (0.0309)	-0.0270 (0.0307)
year dummy(2014)	-0.0667* (0.0322)	-0.0653* (0.0323)	-0.0733* (0.0315)	-0.0697* (0.0322)	-0.0613 (0.0322)	-0.0717 (0.0318)

Equity Holding Conditional on Participation

Table 8: Equity Allocation conditional on Equity Ownership: Truncated Regression Results

Dependent Variable: Average Annual Equity Share

	I	II	III	IV	V	VI
<i>r_{bret}</i>		0.000345 (0.000213)				-0.0001 (0.0002)
<i>r_{soep}</i>			0.0144*** (0.00264)			0.0124* (0.0034)
<i>r_{lottery}</i>				0.000856** (0.000267)		0.0002 (0.0003)
<i>r_{dospert}</i>					0.00353** (0.00121)	0.0012 (0.0013)
marital status	-0.00379 (0.0119)	-0.00172 (0.0120)	-0.00205 (0.0118)	-0.00320 (0.0118)	-0.00130 (0.0119)	-0.0017 (0.011)
age	-0.00225* (0.000954)	-0.00231* (0.000956)	-0.00227* (0.000903)	-0.00224* (0.000909)	-0.00222* (0.000946)	-0.0021 (0.0008)
gender	0.0574*** (0.0108)	0.0568*** (0.0107)	0.0432*** (0.0104)	0.0521*** (0.0101)	0.0561*** (0.0106)	0.0420* (0.010)
log of contributions	0.0169* (0.00755)	0.0164* (0.00750)	0.0186** (0.00717)	0.0177* (0.00725)	0.0154* (0.00746)	0.0175 (0.0070)
year dummy(2009)	-0.0274* (0.0125)	-0.0266* (0.0125)	-0.0286* (0.0120)	-0.0290* (0.0123)	-0.0269* (0.0124)	-0.0286 (0.011)
year dummy(2010)	0.0135 (0.0131)	0.0140 (0.0130)	0.0131 (0.0127)	0.0118 (0.0128)	0.0152 (0.0130)	0.0134 (0.012)
year dummy(2011)	0.0922*** (0.0129)	0.0930*** (0.0129)	0.0902*** (0.0126)	0.0907*** (0.0128)	0.0941*** (0.0128)	0.0889* (0.012)
year dummy(2012)	0.0791*** (0.0136)	0.0794*** (0.0135)	0.0751*** (0.0132)	0.0770*** (0.0135)	0.0803*** (0.0135)	0.0740* (0.012)
year dummy(2013)	0.0602*** (0.0141)	0.0608*** (0.0141)	0.0547*** (0.0138)	0.0581*** (0.0140)	0.0616*** (0.0140)	0.0542* (0.013)
year dummy(2014)	0.0589*** (0.0150)	0.0603*** (0.0151)	0.0547*** (0.0146)	0.0574*** (0.0149)	0.0607*** (0.0149)	0.0542* (0.014)

Concluding Remarks

- ▣ Inclusion of **risk aversion instruments** improves the predicted power of statistical models confirmed by likelihood ratio tests.
- ▣ The most significant effect is observed for the **self reported risk attitude**.
- ▣ 1 point increase in self reported risk attitude (scale is 0-10) yields approximately a 2% increase in equity shares.
- ▣ Market conditions have a significant effect on equity shares.
- ▣ Male tend to hold a relatively higher fraction of equities but no significant effect on participation.
- ▣ The amount of contributions have a significant positive effect on equity share.

Further research

- ▣ Inertia:
 - While there is a limit for the number of changes in allocation decisions, this limit is almost never reached.
- ▣ $1/n$ heuristic:
 - Participants with multiple funds often allocate their money equally among these.
- ▣ Commodities, foreign stocks, Eurobond etc.
 - Conventional approach is examining equity shares.

Further research

- ▣ Is equity share the best measure of risk taking?
 - Alternatives: Portfolio volatility
 - Similar effect of self reported risk attitude on portfolio volatility.
- ▣ Negative correlation between volatility and Sharpe ratio.
 - Emerging market - equity premium?
- ▣ Almost 80% of our sample are college graduates
 - A finer division of financial literacy for a subsample of 700 participants: Master degree vs. Undergraduate-
Average Sharpe ratios: 4.9 vs. 3.74