Factor Premia in Private Equity:

How alternative are private markets?

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APT and alternative assets

- Factor premium λ_k for risk exposure β_k to factors, f_k
- Do private capital markets deliver different factors not well-spanned by public markets?
  - Maybe yes: Ang et. al. (2014)
  - Maybe no: Stafford (2016)

What we do

- Extract long-only factors from PE returns.
- Test if they are spanned by public market factors.
- Test *ex ante* fund selection strategy to capture factors.
- Simulate mean variance strategies with public and private factors.

Related clustering studies

- Stocks (long-only asset pricing factors)
- Mutual funds (style analysis)
- Hedge funds (style analysis)
- Housing markets (diversification studies)
- Commercial property markets (div. stud.)

Estimation problems

- Irregular cash-flows.
- Appraisal-based valuations.
- Limited-life funds.
- Complex fee structure.
- Investments within a single fund can span many industries and strategies.
- Long only.

Why not industry classification?

- Existing fund classification may not capture different risk-return profiles.
- Similar strategies and targeted companies across asset classes
- Funds do debt and equity
- Significant heterogeneity within asset classes *(e.g. student housing vs shopping malls, Facebook,Uber,cryptocurrencies)*
- ⇒ We cannot reduce dimensionality by considering asset classes.

Main findings

- **Priced Factor 1**:
  - Large, BO, expansion capital, non-USD.
  - Mostly spanned by earnings quality and low beta factors.
- **Priced Factor 3**:
  - Small, real estate,mezzanine, USD.
  - Not spanned.
- Burgiss style, fund size useful preditors.
- Ex ante PE factors increased Sharpe ratio.

Model for Returns

- Group fixed effects model with unbalanced panel Bonhomme and Manresa (2015).
- Applied to underlying "unsmoothed" quarterly returns. Ross & Zisler (1991)
- Autocorrelation of values is a function of:
  - Characteristics (age, size)
  - Market conditions (sign of observed returns, recession)

Model

- $R_{i,t}^{obs} = \sum_{l=1}^{L} \theta_{i,l,t} \, R_{i,t-1}^{obs} + (1 - \sum_{l=1}^{L} \theta_{i,l,t}) R_{i,t}^{unsm}$

group mean at t idiosyncratic fund return

- $R_{i,t}^{unsm} = \mu_i + \alpha_{li} g_{i,t} + \epsilon_{i,t}$

dummies Lagged returns

- $\sum_{l=1}^{L} \theta_{i,l,t} \, R_{i,t-1}^{obs} = D_{i,t}' \, \delta \quad X_{i,t}$

- $\sum_{l=1}^{L} \theta_{i,l,t} \, R_{i,t-1}^{obs} = (\delta_1 \, 1_{recession} + \delta_2 \, 1_{investment\ period})$

Model Strengths & Weaknesses

- Allows missing obs. and different time spans
- Residuals can be heteroskedastic.
- Long-only portfolio interpretation.
- Models conditional valuation on observables.
- Cluster not mixture.
- Fund not firm.

