Fund Tradeoffs

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Motivation

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  - Largest subcategory: Active equity funds

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  - Largest subcategory: Active equity funds
- Traditional focus: Fund performance
  - Berk and Green (2004) critique
- Our focus: Fund behavior
  - Tradeoffs between fund characteristics?

What we do

- Build an equilibrium model connecting key **fund characteristics**
  - Fund size
  - Expense ratio
  - Turnover
  - Portfolio liquidity

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  - Relate it to portfolio diversification
  - Derive simple measures of portfolio liquidity and diversification

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- Introduce the concept of **portfolio liquidity**
  - Relate it to portfolio diversification
  - Derive simple measures of portfolio liquidity and diversification
- Test the model's predictions for U.S. equity mutual funds
  - Find strong empirical support
- Use the model to identify misallocation to mutual funds

Portfolio liquidity and diversification

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  - Holding fund size and turnover constant

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  - Holding fund size and turnover constant
- Simple trading cost function $\Rightarrow$

$$\text{Portfolio Liquidity} = \text{Stock Liquidity} \times \text{Diversification}$$

- Diversification also has two components:

$$\text{Diversification} = \text{Coverage} \times \text{Balance}$$

  - Greater coverage $\Leftrightarrow$ More stocks in portfolio
  - Greater balance $\Leftrightarrow$ Portfolio weights closer to market-cap weights

Main empirical results

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- Mutual funds with less **liquid** portfolios have
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- Mutual funds with less **diversified** portfolios have
  - Smaller size
  - Higher expense ratios
  - Lower turnover
  - More liquid holdings
- Larger funds are cheaper
- Funds that trade less are larger and cheaper
- Funds that are too big perform worse
- All these findings are consistent with our model, and with decreasing returns to scale in active management

Literature

- Decreasing returns to scale in active management
  - Several papers relate fund size to performance
  - We relate fund size to portfolio liquidity and turnover

  - Berk and Green (2004), Chen et al. (2004), Pollet and Wilson (2008), Yan (2008), Pástor, Stambaugh, and Taylor (2015), Reuter and Zitzewitz (2015), Busse et al. (2017), Harvey and Liu (2017)

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- Portfolio diversification
  - Common measures: Number of stocks, Herfindahl index of weights
  - Our measure blends both ideas, has strong theoretical motivation
  - We explore what kinds of funds are more likely to diversify

  - Blume and Friend (1975), Kacperczyk, Sialm, and Zheng (2005), Goetzmann and Kumar (2008), Cremers and Petajisto (2009)

Road map

- Introduce portfolio liquidity
  - Theory
  - Empirics
- Tradeoffs among fund characteristics
  - Theory
  - Empirics
- Predict fund returns
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Introducing portfolio liquidity

$$L = \left(\sum_{i=1}^{N} \frac{w_i^2}{m_i} \right)^{-1}$$

$$\begin{aligned} N &= \text{number of stocks in portfolio} \\ w_i &= \text{portfolio's weight on stock } i \\ m_i &= \text{weight on stock } i \text{ in a value-weighted benchmark} \end{aligned}$$

Introducing portfolio liquidity

- Fund's dollar trading costs: $C = \sum_i^N D_i C_i$
  - D_i = dollar amount traded of stock i
  - C_i = cost per dollar traded of stock i

- **Assumption 1**: Larger trades have higher proportional costs

$$C_i = \tilde{c}\frac{D_i}{M_i} , \qquad M_i = \text{stock } i\text{'s market cap.}$$

- **Assumption 2**: Fund expects to trade portfolio proportionally

$$E(D_i) = \underbrace{A}_{AUM} \times \underbrace{T}_{turnover} \times \underbrace{w_i}_{portfolio\ \ weight}$$

Introducing portfolio liquidity

These assumptions ⇒

$$E(C) = \left(\frac{c}{M}\right)(AT)^2 \underbrace{\left(\sum_{i=1}^{N} \frac{w_i^2}{m_i}\right)}_{L^{-1}}$$

Definition:

If two funds have equal size and equal turnover,
the fund with lower trading costs has greater portfolio liquidity.

Introducing portfolio liquidity

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Introducing portfolio liquidity

Expected cost is quadratic in V:

$$E(C) = \left(\frac{c}{M}\right) \underbrace{(AT)^2 L^{-1}}_{V^2}$$

where $V = ATL^{-\frac{1}{2}}$ is liquidity-adjusted dollar trading volume

Properties of portfolio liquidity

- $L \in (0, 1]$
- Least liquid portfolio: Single, smallest stock in benchmark
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- Least liquid portfolio: Single, smallest stock in benchmark
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- Decomposition:

$$L = \underbrace{\frac{1}{N}\sum_{i=1}^{N} \mathcal{L}_i}_{\text{Stock Liquidity}} \times \underbrace{\left(\frac{N}{N_M}\right)\left[1 + \text{Var}^*\left(\frac{w_i}{m_i^*}\right)\right]^{-1}}_{\text{Diversification}}$$

