

Portfolio choice in pension funds: evidence from Italy

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Motivation

In recent years, many countries reformed their public pension system, tightening the eligibility rules and reducing the generosity of benefits. Partly as a result, there has been an increase in the importance of private pension plans, both in terms of assets under management and in terms of number of participants.

Motivation

Private pension investment requires the worker to make several choices.

She or he has to decide whether and how much to contribute, choosing the most appropriate investment line and the timing of the eventual withdrawal.

These choices are even more difficult in a time of financial turmoil, when both the probability and the cost of errors are magnified.

Motivation

While there is an extensive body of research about pension plan participation decisions, far less attention has been devoted to portfolio allocation of fund participants.

We aim to shed light on this issue looking at a new panel dataset collecting information on participants to a DC pension fund for employees of an Italian middle-sized bank.

Related literature

- ▶ Agnew et al. (2003), which studies a large US investment fund of the 401(k) type ;
- ▶ Ameriks and Zeldes (2004), which uses a panel data set from a large US pension fund, for public sector teachers and university professors (TIAA-CREF);
- ▶ Papke (2003), which uses a panel data set from the National Longitudinal Survey of Mature Women (NLS-MW).

Description

We use information provided by a DC pension fund sponsored by a medium size Italian bank.

The dataset includes information on individual demographic and employment characteristics and information on all 3,820 retirement accounts from December 2001 to December 2008, for a total of 20,123 year-individual data points.

Participants' characteristics

	Pension plan participants	SHIW (Private sector)	SHIW (Financial sector)		Pension plan participants	SHIW (Private sector)	SHIW (Financial sector)
Gender				Education			
Female	31.8%	45.8%	42.9%	Elementary school	0.3%	29.5%	0.4%
Male	68.2%	54.2%	57.2%	Middle school	4.7%	28.3%	8.5%
				High school	53.3%	33.1%	69.8%
				Bachelor degree	41.7%	9.2%	21.4%
Age				Job position			
less than 35	38.4%	19.1%	25.2%	Blue collar	2.0%	47.5%	0.8%
35-44	27.6%	22.0%	37.7%	White collar	64.1%	44.7%	74.2%
45-54	22.3%	17.2%	27.5%	Middle mng	32.0%	5.5%	20.5%
55 or more	11.7%	41.7%	9.6%	Senior mng	1.9%	2.3%	4.4%
Marital status							
Unmarried	39.7%	21.2%	27.8%				
Married	49.2%	62.6%	62.6%				
No longer married	3.9%	16.2%	9.6%				

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The investment lines

The plan offers five investment lines: guaranteed returns, money-market, bond, balanced bond and balanced equity.

In order simplify the exposition we collapse the three less risky investment lines in one, as a results we have three possible investment lines:

- ▶ zero-share investment line;
- ▶ 40%-share investment line;
- ▶ 70%-share investment line.

The workers' choices

Upon enrolment, participants choose only one of the five investment lines offered by the plan, where all their retirement wealth will be invested.

At the end of November, participants can change the investment line and the level of their monthly contributions into the fund. Changes are effective from January 1 of the following year.

In our dataset we can observe yearly individual choices (investment line and contribution).

Distribution among different investment lines

At the end of 2007 the total wealth accumulated by investors amounted to 97 million of euros, of which more than 60% was held by participants over 45 year old.

In 2007 the composition across investment lines was such that 45% of total retirement wealth was invested in the balanced bond investment line, 26% in the balanced equity investment line, 21% in the monetary/guaranteed investment line and the remaining 8% in the bond investment line.

A mean-variance investor

Suppose that there are two assets a riskless one and a risky one and investor i has standard mean variance preferences:

$$U(\alpha_{i,t}, \rho_{i,t}) = \alpha_{i,t}Er^s + (1 - \alpha_{i,t})r^b - \frac{1}{2\rho_{i,t}}\text{Var}(\alpha_{i,t}r^s + (1 - \alpha_{i,t})r^b)$$

where $\alpha_{i,t}$ is the proportion of risky assets in the portfolio, r^s and r^b are the returns of the risky and riskless assets and $\rho_{i,t}$ is the risk propensity.

A mean-variance investor

The investor must chooses to invest in one of three investment lines which differ with respect to the fraction a of the risky asset in their portfolios (a). Let us assume that $0 = a_0 < a_1 < a_2$.

The most preferred investment line depends on the degree of risk propensity of the investor in a natural manner.

$$\alpha_{i,t} = a_0 \text{ if } \rho_{i,t} \leq \rho_1$$

$$\alpha_{i,t} = a_1 \text{ if } \rho_1 < \rho_{i,t} \leq \rho_2$$

$$\alpha_{i,t} = a_2 \text{ if } \rho_{i,t} > \rho_2$$

where $\rho_1 = \frac{1}{2} \frac{\sigma^2}{E(r^s) - r^b} (a_0 + a_1)$ and $\rho_2 = \frac{1}{2} \frac{\sigma^2}{E(r^s) - r^b} (a_1 + a_2)$.

