Better investing through technology
Fintech is a big space
Fintech is a big space
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Robo-advisor

“provides financial advice or investment management online with moderate to minimal human intervention. They provide digital financial advice based on mathematical rules or algorithms, executed by software.”
Betterment

Automated, online financial advising platform

- Goal-based advice and investment management
- Higher returns at a lower cost by using technology to automate optimal investing practices
In a nutshell

Better investing outcomes through:

- Low costs
- Diversified portfolio
- Smart portfolio management
- Tax optimization
- Good investing behavior
We construct optimal investment portfolios

- Global portfolio of stocks and bonds
- Managed algorithmically
We keep costs low

Mean and range of fund costs:

- **Low-cost broad index ETFs**
- **Portfolio expense ratios:** 7bps - 17bps
- **Technology keeps Betterment’s management fee low:** 25bps
We keep taxes low

Additional Returns with Tax Loss Harvesting+

Backtested performance with tax savings reinvested, 2000-2013

+ $45k gains
+ 0.77% returns

- ETFs vs Mutual Funds
- Sell the right lots (FIFO vs smart management)
- Smart rebalancing
- Tax Loss Harvesting
- Asset location
We provide investment advice

- Goal-based advice to reach desired financial outcomes
- Recommended saving amount
- Recommended risk level
We promote good behavior

- Smart defaults
- Automated rebalancing
- Using investor biases for good
- Goal-based
We do this across multiple lines of business
History of technology in financial services

(Told with a brief analogy)
Experts behind screens

✖ Limited capacity

✖ Potential for errors manual, mechanical, and redundant processes.

✔ Can solve complicated problems.
Guided and self-directed

Machines are better
- Rule-based decisions
- Calculations at scale
- Data aggregation and retrieval
  *Ex: flight check-in*

Humans are better
- Complex decisions
- Abstract thought
- Flexibility in logic and inputs
  *Ex: lost bag*

Get customers comfortable interacting with machines (UX)
Financial planning is not flight check-in

- What can be self-directed?
- What can be automated?
- What requires expert guidance?
- How to deal with complexity
  - Financial complexity
  - Human/behavioral complexity
Adding technology to investment management
Spending time efficiently

- Human
- Algorithm

- Asset allocation
- Retirement withdrawals
- Tax loss harvesting
- Rebalancing
- Behavioral coaching
- Asset tax location

Value to customer
The line is moving over time

- Asset allocation
- Rebalancing
- Retirement withdrawals
- Behavioral coaching
- Tax loss harvesting
- Asset tax location

Value to customer

Human

Algorithm
Optimize returns net of fees, taxes, and behavior. Technology can help.

Portfolio Returns
- fees
- taxes
- behavior

Investor Returns
How we think about investing
Evidence-based investing

- Markets are unpredictable
  - Find other free lunches
    - Diversification
    - Lower taxes

- Computers can do many things better (and cheaper) than humans
  - Rebalancing
  - Tax strategies

- Reduce mistakes
  - Automation
  - Smart defaults / notifications
Hierarchy of Outperformance

Optimize what you can, obsess over what you control

Markets are unpredictable
- Diversify globally
- Lower taxes

Computers can do many things better (and cheaper) than humans
- Rebalancing
- Tax strategies

Reduce mistakes
- Automation
- Smart defaults / notifications

Most uncertain
- Asset allocation
- Fund selection
- Trading
- Taxes
- Diversification

Most certain
- Low costs

Diversify globally
- Lower taxes

Computers can do many things better (and cheaper) than humans
- Rebalancing
- Tax strategies

Reduce mistakes
- Automation
- Smart defaults / notifications
Optimize for Portfolio Returns
Optimize returns net of fees, taxes, and behavior

**Portfolio Returns**
- fees
- taxes
- behavior

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**Investor Returns**
Globally optimal asset allocation

- Asset returns based on equilibrium pricing and empirical evidence
- Built for maximum diversification
Starting with a mean variance framework

Expected risk and return

- Betterment Portfolios
- Naive Portfolios

Dots represent the 0%, 50%, and 100% stock portfolios.
In reality, MVO is very sensitive to its inputs

Real world problems

- We don’t know **future returns** or **future volatility** with very much certainty

- Small changes in estimates of returns will have a **big impact** on resulting portfolios
### MVO as an error maximizer