$$\mathcal{L}_i = M_i / \overline{M}$$

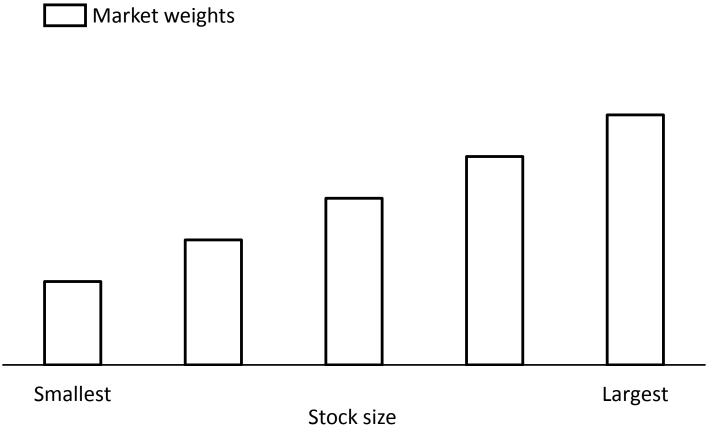
$\overline{M}$ = average market cap of stocks in benchmark

Properties of portfolio diversification

$$\text{Diversification} = \underbrace{\left(\frac{N}{N_M}\right)}_{\text{Coverage}} \times \underbrace{\left[1 + \text{Var}^*\left(\frac{w_i}{m_i^*}\right)\right]^{-1}}_{\text{Balance}}$$

- **Coverage:** What fraction of available stocks do you hold?
- **Balance:** How close are your weights to market-cap weights among stocks you hold?
- Diversification, Coverage, Balance are all $\in (0, 1]$

Example



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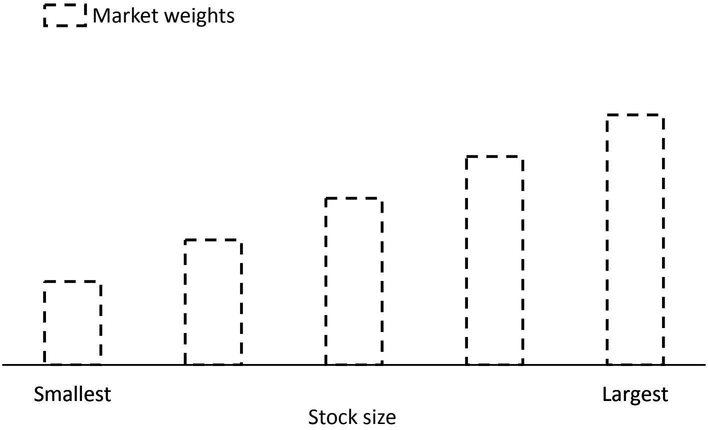
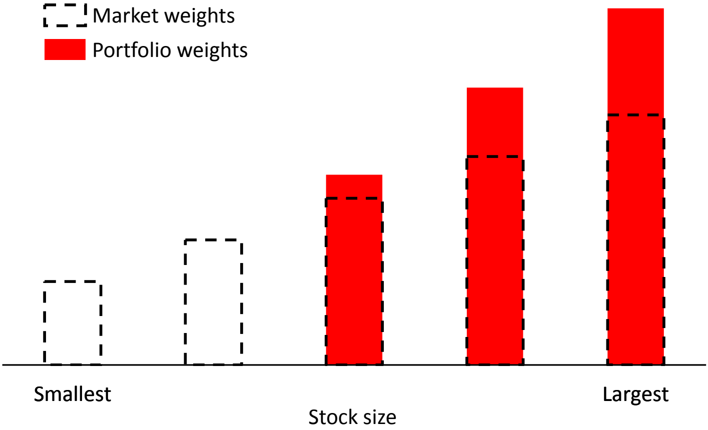
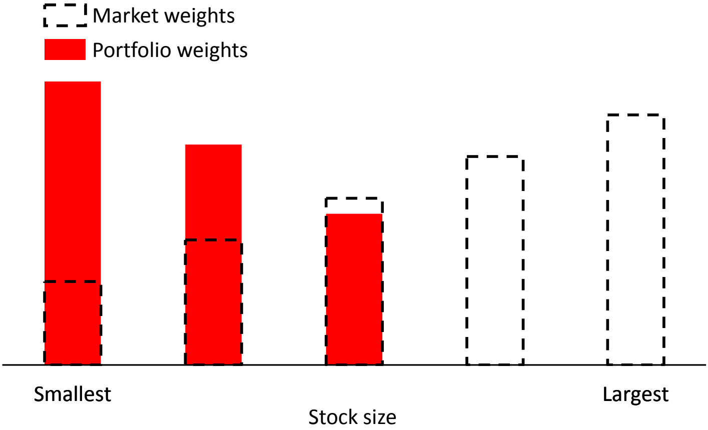