The empirical model

We assume that risk propensity depends on: gender, marital status, education, job position, age, and a full set of time dummies:

$$\rho_{i,t} = \beta X_{i,t} + \varepsilon_{i,t}$$

Therefore,

$$P(\alpha_{i,t} = a_0 | X_{i,t}) = P(\beta X_{i,t} + \varepsilon_{i,t} \leq \rho_1) = \Phi(\rho_1 - \beta X_{i,t})$$

$$P(\alpha_{i,t} = a_1 | X_{i,t}) = \Phi(\rho_2 - \beta X_{i,t}) - \Phi(\rho_1 - \beta X_{i,t})$$

$$P(\alpha_{i,t} = a_2 | X_{i,t}) = 1 - \Phi(\rho_2 - \beta X_{i,t})$$

The empirical model

In order to assess the economic significance of the regressors we, first, run our baseline regression.

Then, we use the estimated parameters to compute the expected α_{it} :

$$E(\alpha_{it}|X_{it}) = a_0 P(\alpha_{it} = a_0|X_{it}) + a_1 P(\alpha_{it} = a_1|X_{it}) + a_2 P(\alpha_{it} = a_2|X_{it})$$

Estimated shares of stocks implied by the ordered probit model

	2001	2002	2003	2004	2005	2006	2007	2008
Age								
(male, white collar, high school, married; percentage points)								
25	54.0	47.5	47.3	49.3	49.0	46.7	45.2	47.8
35	49.3	42.1	41.9	44.0	43.7	41.3	39.6	45.2
45	44.0	36.4	36.2	38.4	38.1	35.6	33.8	42.4
55	38.4	30.6	30.4	32.6	32.3	29.8	28.1	39.6
65	32.6	25.0	24.8	26.9	26.6	24.2	22.6	20.0
Job position								
(male, 35 years old, high school, married; percentage points)								
white collar	49.3	42.1	41.9	44.0	43.7	41.3	39.6	39.6
middle management	51.3	44.4	44.3	46.3	46.0	43.6	42.0	45.6
senior management	52.4	45.6	45.5	47.5	47.2	44.9	43.3	46.9
Education								
(male, 35 years old, white collar, married; percentage points)								
lower than high school	46.8	39.3	39.2	41.3	41.0	38.5	36.8	31.2
high school	49.3	42.1	41.9	44.0	43.7	41.3	39.6	33.9
bachelor degree	48.4	41.1	41.0	43.1	42.8	40.3	38.6	32.9

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45	44.0	36.4	36.2	38.4	38.1	35.6	33.8	42.4
55	38.4	30.6	30.4	32.6	32.3	29.8	28.1	39.6
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45	44.0	36.4	36.2	38.4	38.1	35.6	33.8	42.4
55	38.4	30.6	30.4	32.6	32.3	29.8	28.1	39.6
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45	44.0	36.4	36.2	38.4	38.1	35.6	33.8	42.4
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The choice of switching investment line

In this part, we focus specifically on shifts from one investment line to another.

Workers usually remain in their previously chosen investment line; however, 30% of them switch line at least once, and switching explains most of the aggregate change in allocation observed over time.

The choice of switching investment line

We, first, run our baseline regression on different sub-samples, in order to control for unobservable variations. We group investors according to the investment line chosen in period $t-1$.

Then we use the estimated parameters to compute the conditional probability to switch from one investment line to another. The probabilities are summarized in conditional transition matrices.

We compute such probabilities for two alternative settings of the explanatory variables in order to assess their impact.

Transition probabilities depending on age

Initial investment line	Chosen investment line		
	Zero-shares	40%-shares	70%-shares
less than 30 years old			
Zero-shares	98.7%	1.1%	0.2%
40%-shares	6.2%	92.1%	1.7%
70%-shares	1.6%	2.6%	95.8%
from 30 to 40 years old			
Zero-shares	97.8%	1.8%	0.4%
40%-shares	8.9%	90.0%	1.1%
70%-shares	2.8%	3.9%	93.3%
from 40 to 50 years old			
Zero-shares	98.1%	1.6%	0.3%
40%-shares	9.1%	89.9%	1.0%
70%-shares	3.5%	4.5%	92.0%
more than 50 years old			
Zero-shares	99.5%	0.4%	0.1%
40%-shares	17.9%	81.8%	0.3%
70%-shares	7.7%	7.8%	84.6%

Note: The table shows model-based probabilities to switch from the initial line (rows) to the chosen line (columns). We take as reference point a male, white collar worker with high school degree who is married.

Transition probabilities depending on age: Inertia

Initial investment line	Chosen investment line		
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Transition probabilities depending on age: Switching

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40%-shares	8.9%	90.0%	1.1%
70%-shares	2.8%	3.9%	93.3%

Note: The table shows model-based probabilities to switch from the initial line (rows) to the chosen line (columns). We take as reference point a male, white collar worker with high school degree who is married.