Estimation

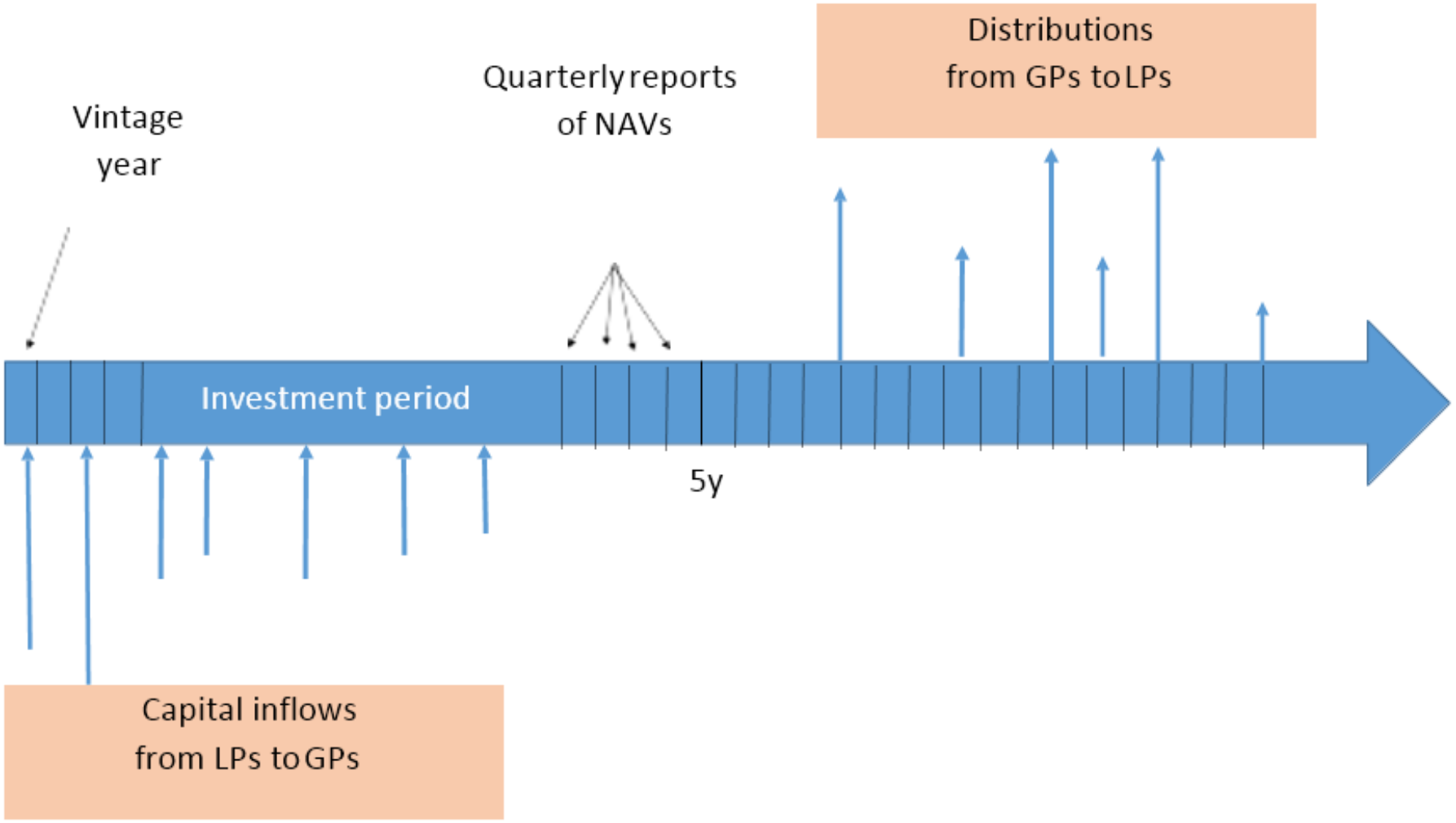
- Choose θ,δ,α,μ to minimize fund SSE over i,t