Example: High Stock Liquidity



Example: Low Stock Liquidity



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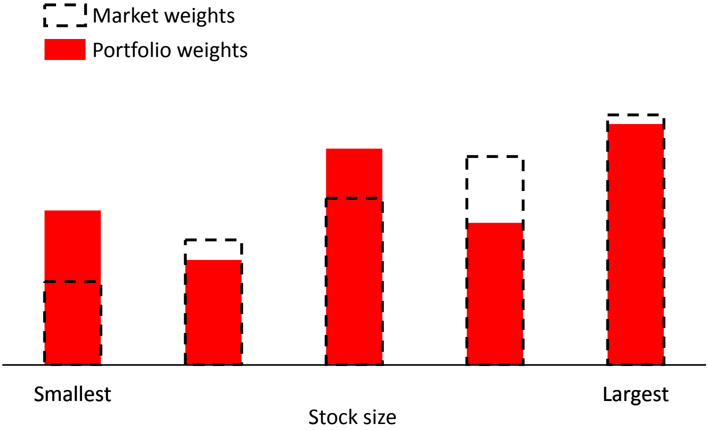

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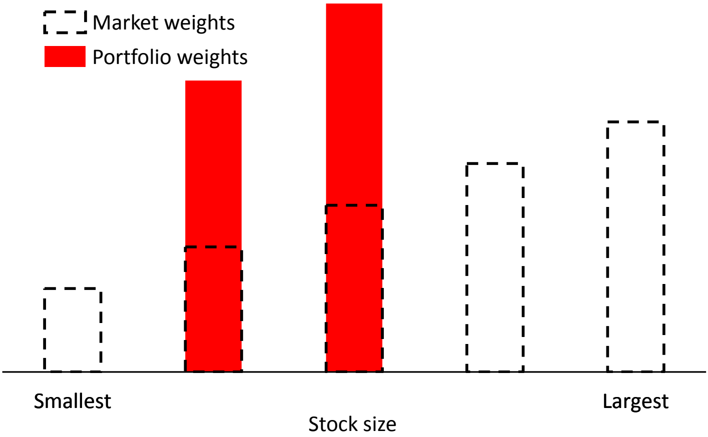
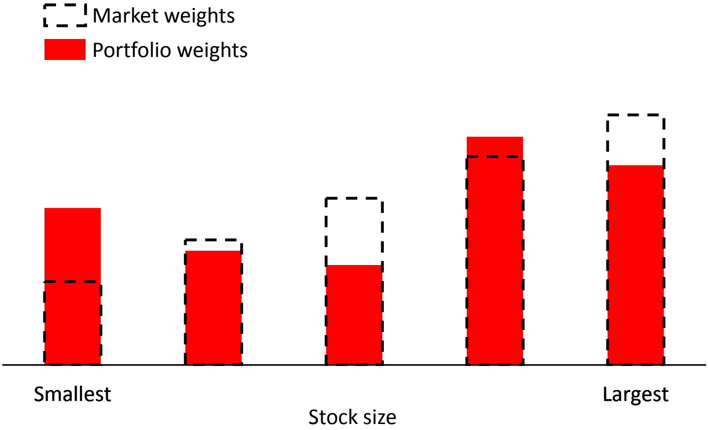


Example: High Coverage



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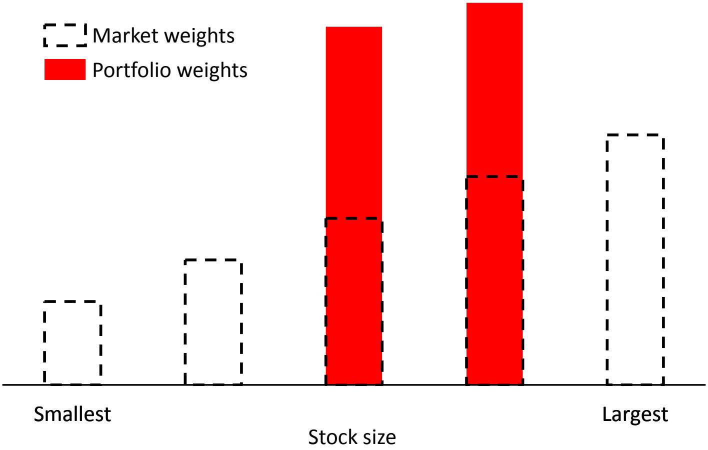
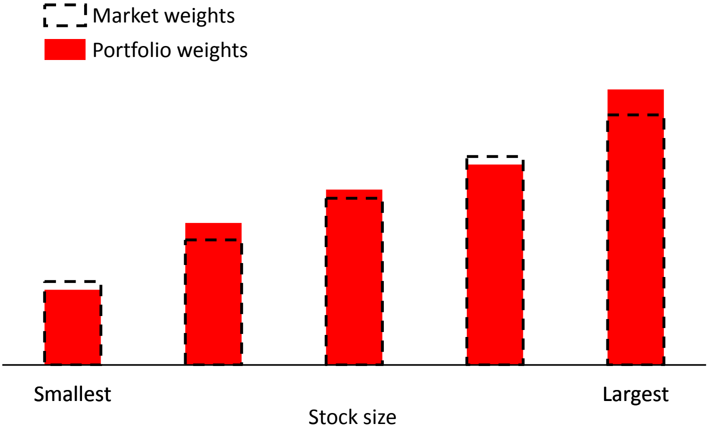


