Delegated Portfolio Management: Theory and Experiment

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Goals

- To develop a theory of competition in portfolio management and resulting asset pricing
- To verify the theory with an experiment

Past Research

- Contract theoretic :

  What is the optimal contract between one investor (principal) and one manager (agent)? (Bhattacharya-Pfleiderer [1985], Stoughton [1993], Heinkel and Stoughton [1994], Ou-Yang [2003], Dybvig et al [2010]…)
- Talent among managers (Berk-Green [2004])
- Pricing implications if managers had complete freedom choosing portfolios and are compensated in specific ways (e.g., fixed % of value of assets under management) (Brennan [1993], Cornell and Roll [2005], Cuoco-Kaniel [2006])
- Agranov et al [2010]: what offers will be given by two managers? Offers = portfolios!

Where We Differ:

- There is never an exclusive relationship investor-manager:
  - Investors can choose many managers
  - The individual rationality constraint for the manager is endogenous: it depends what other managers are doing
- “Doing” = promising portfolios (like Agranov, but we will assume free entry – perfect competition)
- There will be no talent
- We study not only the nature of portfolios offered (given a manager fee structure), but also the impact on prices in the market, assuming that only managers trade

Theoretical Background

- Rothschild-Stiglitz (1976): competitive equilibrium for insurance contracts – they look at deductibles offered in equilibrium
- Extension (and experimental test) in Asparouhova (2006)
- Despite controversies, this equilibrium predicts outcomes well:
  - In the lab (provided equilibrium is Pareto optimal); see Asparouhova (2006)
  - Emergence of subprime mortgages
  - Banks don't (need to) check creditworthiness

Theoretical Setting

1. Managers offer (to invest in units of) a particular convex linear combination of Arrow-Debreu securities
2. Investors get proceeds *minus* a *fixed fee f per contract* (back-end load fee)
3. Investors hand over enough assets to managers needed to implement the promised portfolio
4. Importantly: managers are bailed out when proceeds from investment is not sufficient to cover fee

Fourth point leads to sharp predictions which will aid interpretation of the results from the experiment (meant not *to imitate reality, but to* test theory*)*

Equilibrium Definition

- Supply is equal to demand in the inter-manager market
- Everyone behaves optimally (subject to budget constraint)
- There is no portfolio (of A-D securities) different from contracted portfolios and such that it would make at least one investor better off.

Main Theory Result

There exists an equilibrium where

- Managers offer to trade to portfolios that implement Arrow-Debreu (AD) securities
- CAPM pricing holds in the inter-manager marketplace

Intuition

- *In terms of state securities, manager DERIVED demands equal investor (original) demands net of a (state-independent) fee, so they satisfy the same key property needed for CAPM to emerge:* PORTOLIO SEPARATION *(demand = constant + state-dependent component that is the same for everyone up to a constant of proportionality)*
- *Entrants who enter and try to "replace" certain "AD" managers (who offer AD securities) will force investors to pay their fee in* ALL STATES, *unlike AD managers*

Variations in the experiment

- In experiment, shares are not determined by values (of assets) contributed to managers (we don't know prices beforehand!)
  - … but by EXPECTED values
  - Which gives the same sharing as long as expected values of initial endowments are the same across subjects
  - They were, to within $1
- In experiment, fees are determined not as a fixed charge per contract unit,
  - … but as a percentage of the expected value of the contributed assets
  - Which makes the (equivalent) fees-per-contract STATE-DEPENDENT
  - Which destroys CAPM pricing in the inter-manager market, but keeps "weak CAPM"

Weak CAPM

- “State-price probability ratios are inversely related to the aggregate wealth in a state”
- (State-price probability ratios = “Radon Nikodym derivative of risk neutral probabilities w.r.t. physical probabilities”)
- Intuition: States when investors are expected to be “poor” are expensive
- … a robust finding in experiments where subjects invest DIRECTLY (Asparouhova-Bossaerts-Plott 2003, Bossaerts-Plott 2004)

Implementation

- Investors choose managers and hand over enough assets (in value) for manager to ``implement promised allocations”
- Equivalent to:
  1. Investors choose manager
  2. Investors hand over assets and get a share in the managers portfolio equal to the *value* of the contributions relative to all contributions
  3. Management fees are a percentage of (value) of assets under management (charged as back-end)
- PROBLEM: we don’t know value (yet) when shares are determined
- (Same problem in the “real world,” where it is solved in an “unfair” way - use PAST closing prices to determine relative shares)

What if…

- … we determine shares based on EXPECTED payoff of contributed assets.
- If all investors start with initial wealth with same *expected payoff* and same *value* then
  1. Investors still prefer managers who offer AD securities
  2. WEAK CAPM holds
- (Only change: expressed as fraction of AD securities, fees are now state dependent)

Experiment

	State		
	X	Y	Z
Asset A	5	80	0
Asset B	0	30	80
Bond	100	100	100

- Week-long “periods”
- Three one-period assets (NOT AD securities!)
- 32 managers and ~70 investors
- Managers receive assets, shares for investors determined by relative expected value of contributed assets
- Fee paid as a percentage of expected value of assets under management, charged after liquidating dividends are received (BUT: we bail out)
- $25K experiment!