<table>
<thead>
<tr>
<th></th>
<th>Portfolio 1</th>
<th></th>
<th>Portfolio 2</th>
<th></th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>St. Dev</td>
<td>E[r]</td>
<td>E[r]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US Stocks (SPY)</td>
<td>15.5%</td>
<td>5%</td>
<td>5.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Int’l Stocks (VEA)</td>
<td>19.4%</td>
<td>6.8%</td>
<td>6.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US Bonds (AGG)</td>
<td>4.0%</td>
<td>0.6%</td>
<td>0.6%</td>
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<td></td>
</tr>
<tr>
<td></td>
<td><strong>Portfolio 1</strong></td>
<td></td>
<td><strong>Portfolio 2</strong></td>
<td></td>
<td><strong>Change</strong></td>
</tr>
<tr>
<td>US Stocks (SPY)</td>
<td>12.6%</td>
<td></td>
<td>58%</td>
<td></td>
<td>45.4%</td>
</tr>
<tr>
<td>Int’l Stocks (VEA)</td>
<td>67.5%</td>
<td></td>
<td>32.7%</td>
<td></td>
<td>-34.8%</td>
</tr>
<tr>
<td>US Bonds (AGG)</td>
<td>19.9%</td>
<td></td>
<td>9.3%</td>
<td></td>
<td>-10.6%</td>
</tr>
</tbody>
</table>

0.5% change in expected returns

Massive shift towards US stocks
There are a number of solutions

- Asset and group constraints
  - Eg:
    - Less than 10% weight in any single security
    - Less than 20% weight in any sector/region/etc
- Black-Litterman
  - Assume the market portfolio has the correct returns
  - Then combine with your own view
- Robust optimization
  - Add error into your optimization and run a bunch of times
Weights anchored to the global market portfolio

Global allocation of assets
Combine with views

+ Small-cap stocks
+ Value stocks

(H/T: Fama-French)
Resulting Betterment portfolio
Resulting Betterment portfolio
Manage to optimal portfolio weights with technology
Manage to target weights automatically

- Use technology to monitor portfolio risk intra-day
- Use cash flows to rebalance when possible

Current Portfolio

Developed Markets

30.1% / $1,647.00

Target Allocation

70% stocks
Rebalancing as a source of alpha

Rebalancing less than 100% correlated assets results in outperformance compared to simple buy and hold of either asset.

Bouchey, 2012
Rebalancing as a source of alpha

Growth of $1:

\[ g = \mu - \frac{\sigma^2}{2} \]

Growth of portfolio:

\[ g_p = \sum_{i=1}^{N} w_i g_i + \frac{1}{2} \left( \sum_{i=1}^{N} w_i \sigma_i^2 - \sum_{i,j=1}^{N,M} w_i \sigma_{ij} w_j \right) \]

= Average Growth + \( \frac{1}{2} \) Average Variance
  - \( \frac{1}{2} \) Portfolio Variance

= Average Growth + Rebalancing Premium

Bouchey, 2012
Risk levels by goal type and horizon

**Major Purchase** - Shorter time horizons; liquidate full account value at maturity

**Retirement** - Longer time horizons; periodic withdrawals
Adjust risk level automatically

Continuous risk management, better opportunity for rebalancing with cash flows
Minimize fees
Optimize returns net of fees, taxes, and behavior

Portfolio Returns

- fees
- taxes
- behavior

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Investor Returns
Technology + experts for fund selection

- Use technology to **filter**, **rank** and **sort** securities in our investable universe
- Display the top candidates in more detail
- Expert review and investment committee approval before adding to portfolio
Start by filtering investable universe

- Start with the all investable ETFs
- Remove concentrated, niche and specialty funds
- Focus on broad-based index funds

ETF Exclusion By Category

Sort by Total Cost of Ownership (TACO)

\[
\text{TACO} = \text{Cost to Hold} + \text{Cost to Trade}
\]

\[
\text{Cost to Hold} = \text{Expense Ratio} + \text{Tracking Difference}
\]

\[
\text{Cost to Trade} = \text{Bid-Ask Spread} + \text{Liquidity (Volume)}
\]
### Detailed view of top candidates

