

# Robo-advising

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# Plan of the Talk

- ① Introduction to Robo-advisors
  - What is Robo-advising?
  - Main features of robo-advisors
  - Taxonomy of robo-advisors
- ② Robo-advisors for Investment Decisions
  - for short-term—trading
  - for long-term—retirement
- ③ Roboadvising for Consumption, Saving & other Decisions
- ④ Open Questions in Robo-advising

# Relevant Material

## Robo-advising for Investment Decisions

- *"Robo-advising,"* D'Acunto & Rossi
- *"The Promises and Pitfalls of Robo-advising,"* D'Acunto, Prabhala & Rossi
- *"Who Benefits from Robo-advising? Evidence from Machine Learning"* Rossi & Utkus
- *"The Needs and Wants in Financial Advice: Human vs Robo-Advising,"* Rossi & Utkus

## Robo-advising for Consumption, Saving, Debt and Lending

- *"New Frontiers of Robo-Advising: Consumption, Saving, Debt Management, and Taxes,"* with Francesco D'Acunto
- *"Crowdsourcing Peer Information to Change Spending Behavior,"* D'Acunto, Rossi & Weber
- *"Correcting Present Bias in Saving Decisions with FinTech"* Gargano & Rossi
- *"How Costly Are Cultural Biases? Evidence from FinTech"* D'Acunto, Ghosh & Rossi
- *"Improving Households' Debt Management with Robo-advising"* D'Acunto et. al.

# What is Robo-advising?

Robo-advising is

- 1 Generated by a computer algorithm
- 2 Tailored to clients' characteristics
- 3 Easy to implement – Automatic execution, Financial education

Unbiased advice delivered electronically is rarely followed (Bhattacharya et al., 2012):

*“You can lead a horse to water, but you can't make it drink!”*

**Robo-advising: middle ground btw no-intervention & nudges**

## Why are Robo-advisors Important?

- Most investors are not financially savvy
- Traditional Financial Advisers could help, but they
  - are expensive
  - generally ineffective (Linnainmaa, Melzer, and Previtero, 2016)
  - they cater mainly to wealthier individuals
- Scope to
  - improve the effectiveness of financial advice
  - increase the number of people who receive advice

# Advantages and Disadvantage of Robo-advisors over Traditional Advisors

**Advantages.** Robo-advisors can

- 1 offer financial advice for low fees
- 2 serve individuals with any level of wealth
- 3 be monitored and improved over time
- 4 their decisions can be explained to investors and regulators

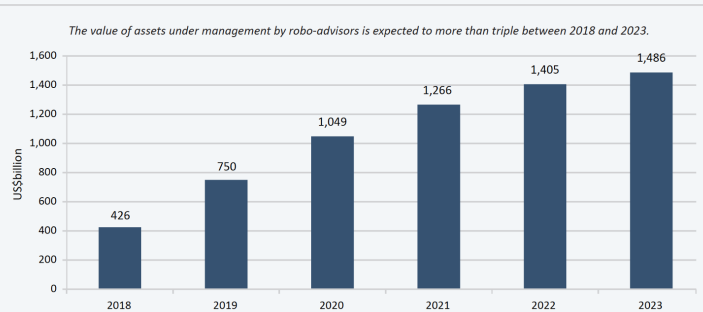
**Disadvantages:**

- 1 many potential clients are algorithmic-averse
- 2 many algorithms do not work very well

# Robo-advising in the Asset Management Space (US)

## Robo-Advisors: Investing Through Machines, WB 2019

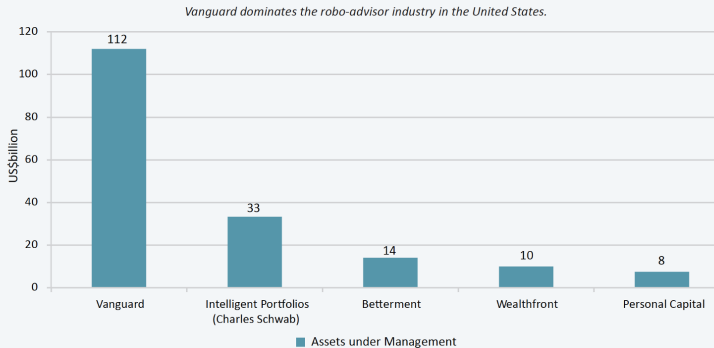
Figure 1. Projected Assets Managed by Robo-Advisors in the United States, 2018–23