Period	Number of Participants		Per Capita Market Portfolio		
	Type A	Type B	A	B	Cash
I	30	34	46.9	37.2	$7.59
II	28	38	42.4	40.3	$7.73
III	37	34	52.1	33.5	$7.44
IV	37	35	51.4	34	$7.46
V	34	33	50.7	34.5	$7.48
VI	35	35	50	35	$7.50

Table 1: **Timeline For One Week-Long Period**

Wed	**Fri**	**Sat**	**Mon**	**Tue**
Investors and managers informed of payoffs	Performance indices published on website	Sign-up announcement for investors	Performance indices published in *Tech*	6pm Close of investor allocation stage
		(Only First Week) Sign up for managers	Investors receive access to allocation software	10pm Managers see allocations and trading starts
				10:30pm Trading ends

Investor Choices

Period	Gini Index	Largest Manager Market Share
I	0.1334	0.0524
II	0.5039	0.1236
III	0.3434	0.1032
IV	0.4905	0.1995
V	0.4978	0.2034
VI	0.5491	0.1342

Table 7: **Portfolio Manager Market Shares (in %), Per Perio**

Period	I	II	III	IV	V	VI
Albite	2.02[11]	0.34	8.14	4.28	2.42	2.53
Alexandrite	2.38	11.61	10.36	19.95	20.34	8.67
Allanite	2.42	1.96	1.16	2.03	2.91	2.74
Alunite	2.34	2.27	5.69	1.88	1.78	2.21
Amazonite	4.62	6.68	6.19	3.71	5.65	6.80
Amblygonite	5.31	4.38	2.58	6.60	5.48	11.69
Amosite	2.33	0.98	3.89	1.81	0.77	1.29
Andalusite	3.36	0.84	1.22	1.08	2.27	0.85
Anthophyllite	2.78	1.70	0.89	2.03	0.86	0.63
Atacamite	3.38	4.39	2.72	1.25	1.74	0.74
Barite	2.93	2.19	1.12	0.46	0.84	0.57
Bassanite	2.84	3.18	2.11	1.09	5.66	2.68
Beidellite	3.17	1.83	2.06	1.37	0.89	0.74
Bementite	2.96	0.64	4.66	3.20	2.23	5.27
Bentonite	2.31	0.69	1.62	1.12	0.78	0.76
Bertrandite	2.01	10.57	2.98	0.90	4.54	6.27
Biotite	2.48	1.09	1.56	1.19	1.36	1.07
Birnessite	2.47	7.71	0.99	1.04	0.58	0.51
Bloedite	3.44	0.28	3.72	1.86	0.79	0.46
Boracite	3.06	1.44	1.67	3.30	3.77	2.44
Calcite	3.35	1.80	2.90	3.80	1.41	0.71
Carnallite	3.29	0.62	3.90	2.32	6.53	10.80
Celestite	2.78	1.82	1.64	1.23	0.89	0.50
Chalcopyrite	4.41	1.58	1.54	2.94	0.49	2.65
Chlorite	4.42	2.21	2.96	2.67	2.09	1.33
Colemanite	3.52	0.97	2.99	15.66	4.82	6.26
Cornadite	2.74	3.62	6.65	4.42	9.08	13.42
Cristobalite	3.12	1.87	3.07	1.55	2.22	0.69
Cryolite	3.42	6.15	2.82	0.91	1.13	0.70
Dolomite	4.02	12.36	2.28	1.20	1.97	1.18
Dumortierite	2.84	1.53	1.52	1.82	0.91	1.07
Dunite	3.48	0.70	2.38	1.34	2.80	1.77

Investor Choices

Explanatory Variable	Coefficient	Standard Error	t	p value
Intercept	0.047	0.006	7.77	< 0.001
LagDistanceAD	-0.020	0.004	-5.33	< 0.001
Intercept	0.023	0.003	6.91	< 0.001
LagDistanceAD	-0.010	0.003	-3.24	0.003
LagReturn	0.023	0.002	10.43	< 0.001