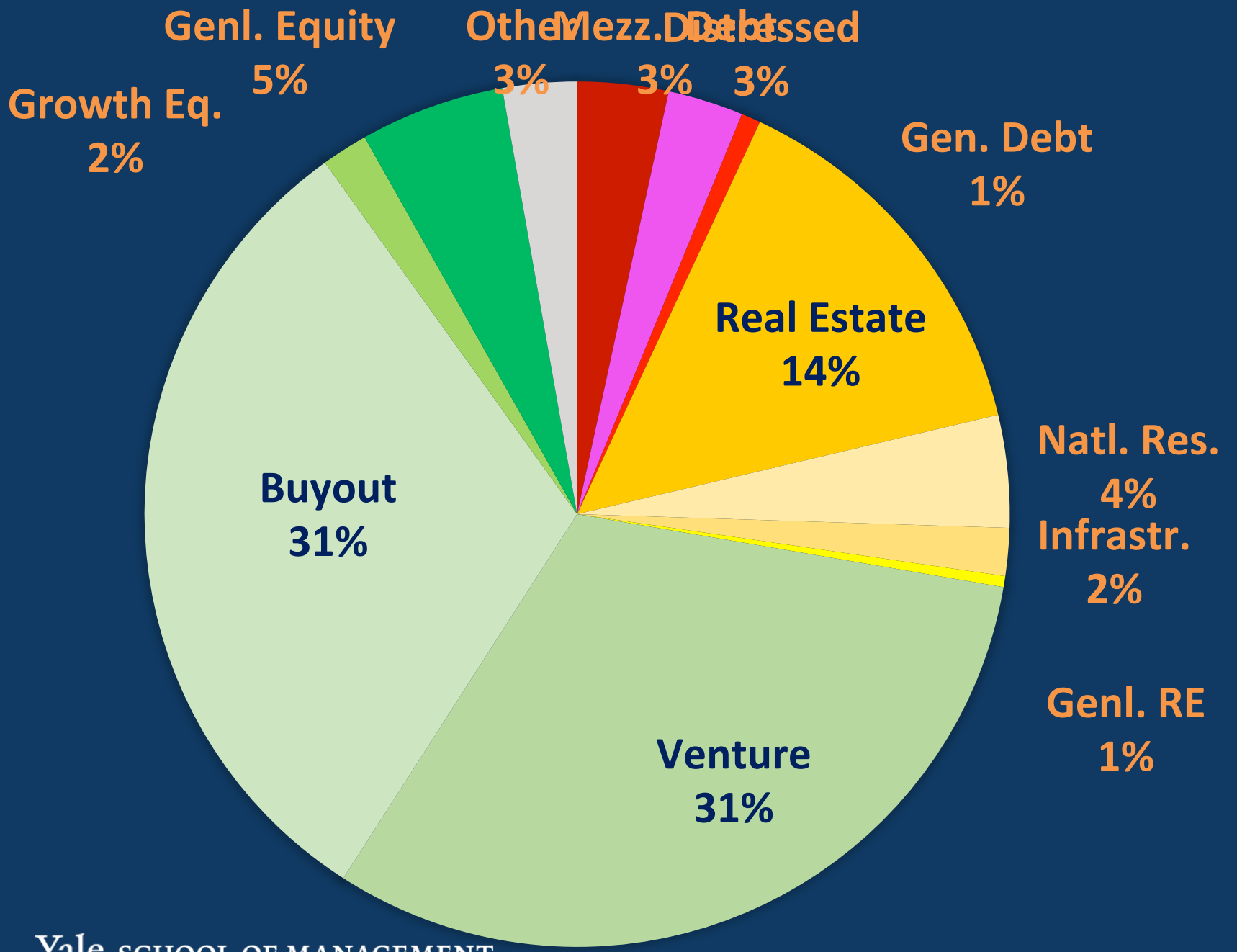
$$\sum i=1\uparrow N \sum t=1\uparrow T \epsilon\downarrow i,t\uparrow 2 \downarrow\uparrow$$

- Extension of k-means in the absence of autocorrelation and with a balanced panel of data
- The optimal number of groups is determined using the Bayesian Information Criterion.
- Accuracy of the algorithm studied using numerical simulations

Data (Burgiss)

- 4,282 funds classified into 4 broad types and 12 asset classes (manually classified by experts)
- Time series of cash flows and NAVs 1980- 2016.
- Fund characteristics: vintage year, size (committed amount), geographical area, currency.


Distributions
from GPs to LPs
Quarterly reports
of NAVs
Vintage
year
Investment period
5y
Capital inflows
from LPs to GPs



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We use the NAVs...

- Compute modified IRR (8% financing rate), each quarter using NAVs as initial investment and final dividend.
- NAVs conservative and smoothed (Jenkinson et al., 2013).
- Incentives to over-report before raising a new fund (Chung et al., 2012) & under-report otherwise.

AR model

- Six specifications of autocorrelation:
- AR(4)
- AR(2) crossed with asset class
- AR(2) crossed with fund age
- AR(2) crossed with fund size
- AR(2) crossed with fund geography
- AR(2) crossed with time period (S&P 500 returns, recession, end-of-year effect)

- ⇒ 2 lags + end-of-year effect; first lag crossed with a dummy that is 1 if the fund is between 2 and 4 years old.

Factor 1:

- Large, non-dollar, buyout, and expansion capital funds.
- Factor 1 spanned by traded factors:
  - US market profitability
  - quality of earnings
  - European low-beta factor
- Implies holding of high margin, non-cyclical firms, with lower-risk financial ratios
- Different from the type of firms bought by buyout companies. Bought or built?