Conclusions

We studied investors' portfolio choices in a very neat real-world setup.

- ▶ There is a tendency to choose safer investment lines as people age.
- ▶ There is a shift away from shares. This might be consistent with the disappointing stock market performance during our sample period.

Conclusions

- ▶ Job position has an impact on portfolio choices: people with a higher position tend to take more risks.
- ▶ Education has no clear impact on portfolio choices, this can reflect that our sample includes well-educated workers. Never the less education increases the likelihood of switching for those workers in the zero-shares investment lines.

The investment lines

The **guaranteed investment line** is managed by two insurance companies that guarantee a minimum gross return equal to 3%.

The **money-market investment line** is invested in euro-denominated money market instruments (at least 80%) and other debt securities (up to 20%).

The **bond investment line** is invested in euro-denominated money market instruments (up to 20%) and other debt securities (at least 80%).

The investment lines

The **balanced investment line** is invested in money market instruments (up to 20%), other debt securities (up to 80%), and equities (up to 40%).

The **equity investment line** is invested in money market instruments (up to 20%), other debt securities (up to 50%), and equities (up to 70%).

The investment lines

In order simplify the exposition we collapse the three less risky investment lines in one, as a results we have three possible investment lines:

- ▶ zero-share investment line;
- ▶ 40%-share investment line;
- ▶ 70%-share investment line.

Ordered probit model: marginal effects

Variable	Value	Probability of the zero-share allocation		Probability of the 40% equity allocation		Probability of the 70% equity allocation	
		coeff.	prob.	coeff.	prob.	coeff.	prob.
Male	0	-0.028	0.000	-0.006	0.023	0.034	0.000
High school	0	-0.036	0.003	-0.008	0.045	0.043	0.002
Bachelor degree	0	-0.023	0.063	-0.004	0.148	0.028	0.063
White collar	0	-0.048	0.021	-0.012	0.007	0.060	0.014
Middle mng	0	-0.076	0.000	-0.024	0.000	0.100	0.000
Senior mng	0	-0.090	0.000	-0.032	0.003	0.122	0.000
Married	0	0.000	0.994	0.000	0.994	0.000	0.994
Age (years)	37	0.008	0.000	0.001	0.000	-0.009	0.000
2002	0	0.087	0.000	-0.001	0.916	-0.086	0.000
2003	0	0.114	0.000	-0.005	0.527	-0.109	0.000
2004	0	0.116	0.000	-0.006	0.502	-0.110	0.000
2005	0	0.082	0.000	0.000	0.983	-0.082	0.000
2006	0	0.087	0.000	-0.001	0.905	-0.087	0.000
2007	0	0.127	0.000	-0.008	0.382	-0.119	0.000
2008	0	0.154	0.000	-0.015	0.168	-0.139	0.000

Note: The table reports the marginal effects of the explanatory variables on the probability of choosing one of the three asset allocations. The explanatory variables are all dummy variables except Age.

For the dummy variables the effects refer to a change from 0 to 1. The reference dummies are female, primary and middle school, blue collar workers, unmarried, 2001. Statistically significant coefficients ($p < 0.05$) are in bold.

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Ordered probit model: marginal effects

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Portfolio choices performance

Year of switch	Chosen fund at the end of 2008				
	Guaranteed	Cash	Bond	Balanced Bond	Balanced Equity
2003 Avg gains/losses	22.7%	31.0%	36.9%	14.9%	-15.7%
Actual return	33.6%	19.4%	12.5%	10.1%	0.1%
<i>Number of switchers</i>	24	17	44	26	7
2004 Avg gains/losses	31.2%	36.4%	39.9%	11.8%	-21.7%
Actual return	30.7%	18.8%	14.3%	11.2%	-0.2%
<i>Number of switchers</i>	18	6	8	8	1
2005 Avg gains/losses	14.1%	41.4%	40.9%	9.7%	-30.0%
Actual return	32.2%	25.6%	22.8%	11.0%	-5.7%
<i>Number of switchers</i>	31	10	12	66	15
2006 Avg gains/losses	21.9%	52.7%	36.5%	3.8%	-24.0%
Actual return	33.4%	33.8%	24.8%	7.2%	-12.1%
<i>Number of switchers</i>	13	7	6	33	24
2007 Avg gains/losses	29.4%	76.9%	61.6%	18.8%	-31.4%
Actual return	42.2%	45.7%	43.0%	18.1%	-21.4%
<i>Number of switchers</i>	18	8	13	64	21
2008 Avg gains/losses	35.6%	66.1%	57.4%	21.9%	-28.9%
Actual return	35.6%	42.6%	32.8%	13.6%	-22.2%
<i>Number of switchers</i>	14	42	13	11	16

Note: Gains and losses are computed as difference between actual return and potential return in case of not switching. We consider workers who has changed fund only once and we compute the cumulative gains/losses and the total return after normalizing the