Example: High Balance



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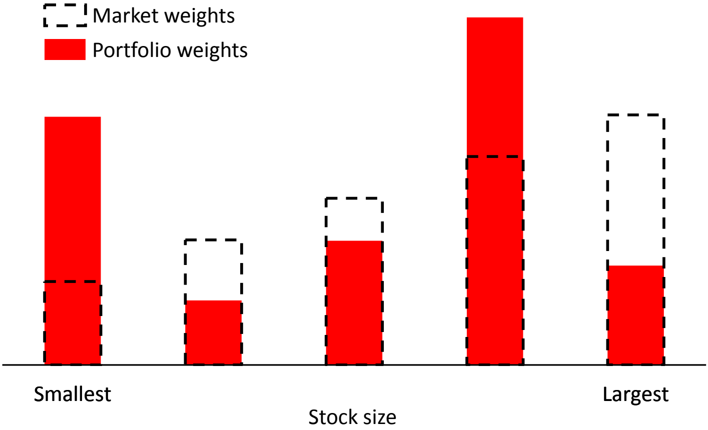
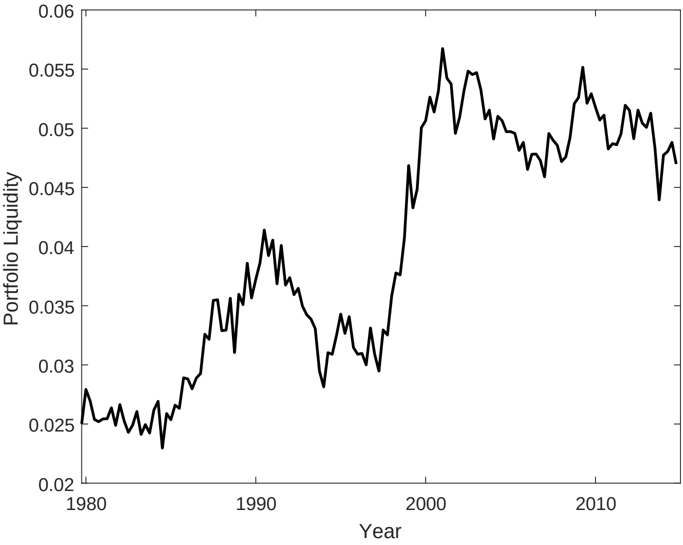


Sample

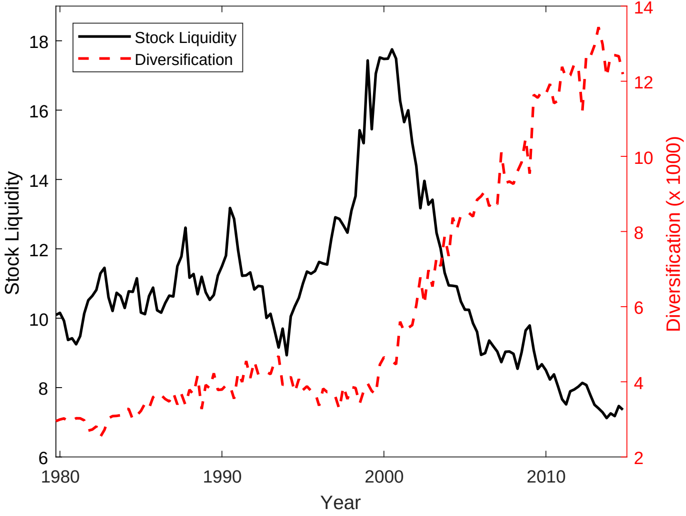
- 2,789 active U.S. domestic equity mutual funds, 1979–2014

- **Data**: Combine CRSP, Morningstar, Thomson Reuters
  - Check accuracy across databases
  - Exclude index funds, non-equity funds, international funds, industry funds, target-date funds, funds of funds, funds with size $<$ \$15 million

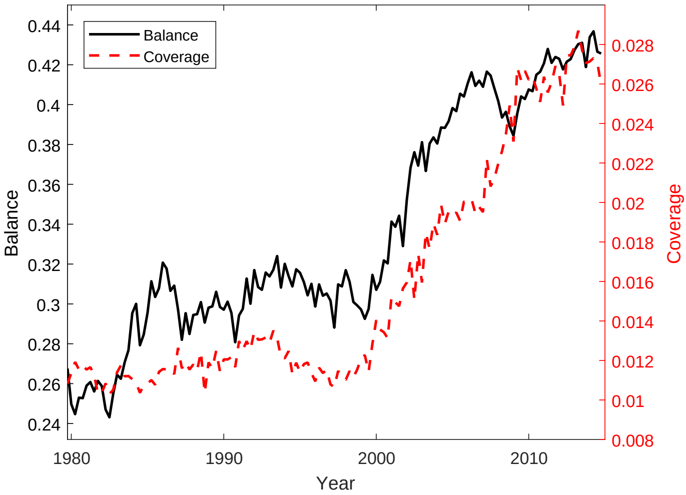
Portfolio liquidity has doubled...



