Fund Tradeoffs

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Luke Taylor (Wharton)
Motivation

- **US mutual funds**
  - manage $21 trillion dollars
  - hold 25% of corporate equity
  - nearly 70% of equity-fund AUM is actively managed
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- Scale diseconomies in active management
  - Berk and Green (2004): expected performance (alpha) is zero
  - inherent challenge for performance-based evidence
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- Fund characteristics: strong evidence of scale diseconomies
Main contributions

- Equilibrium model linking key fund characteristics
  - fund size, expense ratio, turnover, portfolio liquidity

Strong empirical evidence of implied tradeoffs consistent with scale diseconomies

Introduce portfolio liquidity, the product of:
  - average liquidity of the stocks held
  - diversification of the portfolio

New diversification measure, the product of:
  - coverage: number of stocks held vs. benchmark
  - balance: weights on stocks held vs. market-cap weights

Fund activeness: combines portfolio liquidity and turnover
Fund scale: combines activeness as well as fund size
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Implied fund tradeoffs supported by our evidence

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- Smaller fund $\Leftrightarrow$ higher fee
Literature

- Our focus on fund characteristics seems novel
- Involves some familiar concepts
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- Decreasing returns to scale in active management
  - Several papers relate fund size to performance
  - We relate fund size to multiple fund characteristics

- 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
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Introducing portfolio liquidity

- Portfolio is more liquid $\iff$ less costly to trade a fraction of it
Introducing portfolio liquidity

- Portfolio is more liquid ⇔ less costly to trade a fraction of it
- Simple trading cost function ⇒

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

*N*: number of stocks in portfolio

*w*<sub>*i*</sub>: portfolio’s weight on stock *i*

*m*<sub>*i*</sub>: weight on stock *i* in a value-weighted benchmark
Introducing portfolio liquidity

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- $m_i$: weight on stock $i$ in a value-weighted benchmark

- $L \in (0, 1]$
- Least liquid portfolio: single, smallest stock in the benchmark
- Most liquid portfolio: the benchmark portfolio ($L = 1$)
Introducing portfolio liquidity

Assumption: larger trades have higher proportional costs:

\[ C_i = c \frac{D_i}{M_i} \]

- \( C_i \): cost per dollar traded of stock \( i \)
- \( D_i \): dollar amount traded of stock \( i \)
- \( M_i \): stock \( i \)'s market cap
- \( c \): same for all stocks in the portfolio’s benchmark
Introducing portfolio liquidity

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- If \( D \) is the total dollar amount of the portfolio traded

\[ D_i = Dw_i \]
Introducing portfolio liquidity

- Total cost of trading that dollar amount $D$ of the portfolio:

$$C = \sum_{i}^{N} D_i C_i$$

$$= \sum_{i}^{N} (Dw_i) \left( c \frac{Dw_i}{M_i} \right)$$

$$= \left( \frac{c}{M} \right) D^2 \left( \sum_{i=1}^{N} \frac{w_i^2}{m_i} \right)$$

$(M$: market capitalization of all stocks in the benchmark$)$
Introducing portfolio liquidity

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$L^{-1}$

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- Fund’s expected trading cost: \( C = \theta A^\gamma T^\lambda L^{-\phi} \)
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\[ \Rightarrow F = \left( \frac{1}{\theta} T^{-\lambda} L^{\phi} \left[ \mu g(T, L) - f \right] f^{\gamma-1} \right)^{\frac{1}{\gamma-1}} \]
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- FOC for  \( f \) implies

\[ \ln L = b_0 + b_1 \ln A - b_2 \ln f + b_3 \ln T \]

-  \( b_0, b_1, b_2, \) and  \( b_3 \) are positive constants
-  they don’t depend on fund-specific skill,  \( \mu \)
Empirical evidence

- 2,789 active U.S. domestic equity mutual funds, 1979–2014
- 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
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- Panel regression, fund $i/quarter$ $t$,

$$ (\ln L)_{i,t} = a_0 + a_1 (\ln A)_{i,t} + a_2 (\ln f)_{i,t} + a_3 (\ln T)_{i,t} + \epsilon_{i,t} $$
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- Sector-quarter fixed effects, essentially treating
  - the model as cross-sectional
  - $L$ as defined using a sector-specific benchmark
  - $c$ as constant within a given sector and quarter
- Cluster by funds
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- Cluster by funds
- **Expect** \( a_1 > 0, a_2 < 0, a_3 > 0 \)
Explaining mutual funds’ portfolio liquidity

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fund Size</td>
<td>0.157</td>
<td></td>
<td>0.124</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(17.77)</td>
<td></td>
<td>(13.76)</td>
<td></td>
</tr>
<tr>
<td>Expense Ratio</td>
<td>-0.766</td>
<td></td>
<td>-0.608</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-13.29)</td>
<td></td>
<td>(-11.26)</td>
<td></td>
</tr>
<tr>
<td>Turnover</td>
<td></td>
<td>0.0408</td>
<td>0.101</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.93)</td>
<td>(4.93)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>88925</td>
<td>89017</td>
<td>81892</td>
<td>76928</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.627</td>
<td>0.623</td>
<td>0.591</td>
<td>0.652</td>
</tr>
<tr>
<td>$R^2$ (FEs only)</td>
<td>0.594</td>
<td>0.588</td>
<td>0.591</td>
<td>0.598</td>
</tr>
</tbody>
</table>
Components of portfolio liquidity