<table>
<thead>
<tr>
<th>Component</th>
<th>Ticker</th>
<th>Name</th>
<th>ExpRatio (bps)</th>
<th>Spread (bps)</th>
<th>Cost to trade (bps)</th>
<th>Track. Diff (bps)</th>
<th>taco</th>
<th>taco_rank</th>
<th>ADV</th>
<th>Index</th>
<th>Potential ExpRatio (bps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQ_US_AC_AS_NA</td>
<td>VTI</td>
<td>Vanguard Total Stock Market ETF</td>
<td>4</td>
<td>0.8</td>
<td>0.9</td>
<td>-0.7</td>
<td>3.9</td>
<td>1</td>
<td>234.34</td>
<td>CRSP US Total Market Index</td>
<td></td>
</tr>
<tr>
<td>EQ_US_AC_AS_NA</td>
<td>SCHB</td>
<td>Schwab US Broad Market ETF</td>
<td>3</td>
<td>2.7</td>
<td>14.3</td>
<td>-6.1</td>
<td>6.8</td>
<td>2</td>
<td>21.44</td>
<td>Dow Jones US Broad Stock Market Index</td>
<td></td>
</tr>
<tr>
<td>EQ_US_AC_AS_NA</td>
<td>ITOT</td>
<td>iShares Core SP Total US Stock Market ETF</td>
<td>3</td>
<td>3.9</td>
<td>15.2</td>
<td>-8</td>
<td>7.1</td>
<td>3</td>
<td>29.52</td>
<td>SP Total Market Index</td>
<td></td>
</tr>
<tr>
<td>EQ_US_AC_AS_NA</td>
<td>IWV</td>
<td>iShares Russell 3000 ETF</td>
<td>20</td>
<td>1.9</td>
<td>13.3</td>
<td>-18.1</td>
<td>23</td>
<td>4</td>
<td>16.79</td>
<td>Russell 3000 Index</td>
<td></td>
</tr>
</tbody>
</table>
Process keeps costs low

- Low-cost, broad index ETFs
- Portfolio expense ratios:
  7bps - 17bps
- Technology keeps management fees low:
  25bps
Keep taxes low
Optimize returns net of fees, taxes, and behavior

Portfolio Returns
- fees
- taxes
- behavior

Investor Returns
Tax minimization strategies

- Asset location
- Tax loss harvesting
- Lot sorting
- Rebalancing
- Investment vehicle (ETFs)
Asset location

Putting tax-inefficient investments (bonds) in tax-efficient accounts (IRAs)
Asset Location

Not asset located:

- Self-contained diversified portfolio in each account -- Roth, Traditional and taxable accounts

Asset located:

- Maintain overall level of diversification
- Locate tax-inefficient assets in tax-advantaged accounts
Asset location can be optimized

- Optimized using linear programming
- Accounts are continuously monitored
- Goes beyond rules of thumb:
  - Consider growth rate of assets
    - Dividend yield and growth rate matter
  - Consider tax drag and liquidation taxes
  - QDI ratios
Asset location implementation is tested for tax alpha using tax lot monte carlo simulations

As a result, investors can get higher take-home returns from TCP than they do traditionally

<table>
<thead>
<tr>
<th>Asset Allocation</th>
<th>Additional Tax Alpha with TCP (Annualized)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% Stocks</td>
<td>0.82%</td>
</tr>
<tr>
<td>70% Stocks</td>
<td>0.48%</td>
</tr>
<tr>
<td>90% Stocks</td>
<td>0.27%</td>
</tr>
</tbody>
</table>

https://www.betterment.com/resources/research/tax-coordinated-portfolio-white-paper/
Tax loss harvesting
Tax Loss Harvesting: An example

Emerging Markets, 1/2/2014 – 5/21/2014

$331 loss harvested

VWO

IEMG

Remain in alternate ticker
TLH innovations

- Stay in secondary ticker after harvest (i.e., don’t switch back immediately)
- Rebalance with each harvest
- Considering spousal accounts to avoid wash sales
- Different secondary ticker for IRA accounts to avoid permanent wash sale rule
- Continuous, intraday monitoring
TLH is backtested to demonstrate after-tax alpha

- Average rate tax payer
- Average savings schedule

https://www.betterment.com/resources/research/tax-loss-harvesting-white-paper/
Tax lot management
Intelligent lot sorting

- Automatically manage sales at the lot-level intelligently
- Sell lots with losses first, then least gains