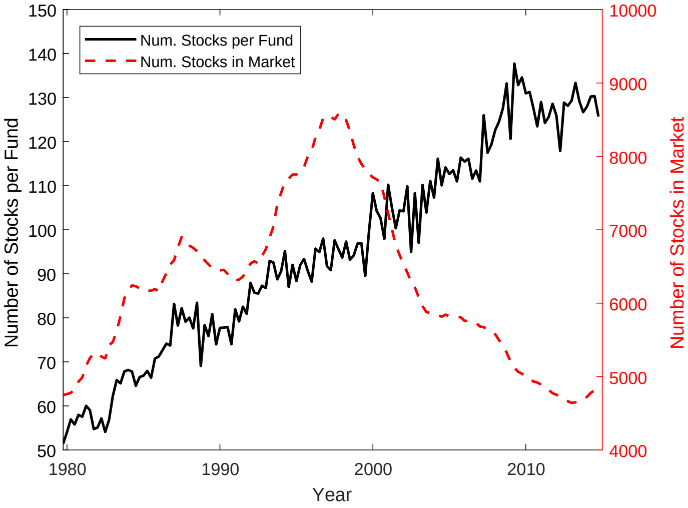
...because diversification has tripled



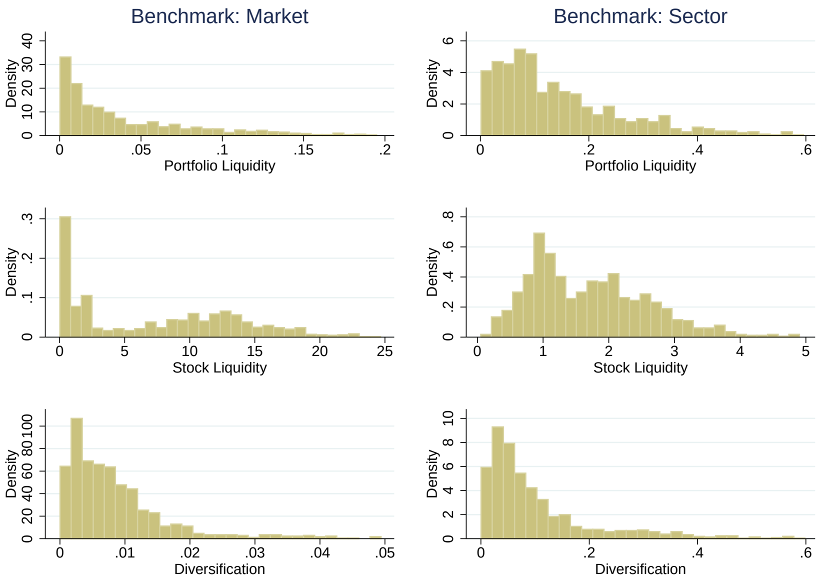
Both components of diversification have trended up



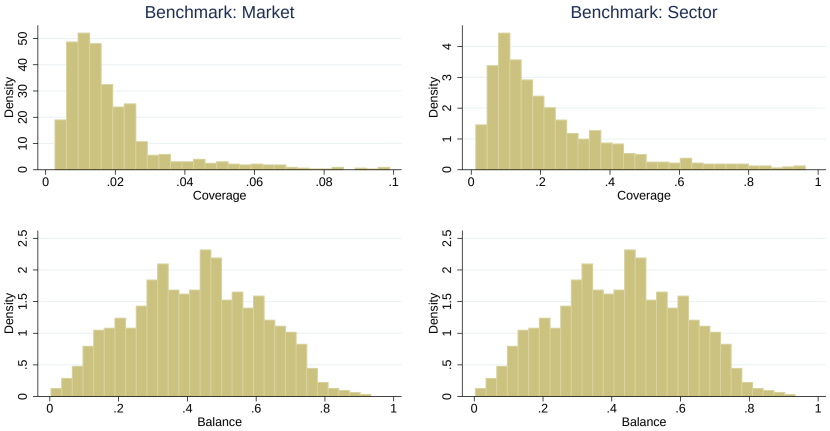
Funds are holding more and more stocks



Portfolio liquidity is low, due to low diversification



Low diversification is driven mostly by low coverage



Road map

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- Tradeoffs among fund characteristics
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- Predict fund returns
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  - Empirics

Equilibrium model

- Fund's expected benchmark-adjusted return, before costs & fees:

$$a = \underbrace{\mu}_{\text{skill}} \times \underbrace{TL^{-\frac{1}{2}}}_{\text{activeness}}$$

  - Increasing in μ and T
  - Decreasing in L

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Why do illiquid portfolios generate higher expected returns?

$$L = \underbrace{\text{Stock Liquidity}}_{\text{more mispricing}} \times \underbrace{\text{Coverage}}_{\text{best ideas}} \times \underbrace{\text{Balance}}_{\text{larger bets}}$$

