The Efficiency of Defined Contribution Plan Investment Menus

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Motivation

• Defined contribution (DC) pensions are main US retirement saving vehicle (aka 401(k) plans).

• Employers design plans including contributions, matches, and ever-larger investment menus.

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• Defined contribution (DC) pensions are main US retirement saving vehicle (aka 401(k) plans).

To date, few studies explore 401(k) investment menu design:

– Are plans more efficient when they offer more options?

– Are 401(k) plans offered by employers to their employees efficient?
This Study

We examine recordkeeping data from 1,014 plans administered by Vanguard: # and type of investment choice selected, assets, demographics, non-pension plan-level data.

Participant-level data: and type of investment choice selected, assets, demographics, non-pension total assets, N accounts, source of contributions, 8 to 60 yearly returns for each fund and plan type.

Plan-level data: # and type of investment choice selected, assets, demographics, non-pension total assets, N accounts, source of contributions, 8 to 60 yearly returns for each fund and plan type.
necessary "better."

"More" investment choices are not

Participants behavior may undo efficient menus.

- Utility Loss
- Idiosyncratic Risk Share
- Relative Share Ratio Loss

Three performance measures (Calvet, Campbell and Sodini, 2006)

Intersection test with short sale constraints (DeRoon, Nijman and

diversification.

Most plans are efficient and permit proper

Preview of Findings:
% of Plans Offered by N Funds Offered

Mean = 13

Num of funds

% of plans

12% 10% 8% plans

Mean = 13

0%
-2%
-4%
-6%
-8%
-10%
-12%
% of Plans Offering Options

% of Plans by Fund Type Offered

Fund Type

International
Money Market Bond
Balanced Equity
Other Company
Stock Company

80
60
40
20
0
100
<table>
<thead>
<tr>
<th>Total N Funds vs. Actively Managed Funds vs.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Index Equity</strong></td>
</tr>
<tr>
<td>Num of Funds</td>
</tr>
<tr>
<td>Num of bonds</td>
</tr>
</tbody>
</table>
Efficiency Test

• Can one improve performance of the tangency portfolio of funds held by a plan, by adding more investment choices not now in the plan menu?

Intersection test with short sale constraints (DeRoon, Nijman and Werker, 2001): 0 > \gamma 

Regression:

\sum \gamma R_i + \gamma \beta_j + \gamma \alpha = \gamma

Result: 94% of the 1,014 plans efficient

Can one improve performance of the tangency portfolio of funds held by a plan, by adding more investment choices not now in the plan menu?
Three Additional Performance Measures at the Plan Level

• Relative Sharpe ratio loss (RSRL): Are plans mean-variance efficient?
• Idiosyncratic risk share (IRS): Do plans permit diversification?
• Utility loss (UL): How might participants lose from constrained menu?

Calvet, Campbell and Sodini, 2006
Relative Sharpe Ratio Loss vs. N Funds

\[ \frac{d}{S} S - 1 = \frac{d}{\text{Relative Sharpe Ratio Loss}} \]
Idiosyncratic Risk Share vs. N Funds

\[ d \frac{\sigma}{\sigma_{\text{idio}}} = d \text{ IRS} \]

mean: 0.03

N of Funds

Idiosyncratic Risk Share vs. N Funds
Annual Utility Loss $\lambda \sigma^2$ vs. N Funds

\[
\frac{d}{d \zeta} S - \frac{b}{d \zeta} S = \frac{d}{\zeta} \mathcal{U}
\]
### Multivariate Regression on Plan Efficiency and Performance

#### Dependent Variables

- **Plan Efficiency Dummy**
  - Mean = 0.03
  - Marginal Effect: 93.8%

- **Relative Sharpe**
  - Mean = 9.34%
  - Marginal Effect: 9.34%

#### Independent Variables

<table>
<thead>
<tr>
<th>OLS Coefficient</th>
<th>Marginal Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company Stock</td>
<td><strong>0.81%</strong></td>
</tr>
<tr>
<td>Actively managed international equity funds</td>
<td>0.24%</td>
</tr>
<tr>
<td>Index international equity funds</td>
<td>0.78%</td>
</tr>
<tr>
<td>Actively managed domestic equity funds</td>
<td><strong>0.81%</strong></td>
</tr>
<tr>
<td>Index domestic equity funds</td>
<td>18.39%</td>
</tr>
<tr>
<td>Actively managed bond funds</td>
<td>0.49%</td>
</tr>
<tr>
<td>Index bond funds</td>
<td>10%</td>
</tr>
<tr>
<td>Offer index balanced funds (yes=1, no=0)</td>
<td>9.34%</td>
</tr>
<tr>
<td>Number of funds square</td>
<td>0.10%</td>
</tr>
<tr>
<td>Number of funds</td>
<td>0.25%</td>
</tr>
</tbody>
</table>

#### Significance Levels

- ****: p < 0.10
- ***: p < 0.01
- ****: p < 0.001

---

The table above illustrates the results of a multivariate regression analysis focusing on plan efficiency and performance. The dependent variable is the plan efficiency dummy, which is a binary indicator (1 = efficient, 0 = inefficient) with a mean of 0.03, indicating 3% of plans being efficient. The relative sharpe, with a mean of 9.34%, shows a marginal effect of 9.34%, suggesting a high level of efficiency in performance. Significant variables include actively managed international equity funds, index international equity funds, actively managed domestic equity funds, index domestic equity funds, actively managed bond funds, index bond funds, offer index balanced funds (yes=1, no=0), and number of funds, among others. Each variable is analyzed for its impact on the dependent variables, with p-values below 0.10, 0.01, and 0.001 indicating statistical significance.
Can Participants "Undo" Efficient Plans?

Tangency Portfolio vs. Naive (1/N) Allocation

Utility Loss (γ=4)

Relative Sharpe

Idiosyncratic Risk

Ratio Loss

Tangency Portfolio vs. Naive (1/N) Allocation

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Conclusions

- Most 401(k) plans offer efficient investment menus.
- No need to offer more than about 8-9 fund choices.
- Participants can undo inefficient menu offerings.
- Better tailored menu is better than more options per se.
- No need to offer more than about 8-9 fund investment menus.

Most 401(k) plans offer efficient investment menus.
Thank you!

For more information:

• Wharton’s Pension Research Council:

  http://prc.wharton.upenn.edu/prc/prc.html