- Decomposition of portfolio liquidity

\[ L = \frac{1}{N} \sum_{i=1}^{N} L_i \times \left( \frac{N}{N_M} \right) \left[ 1 + \text{Var}^* \left( \frac{w_i}{m_i^*} \right) \right]^{-1} \]

- Stock Liquidity

- Diversification

\[ L_i = M_i / \overline{M}, \text{ a measure of stock } i\text{'s liquidity} \]

\[ \overline{M}: \text{ average market cap of stocks in the benchmark} \]

\[ N_M: \text{ number of stocks in the benchmark} \]

\[ \text{Var}^* ( \cdot ) : \text{ variance using the measure defined by the weights } m_i^* \]

\[ m_i^* = m_i / \sum_{i=1}^{N} m_i \]
Components of portfolio liquidity

- Decomposition of diversification

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

- Coverage: fraction of available (benchmark) stocks held
- Balance: closeness to market-cap weights on stocks held
- Diversification, Coverage, Balance are all \( \in (0, 1] \)
Portfolio liquidity has doubled...
...because diversification has tripled
Both components of diversification have trended up
Funds are holding more and more stocks
Explaining the components of portfolio liquidity

<table>
<thead>
<tr>
<th></th>
<th>(1) Diversification</th>
<th>(2) Coverage</th>
<th>(3) Balance</th>
<th>(4) Stock Liq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fund Size</td>
<td>0.134</td>
<td>0.0940</td>
<td>0.0452</td>
<td>0.0122</td>
</tr>
<tr>
<td></td>
<td>(15.00)</td>
<td>(12.08)</td>
<td>(7.54)</td>
<td>(2.35)</td>
</tr>
<tr>
<td>Expense Ratio</td>
<td>-0.622</td>
<td>-0.408</td>
<td>-0.238</td>
<td>-0.132</td>
</tr>
<tr>
<td></td>
<td>(-11.00)</td>
<td>(-9.33)</td>
<td>(-6.95)</td>
<td>(-5.26)</td>
</tr>
<tr>
<td>Turnover</td>
<td>0.122</td>
<td>0.102</td>
<td>0.0247</td>
<td>-0.0146</td>
</tr>
<tr>
<td></td>
<td>(5.96)</td>
<td>(6.37)</td>
<td>(1.92)</td>
<td>(-1.32)</td>
</tr>
<tr>
<td>Stock Liquidity</td>
<td>-0.621</td>
<td>-0.337</td>
<td>-0.308</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-21.61)</td>
<td>(-14.21)</td>
<td>(-14.90)</td>
<td></td>
</tr>
<tr>
<td>Balance</td>
<td></td>
<td>-0.0447</td>
<td></td>
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<td>$R^2$</td>
<td>0.465</td>
<td>0.336</td>
<td>0.286</td>
<td>0.882</td>
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<tr>
<td>$R^2$ (FEs only)</td>
<td>0.240</td>
<td>0.163</td>
<td>0.172</td>
<td>0.857</td>
</tr>
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</table>
Fund activeness

- Recall fund’s gross return: $a = \mu g(T, L)$
- Depends positively on
  - skill, $\mu$
  - activeness, $g(T, L)$
- Expect $g(T, L)$ to be
  - increasing in $T$
  - decreasing in $L$
- Empirical measure of activeness:
  $$g(T, L) = TL^{-1/2}$$
  - motivated by $g$ as a choice variable, plus
  - simplest specification of cost-function parameters
- Model implies activeness is
  - increasing in $f$
  - decreasing in $A$
## Explaining fund activeness

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<td>0.558</td>
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Correlations among fund characteristics

- Model also motivates observed simple correlations

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<th>Correlations</th>
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<tr>
<td></td>
<td>X-sectional</td>
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<td>1. Larger funds are cheaper</td>
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<tr>
<td>2. Funds that trade less are larger and cheaper</td>
<td>Turnover, Fund Size</td>
</tr>
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<tr>
<td>3. Funds with more liquid portfolios are larger and cheaper</td>
<td>Port. Liquidity, Fund Size</td>
</tr>
<tr>
<td></td>
<td>Port. Liquidity, Expense Ratio</td>
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</table>
Cross-sectional correlations over time

- Corr(Portfolio Liquidity, Fund Size)
- Corr(Turnover, Expense Ratio)
- Corr(Portfolio Liquidity, Expense Ratio)
- Corr(Fund Size, Expense Ratio)
Example: Fidelity’s Magellan fund
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Conclusion

- Model & document strong relations among fund characteristics
  - Smaller fund, higher fee, lower turnover $\Rightarrow$ less-liquid portfolio
  - Above three plus less diversified portfolio $\Rightarrow$ more liquid stocks
  - Lower coverage, controlling for the above $\Rightarrow$ higher balance
  - Smaller fund, higher fee $\Rightarrow$ higher activeness
  - Smaller fund $\Leftrightarrow$ higher fee

- Introduce concept of portfolio liquidity
  - Portfolio Liquidity $=\text{Stock Liquidity} \times \text{Diversification}$
  - Derive simple measures of portfolio liquidity and diversification