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- Fund's expected trading profit, gross of costs:

$$aA = \mu \underbrace{ATL^{-\frac{1}{2}}}_{V}$$

Equilibrium model

- Fund's expected trading cost (from before):

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- Fund's expected trading profit, net of costs:

$$\Pi = \mu V - (c/M) V^2$$

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  - Choice of f determines A but does not affect Π
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- Investors compete $\Rightarrow \alpha = 0$ (à la Berk and Green, 2004)
  - This implies $\Pi = Af$

Solution

- Fund's first-order condition:

$$\underbrace{ATL^{-\frac{1}{2}}}_{V} = \frac{\mu M}{2c}$$

- Impose $\alpha = 0 \Rightarrow$

$$A = \frac{\mu^2 M}{4cf}$$

- Combine previous equations $\Rightarrow$

$$\mathbf{\log(L) = \log(A) - \log(f) + 2\log(T)} + \text{constant}$$

Testing the model

- Interpret our main prediction as a panel regression:

$$\log(L) = \beta_0 + \beta_1 \log(A) + \beta_2 \log(f) + \beta_3 \log(T) + \epsilon$$

- 76,928 fund/quarter observations
- Sector $\times$ quarter fixed effects, cluster by fund

Testing the model

$$\log(L) = \log(A) - \log(f) + 2\log(T) + \text{constant}$$

	(1) Portfolio Liquidity	(2)	(3)	(4)	(5)
Fund Size	0.124				
	(13.76)				
Expense Ratio	-0.608				
	(-11.26)				
Turnover	0.101				
	(4.93)				
R^2	0.652				
R^2 (FEs only)	0.598				

Testing the model

$$\log(\text{Portfolio Liquidity}) = \log(\text{Diversification}) + \log(\text{Stock Liquidity})$$

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Fund Size	0.124	0.134			
	(13.76)	(15.00)			
Expense Ratio	-0.608	-0.622			
	(-11.26)	(-11.00)			
Turnover	0.101	0.122			
	(4.93)	(5.96)			
Stock Liquidity		-0.621			
		(-21.61)			
R^2	0.652	0.465			
R^2 (FEs only)	0.598	0.240			

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	(1) Portfolio Liquidity	(2) Diversification	(3) Coverage	(4)	(5)
Fund Size	0.124	0.134	0.0940		
	(13.76)	(15.00)	(12.08)		
Expense Ratio	-0.608	-0.622	-0.408		
	(-11.26)	(-11.00)	(-9.33)		
Turnover	0.101	0.122	0.102		
	(4.93)	(5.96)	(6.37)		
Stock Liquidity		-0.621	-0.337		
		(-21.61)	(-14.21)		
Balance			-0.0447		
			(-2.08)		
R^2	0.652	0.465	0.336		
R^2 (FEs only)	0.598	0.240	0.163		

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	(1) Portfolio Liquidity	(2) Diversification	(3) Coverage	(4) Balance	(5)
Fund Size	0.124	0.134	0.0940	0.0452	
	(13.76)	(15.00)	(12.08)	(7.54)	
Expense Ratio	-0.608	-0.622	-0.408	-0.238	
	(-11.26)	(-11.00)	(-9.33)	(-6.95)	
Turnover	0.101	0.122	0.102	0.0247	
	(4.93)	(5.96)	(6.37)	(1.92)	
Stock Liquidity		-0.621	-0.337	-0.308	
		(-21.61)	(-14.21)	(-14.90)	
Balance			-0.0447		
			(-2.08)		
Coverage				-0.0343	
				(-2.09)	
R^2	0.652	0.465	0.336	0.286	
R^2 (FEs only)	0.598	0.240	0.163	0.172	

Testing the model

log(Portfolio Liquidity) = log(Diversification) + log(Stock Liquidity)

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Expense Ratio	-0.608	-0.622	-0.408	-0.238	-0.132
	(-11.26)	(-11.00)	(-9.33)	(-6.95)	(-5.26)
Turnover	0.101	0.122	0.102	0.0247	-0.0146
	(4.93)	(5.96)	(6.37)	(1.92)	(-1.32)
Stock Liquidity		-0.621	-0.337	-0.308	
		(-21.61)	(-14.21)	(-14.90)	
Balance			-0.0447		
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Coverage				-0.0343	
				(-2.09)	
Diversification					-0.264
					(-24.49)
R^2	0.652	0.465	0.336	0.286	0.882
R^2 (FEs only)	0.598	0.240	0.163	0.172	0.857

Correlations among fund characteristics

- Model also makes predictions about simple correlations Assumptions

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Prediction	Variables (logs)	Correlations: X-sectional	Correlations: T-series
1. Larger funds are cheaper	Fund Size, Expense Ratio	−0.315 (−15.3)	−0.251 (−17.6)

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Prediction	Variables (logs)	Correlations X-sectional	Correlations T-series
1. Larger funds are cheaper	Fund Size, Expense Ratio	−0.315 (−15.3)	−0.251 (−17.6)
2. Funds that trade less are larger and cheaper	Turnover, Fund Size	−0.105 (−6.0)	−0.147 (−12.2)
	Turnover, Expense Ratio	0.130 (6.4)	0.105 (7.6)