<table>
<thead>
<tr>
<th>TaxMin</th>
<th>Industry Standard (FIFO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$3,883</td>
<td>$0</td>
</tr>
<tr>
<td>taxes saved</td>
<td>taxes saved</td>
</tr>
</tbody>
</table>

Based on an actual customer withdrawal of $100k in Apr 2014 with tax rate of 30% LT, 50% ST. [About this data](#)
Other tax features

Smart Rebalancing

- Rebalance with dividends and inflows/outflows
- Only rebalance by selling (and realizing a potential tax event) if we have to
- TLH as rebalancing opportunity

ETFs vs Mutual funds

- ETFs lower tax bills due to their legal structure
- Benefits from create-redeem structure to keep basis high.
- Mutual fund holders must pay the capital gains taxes from those who redeemed shares
Behavior matters

Don’t just do something...
Do something useful
Optimize returns net of fees, taxes, and behavior

Portfolio Returns
- fees
- taxes
- behavior

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Investor Returns
Spending time efficiently

- Behavioral coaching
- Retirement withdrawals
- Asset allocation
- Rebalancing
- Tax loss harvesting
- Asset tax location

Value to customer
Fighting market timing
Bad behavior is costly

Estimates of the Behavior Gap

See references for links to published results and methodologies.

*Given for the most actively trading investors in sample.
A minority of customers market time

.. and tend to do it badly, by reacting to markets

- Average behavior gap of 22 bps
- 74% of accounts are better than this average

Sources: Market data from Xignite; Betterment customer data. Active users for each period are those who changed their allocation in the previous 7 days
The more you futz, the worse off you generally are.

The number of allocation changes is clearly related to the size of your behavior gap.

Sources: Betterment customer data.
Engaging during downturns

Platform and testing FTW
Behaviorally targeted notification

Not every customer is stressed by markets...

How do we target just those who need reassurance?
How effective is a simple in-app notification?
Pitting biases against each other
Pit biases against each other: Market timing vs taxes

- Before an action (allocation change, withdrawal), we show you the likely tax impact.
- You decide if it’s still worth it, after-taxes.
- We give customers the power to do cost/benefit analysis in real time and this impacts their behavior.
We saw a significant reduction in realized gains.
Personalized advice
Advice is goal based

- Aligns portfolio risk with financial objective more accurately
- Mirrors how people actually think about money
  - Mental accounting

What are you looking to achieve through investing?

Here's a list of objectives that we think you might find compelling.

- Being able to retire comfortably
- Having money in case of emergencies
- Earning more from my checking or savings
- Putting my kids through college
- Becoming a homeowner
- I just want to grow my money
Risk levels by goal type and horizon

**Major Purchase** - Shorter time horizons; liquidate full account value at maturity

**Retirement** - Longer time horizons; periodic withdrawals
Feedback on portfolio risk level

**Target Allocation**
- 80% Stocks

**Overall risk**
- Too aggressive

**Auto-adjust**: Off
- Recommended: 60% Stocks

Keep in mind that by turning auto-adjust off, your portfolio risk level will not automatically decrease over time.

**Projections**
- Likely 1 year return: -13% to +31%

**Average annual return**: +6%

**Allocation over Time**
- Graph showing average outcome and outcome range.
We recommend the right amount to save

- Project customer balances into the future
- Show distribution of likely outcomes
- Recommend the right savings amount to reach their goals
Advice on all accounts: External account advice

### Current Portfolio
- **27** Stocks
- **4** Bonds
- **62** Cash
- **6** Other

### Holdings

<table>
<thead>
<tr>
<th>Mutual Fund</th>
<th>Shares</th>
<th>Fund Fees per Year %</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCNTX: Fidelity Contra Fund</td>
<td>79.31</td>
<td>0.68%</td>
</tr>
<tr>
<td>FDCAX: Fidelity Capital Trust Capital Appreciation Pt.</td>
<td>166.98</td>
<td>0.61%</td>
</tr>
<tr>
<td>FDVLX: Fidelity Value Fund</td>
<td>150.86</td>
<td>0.67%</td>
</tr>
<tr>
<td>FLP SX: Fidelity Low-Priced Stock Fund</td>
<td>61.53</td>
<td>0.88%</td>
</tr>
</tbody>
</table>

- **Total Fees Per Year**
  - **High** $2,264.01

- **Idle Cash**
  - **High** $64,875
Thanks!
adam.grealish@betterment.com