Factor 2:

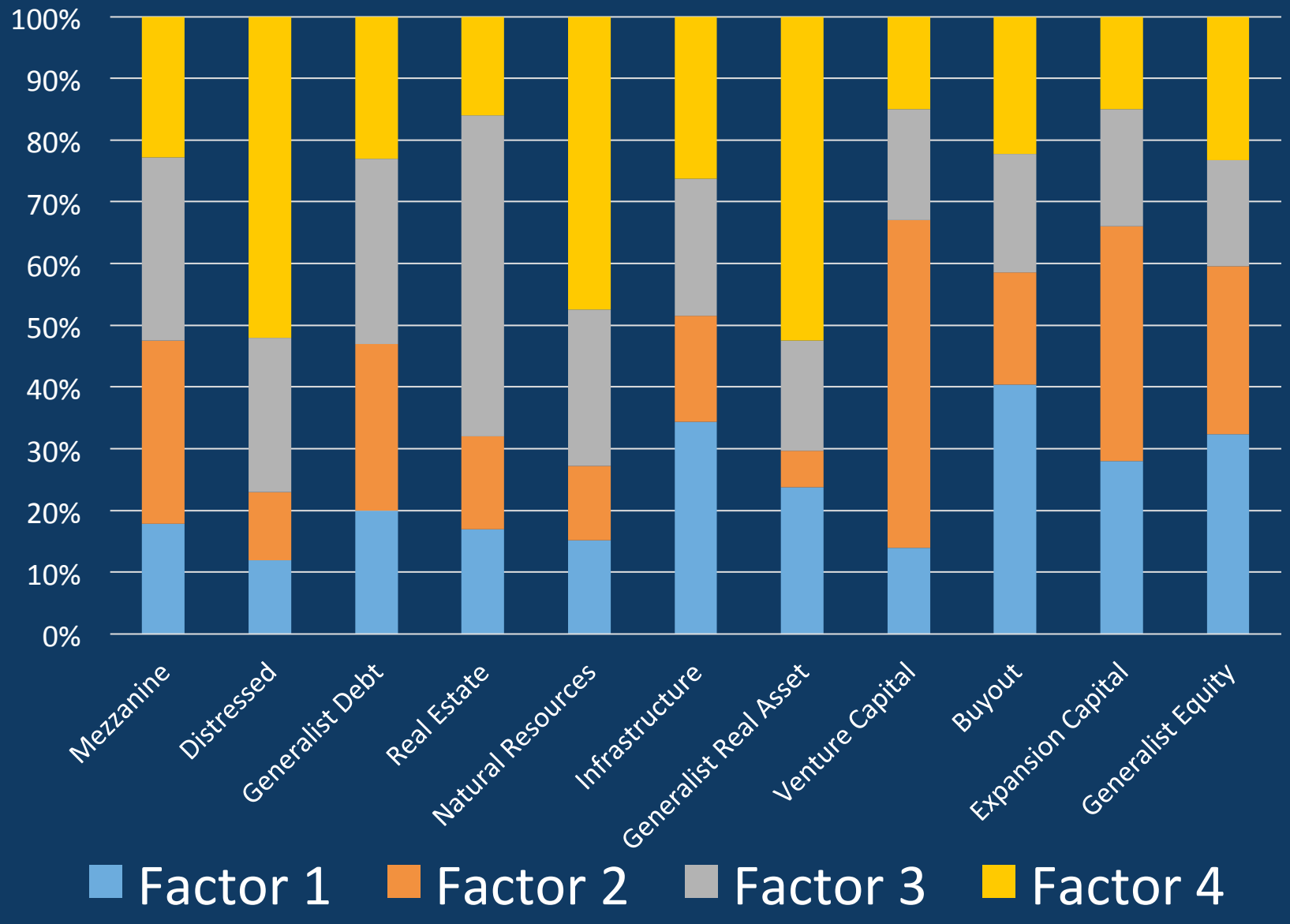
- Venture capital funds and expansion capital funds
- Asian market funds more likely

Factor 3:

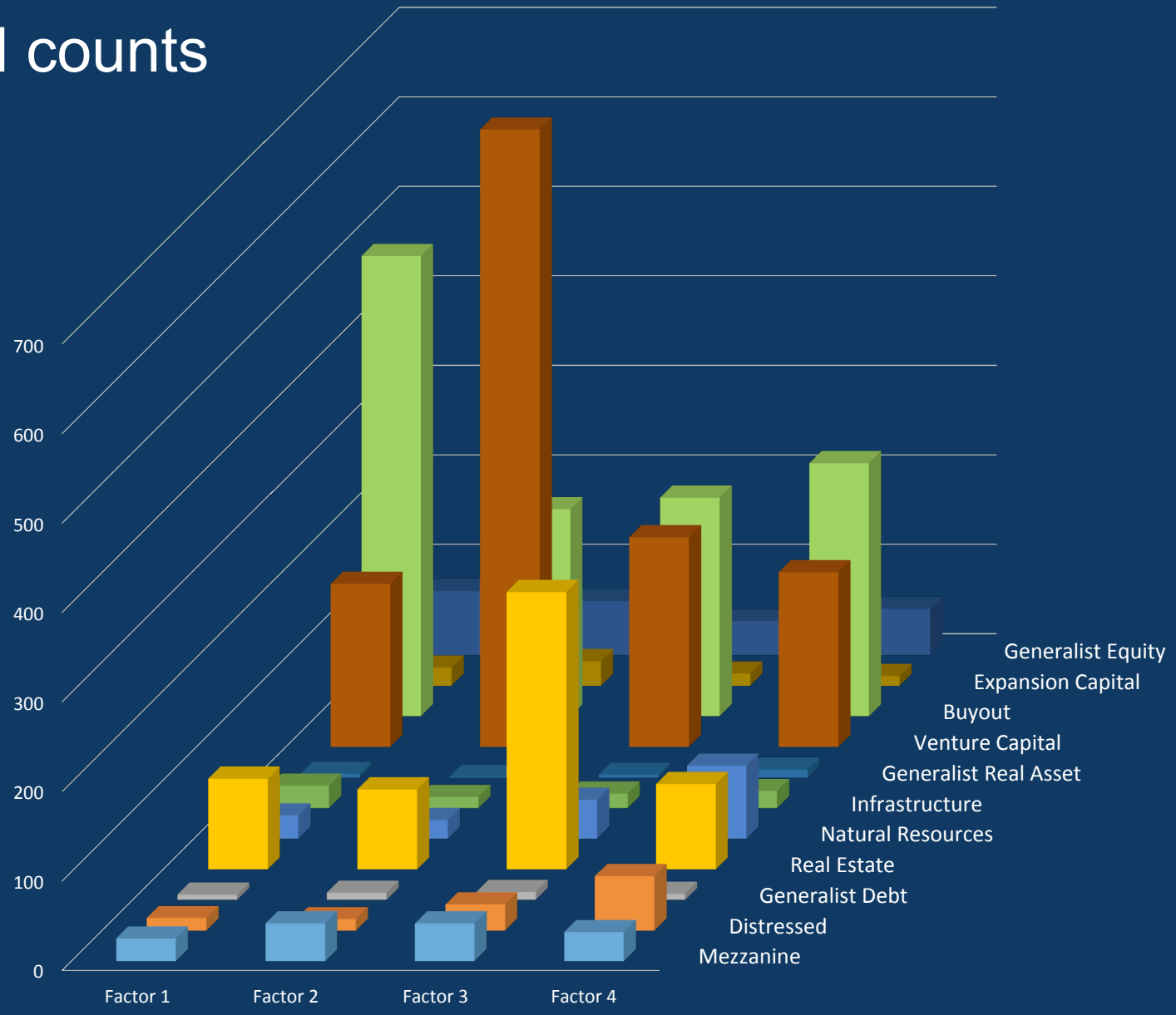
- Small funds, real estate funds, and mezzanine debt funds.
- Factor 2 not well spanned by traded factors.
- Increasing and concave in market.
- Might otherwise be measured as alpha.
- Boundary between asset classes

Factor 4:

- Generalist real estate and natural resources funds
- Energy funds more likely


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Mezzanine
Distressed
Generalist Debt
Real Estate
Natural Resources
Infrastructure
Generalist Real Asset
Venture Capital
Buyout
Expansion Capital
Generalist Equity
Factor 1
Factor 2
Factor 3
Factor 4

Fund counts


700
600
500
400
300
200
100
0
Factor 1
Factor 2
Factor 3
Factor 4
Generalist Equity
Expansion Capital
Buyout
Venture Capital
Generalist Real Asset
Infrastructure
Natural Resources
Real Estate
Generalist Debt
Distressed
Mezzanine