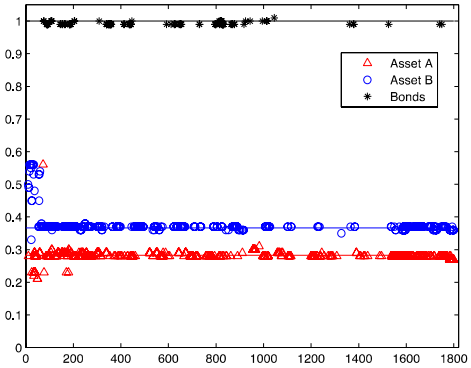
Regression of Manager Market Share onto:

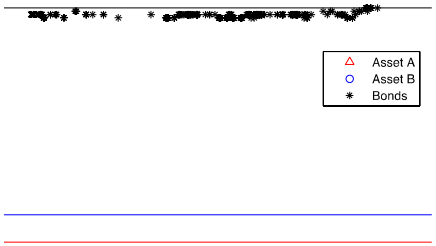
- LaggedDistanceAD: Distance of (lagged) manager portfolio from AD payoff pattern
- LaggedReturn: Lagged realized return on manager portfolio

Investors prefer managers who offer portfolios closer to AD security, but also managers that generated high returns. The latter:

- *May indicate "resolution of indifference" between managers with same distance from AD security*
- *Corresponds to "flows follow performance" in the "real" world*
- *(May provide an additional (observable!) measure of how far manager is from offering an AD security [returns increase in closeness to AD security in 'good' state])*

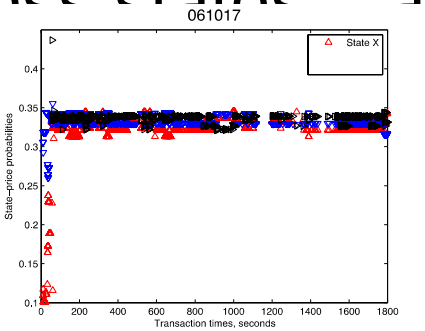
Prices

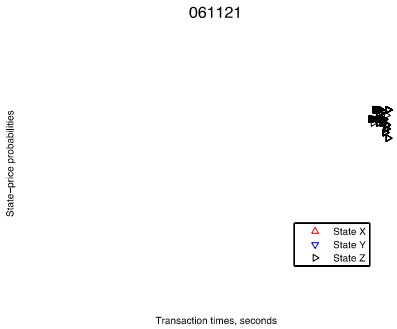

Asset A
Asset B
Bonds
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
200
400
600
800
1000
1200
1400
1600
1800


Asset A
Asset B
Bonds

IMPLIED State-Price Probability Ratios (SPP)

(Weak) CAPM predicts: SPP(X)>SPP(Z)>SPP(Y) (See aggregate dollar wealth across states above)





Statistical Test: Do State-Price Probability Ratios (SPP) Drift (Back) To Weak CAPM?

- Bossaerts-Plott 2004: “tau” tests “no drift” against “drift to re-ranking of SPP according to weak CAPM”
- Confidence intervals based on bootstrapping.

Entire price series			
Period	*tau*	95th percentile	99th percentile
1 (061017)	*0.97*	0.52	0.62
2 (061024)	*0.9386*	0.38	0.49
3 (061030)	*0.9848*	0.6	0.7
4 (061107)	*0.9652*	0.5215	0.66
5 (061114)	*0.9084*	0.9809	0.9849
6 (061121)	*0.9497*	0.2868	0.3

Effect of Market Concentration On Pricing

- Lagged return has an effect on flows of funds
- This leads to higher concentration, and deterioration in pricing
- (Consistent with Bossaerts-Plott-Zame 2007)

	GINI Concentration Index	*Market Share Of Largest Manager*
tau	-0.54 (0.26)	-0.58 (0.23)

FYI: (Strong) CAPM Pricing

- Numerical calculations: CAPM is not much affected because of how fee payment scheme in experiment differs from (base) theory
- Measure how far pricing is from CAPM: *SRD = Difference between Sharpe ratio of market portfolio and maximal Sharpe ratio*
- Correlation of *SRD* with *tau:* 0.55 (s.e. 0.25)

Conclusions

- We propose a new theory of competition in contracts among fund managers focusing NOT on fees BUT on portfolio composition
- The theory includes a prediction about pricing in the (inter-manager) asset market
- Experimental results support the main implications of the theory regarding
  - manager portfolio composition and investor choices
  - pricing