Correlations among fund characteristics

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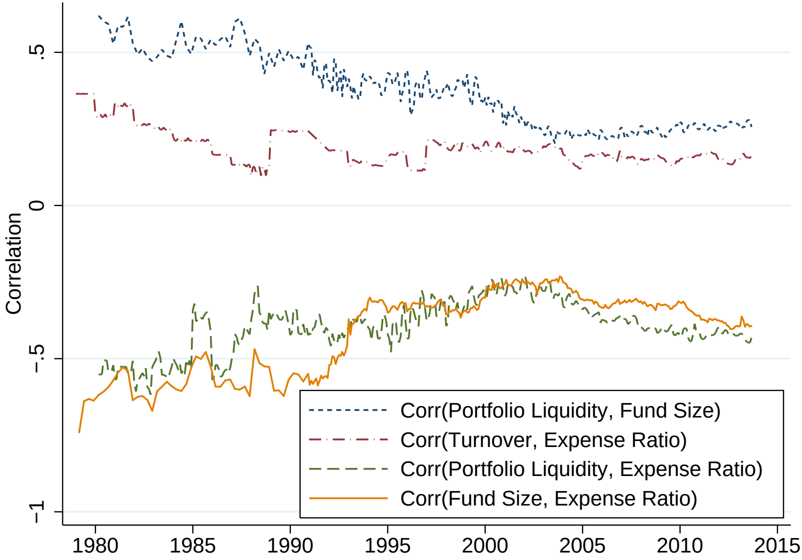
2. Funds that trade less are larger and cheaper	Turnover, Fund Size	−0.105 (−6.0)	−0.147 (−12.2)
	Turnover, Expense Ratio	0.130 (6.4)	0.105 (7.6)
3. Funds with more liquid portfolios are larger and cheaper	Port. Liquidity, Fund Size	0.285 (17.9)	0.308 (18.2)
	Port. Liquidity, Expense Ratio	−0.291 (−13.4)	−0.118 (−6.9)

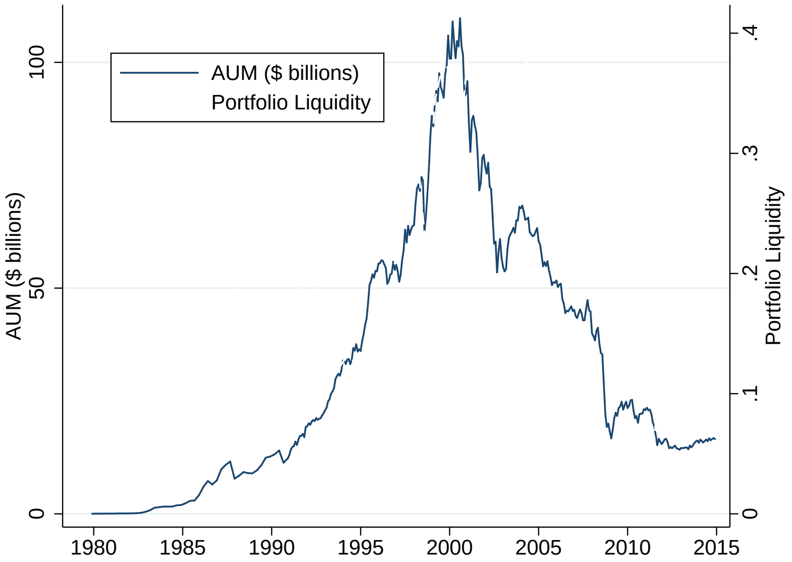
Correlations among fund characteristics

		Correlations	
Prediction	Variables (logs)	X-sectional	T-series
4. Larger funds are less active	Fund Size, Activeness	-0.231 (-13.3)	-0.268 (-17.6)
5. Cheaper funds are less active	Expense Ratio, Activeness	0.255 (13.58)	0.136 (9.20)

Cross-sectional correlations over time



Example: Fidelity's Magellan fund



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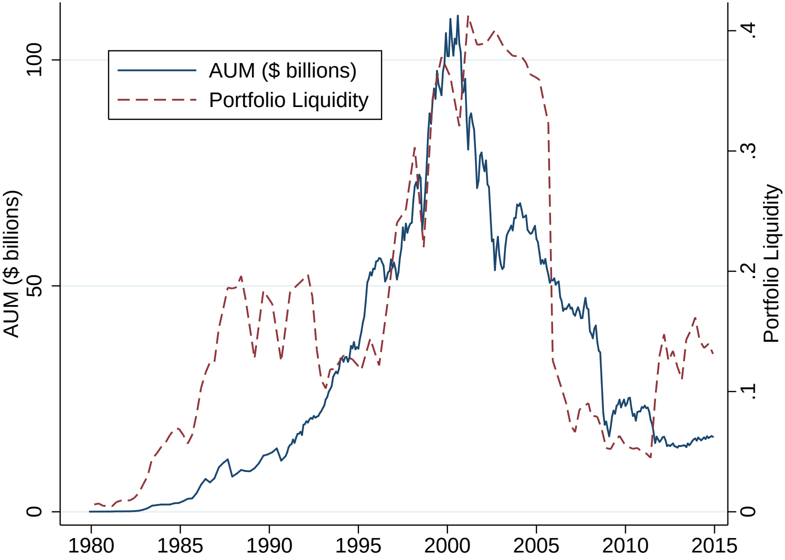