Cap-weighted

Significant Multinomial Logit Loadings

Factor 1	Factor 2	Factor 3	Factor 4
WE-exUK	Early Other	['10-'13]	RE v-add ['93-'97]
Gen BO	RE v-add ['10-'13]	USA RE Opport	China Gen BO
Mega BO other	Asia-exC	USA RE v-add	Energy ['10-'13]
USA Mega	VC other	RE Other	
	Mega Early Other	RE v-add Experienced	
	Early IT	Gen RE Experienced	
	China	RE Opport Experienced	
	Gen RE ['10-'13]	Mezzanine Experienced	
	China Mega		

F-F Factors	Factor 1	Factor 2	Factor 3	Factor 4
S&P 500	0.17	0.04	0.02	**0.16**
SMB	-0.23	**-0.75**	**-0.21**	**-0.25**
HML	0.22	-0.4	**0.22**	-0.03
Profitability	-0.13	0.53	**-0.24**	-0.15
Investment	-0.44	-0.36	-0.26	0.03
Liquidity	0.18	-0.26	0.09	0.04

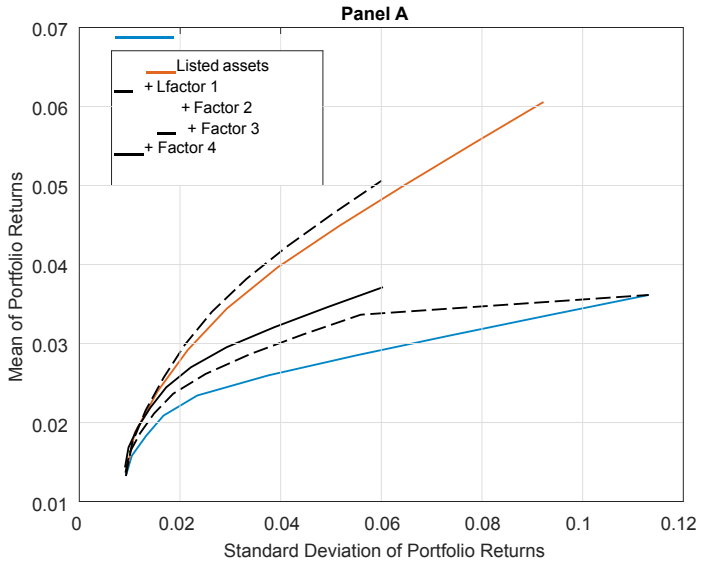
AQR Global	Factor 1	Factor 2	Factor 3	Factor 4
Rm-Rf	0.42	0.31	0.08	0.19
SMB	-0.29	0.33	-0.34	0.15
HML	-0.13	-0.45	-0.09	0.07
QMJ	-0.51	-0.22	-0.26	-0.33
BAB	0.25	-0.25	0.16	0.14

	Factor 1	Factor 2	Factor 3	Factor 4
Market factors				
SPX	0.20	0.21	0.07	**0.17**
SPX^2	-0.51	-0.22	**-1.00**	-0.46
Macroeconomic indicators				
VIX return	-0.02	0.01	0.00	-0.03
Default spread	-2.56	**-9.09**	**-6.93**	-1.40
Inflation	0.86	0.34	0.29	0.78
GDP growth	**2.22**	**3.34**	**1.68**	**1.97**

	Factor 1	Factor 2	Factor 3	Factor 4
Risk premium	**0.034**	0.001	-0.031	0.002
t-stat	2.108	0.068	-1.587	0.158
Panel B: Prices of risk of factors based on Burgiss categories				
	Equity	Debt	Real assets	Generalist
Risk premium	0.002	0.016	0.028	0.008
t-stat	0.26	1.363	0.882	0.588

Mean-variance spanning tests

- Consider traded factors, listed bonds, PE and commodity indices, and our 4 basis assets.
- Compare mean-variance frontier of benchmark portfolio to frontier with portfolio augmented with one basis asset (Huberman and Kandel, 1987).



- Run $R_t^{basis\ asset} = \alpha + \beta R_t^{benchmark} + E_t$ (Ferson et al., 1993, Bekaert and Urias, 1996, Hansen and Jagannathan, 1991).
- Wald test: $H_0 : \alpha = 0$ rejected.
- Same results hold with a utility maximizing investor with power utility and $\gamma = 5$ (DeRoon et al., 1996).