Road map

- Introduce portfolio liquidity
  - Theory
  - Empirics
- Tradeoffs among fund characteristics
  - Theory
  - Empirics
- Predict fund returns
  - Theory
  - Empirics

Predicting fund returns: Theory

- So far: Investors allocate capital perfectly to funds
- Extend model to allow capital misallocation:

$$\underbrace{A}_{\text{actual}} = \underbrace{\bar{A}}_{\text{equilibrium}} \times (1 + \underbrace{\delta}_{\text{excess}})$$

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- Fund observes δ, adjusts its activeness optimally:

$$\underbrace{TL^{-\frac{1}{2}}}_{\text{actual}} = \underbrace{\bar{T}\bar{L}^{-\frac{1}{2}}}_{\text{equilibrium}} \;/\; (1+\delta)$$

Fund gets too much capital $\Rightarrow$ Either $T \downarrow$ or $L \uparrow$

Predicting fund returns: Theory

- Fund's net alpha:

$$\alpha = -\left(\frac{\delta}{1+\delta}\right) f$$

  - Funds that are too big have $\alpha < 0$. Especially for high-f funds.

Predicting fund returns: Theory

- Fund's net alpha:

$$\alpha = -\left(\frac{\delta}{1+\delta}\right) f$$

  - Funds that are too big have $\alpha < 0$. Especially for high-f funds.

- Challenge: How to measure excess fund size ($\boldsymbol{\delta}$)

- Model predicts

$$\log(L) \approx \log(A) - \log(f) + 2\log(T) + \log(c) + \boldsymbol{\delta}$$

- We estimate excess fund size as $\hat{\delta}_{i,t}$ from a panel regression

Predicting fund returns: Panel regressions

Dependent variable: Benchmark-adjusted fund return in month $t + \tau$

	Forecasting Horizon (τ, in months)				
	1	6	12	24	48
Excess size	-0.0360	-0.0282	-0.0283	-0.0236	-0.0118
	(-4.00)	(-3.31)	(-3.51)	(-2.97)	(-1.57)
Observations	199,311	190,612	180,763	161,449	127,440

* Regressions include sector $\times$ month FEs, cluster by sector $\times$ month

Predicting fund returns: Portfolio sorts

Each month t, sort funds into 5 EW portfolios based on $\hat{\delta}_{i,t-12}$
Portfolios' average benchmark-adjusted returns (% per month):

	Excess Fund Size					
	Low	2	3	4	High	High−Low
All Funds	-0.028	-0.055	-0.062	-0.071	-0.082	-0.053
	(-0.78)	(-1.91)	(-2.26)	(-2.73)	(-3.02)	(-1.32)
High Expense Ratio	-0.006	-0.078	-0.094	-0.081	-0.115	**-0.109**
	(-0.14)	(-2.29)	(-3.26)	(-2.77)	(-4.18)	**(-2.47)**
Low Expense Ratio	-0.040	-0.038	-0.037	-0.052	-0.046	-0.006
	(-0.98)	(-1.23)	(-1.16)	(-1.72)	(-1.48)	(-0.13)
High−Low	0.034	-0.040	-0.057	-0.029	-0.069	**-0.103**
	(0.91)	(-1.26)	(-2.08)	(-1.08)	(-3.23)	**(-2.59)**

Conclusions

1. Model & document strong relations among **fund characteristics**
   - Funds with more liquid portfolios are larger, cheaper, and trade more
   - Larger funds are cheaper
   - Funds that trade less are larger and cheaper
2. Introduce concept of **portfolio liquidity**
   - Portfolio Liquidity $=$ Stock Liquidity $\times$ Diversification
   - Derive simple measures of portfolio liquidity and diversification
3. Analyze capital misallocation to mutual funds
   - Funds that are too big underperform

ADDITIONAL SLIDES

Assumptions about μ

1. Larger funds are cheaper
   - $\beta_{\mu,f}$ = slope of $\log(\mu)$ on $\log(f)$
   - Assumption: $\beta_{\mu,f} < 1/2$
2. Funds that trade less are larger and cheaper
   - $\beta_{\mu,A}$ = slope of $\log(\mu)$ on $\log(A)$
   - Assumption: $\beta_{\mu,A} < 1$
   - Assumption: $\beta_{\mu,f} < 1$
3. Funds with more-liquid portfolios are larger and cheaper
   - Assumption: $\beta_{\mu,A} < 1$
   - Assumption: $\beta_{\mu,f} < 1$

Back to correlations