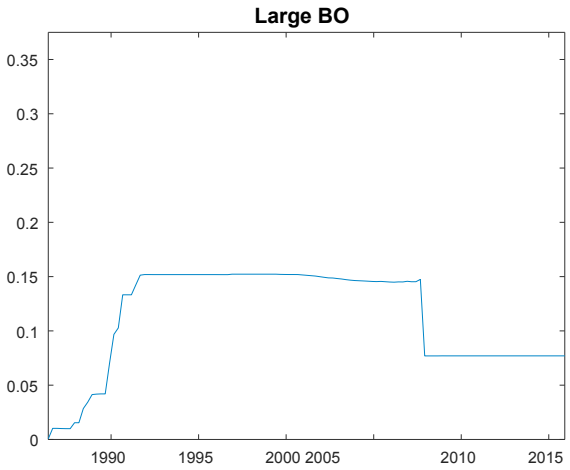
Dynamic investment

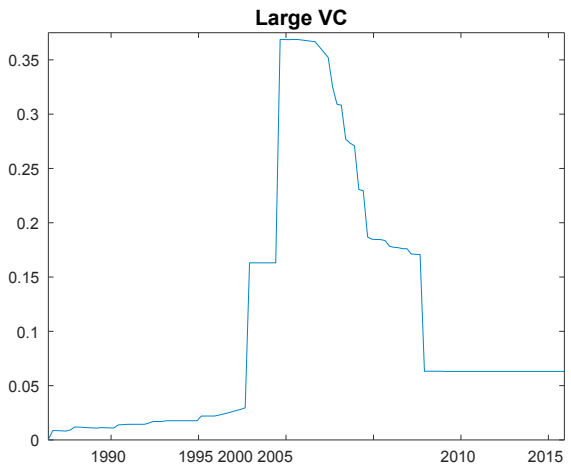
- Each quarter, form portfolios using moments over the past 5 years.

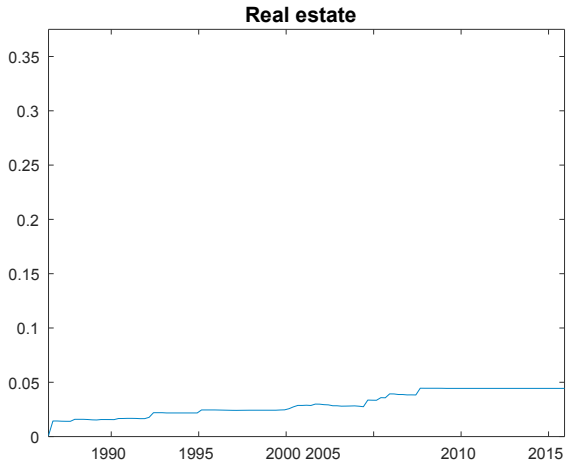
Min over θ: $\gamma/2\ var_t(r_{t+1}(\theta)) - E_t[r_{t+1}(\theta)] + TC_t$

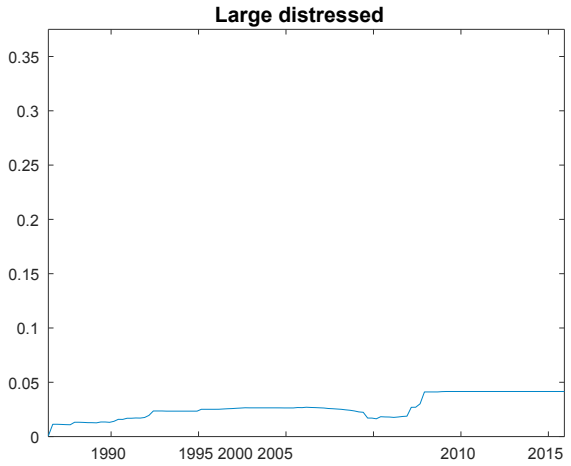
- Transaction costs: 2% for listed equities, 5% buying PE.
- To replicate costly and illiquid secondary market: transaction costs of 15% selling PE.

Dynamic investment









Conclusion

- - Develops a dynamic model that accommodates the complex structure of PE returns and classifies them into long-only portfolios that function as PE factors
- - Estimates the model on an extensive database of PE funds
- - Uncovers a factor structure for PE.
- - Finds a portfolio that is priced in the cross-section of funds (Factor 1: Large Buyout) and another that is associated with VC.