# Robo-advising in the Asset Management Space (US)

## Robo-Advisors: Investing Through Machines, WB 2019

Figure 2. Largest Robo-Advisors in the United States, 2018





# Robo-advising in the Asset Management Space (US)

## ROBO-ADVISOR

### BUSINESS-TO-CONSUMER (B2C)



### BOTH B2B & B2C



### BUSINESS-TO-BUSINESS (B2B)



## ROBO-RETIREMENT

### B2C



### B2B & B2C



## PORTFOLIO MANAGEMENT

### B2C



### B2B



## FINANCIAL SERVICES SOFTWARE

### B2B



## MICRO-INVESTING

### B2C



## INVESTING TOOLS

### B2C



### B2B & B2C



### B2B



## DIGITAL BROKERAGE

### B2C



### B2B



# Are All Robo-advisors Created Equal?

We can classify robo-advisors along four dimensions

- 1 **Personalization of the advice**  
(Target Date Funds as most primitive form of robo-advising)
- 2 **Involvement of the investor in financial plans and choices**  
(Robo-advisors versus robo-managers)
- 3 **Investors' discretion to deviate from the automated advice**  
(Libertarianism versus libertarian paternalism)
- 4 **The presence of any form of human interaction**  
(Pure robo-advisors versus hybrid robo-advisors)

(D'Acunto and Rossi, 2020)

## 2 Cases Under the Microscope

- 1 **Case 1.** Robo-advisor from *anonymous* Indian Brokerage (D'Acunto, Prabhala and Rossi, 2019)
- 2 **Case 2.** Vanguard's Personal Advisor Services (PAS) (Rossi and Utkus, 2020)

Very different approaches with substantially different results

## Case 1. Robo-advising Tool: *Portfolio Optimizer*

Similar to *Portfolio Visualizer* of Silicon Cloud Technologies (US)

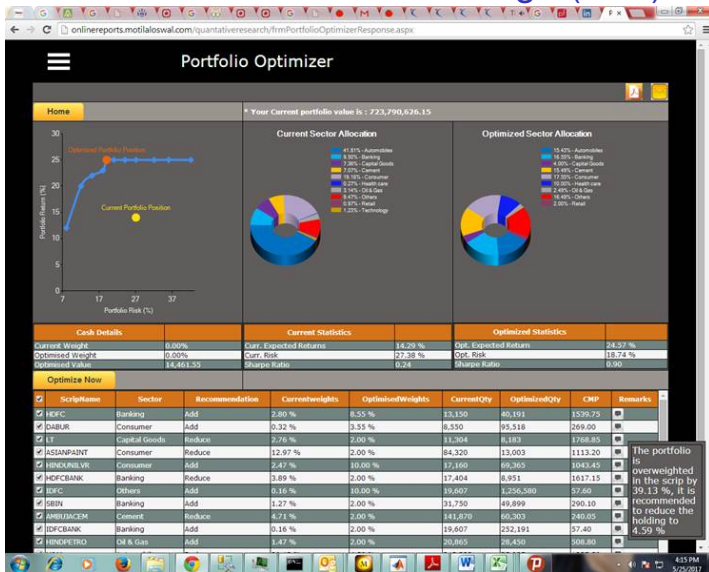
Main Characteristics (some undesirable):

- Markowitz mean-variance portfolio optimization
- 3 years of data to compute variance-covariance matrix
- Existing stocks + up to 15 large stocks
- Imposes short-sales constraints, uses shrinkage
- All suggested trades can be executed in batch mode

Portfolio optimizer data contain:

- Time-stamp of usage by the investor
- Portfolio weights of the investor at the time of usage

# Case 1. Robo-advisor Design (Link)



## Case 1. Conclusions from this Work

### **Robo-advising: different effects on different types of investors**

For *under-diversified* investors, access to robo-advice:

- Increases diversification, reduces portfolio volatility
- Increases investor attention to their portfolio
- Improves portfolio performance

For *already diversified* investors, access to robo-advice:

- No change, or reduction in the number of stocks held
- Increases number of trades and fees paid, but not performance

Everybody enjoys lower incidence of behavioral biases

## Case 2. Setting

### Vanguard's Personal Advisor Services (PAS)

- largest hybrid robo-advisor in the world
- \$120B under management
- explosive growth since inception

### Key Characteristics of PAS:

- Very different from the indian robo-advisor
  - For long-term portfolio allocation
  - Based mainly on mutual funds—now ETFs.
  - Allows little consumer discretion

## Case 2. Key Features of PAS

At sign-up, investors are profiled on

- financial objectives
- risk-tolerance
- investment horizons
- demographic characteristics

Investors are then proposed a comprehensive financial plan, i.e.,

- cash flow forecast
- probability of financing a secure retirement
- recommended portfolio strategy

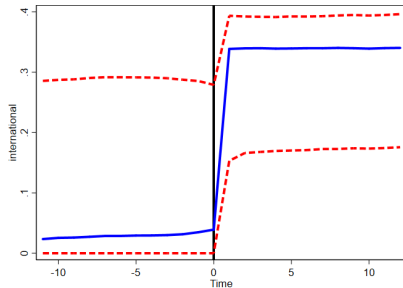
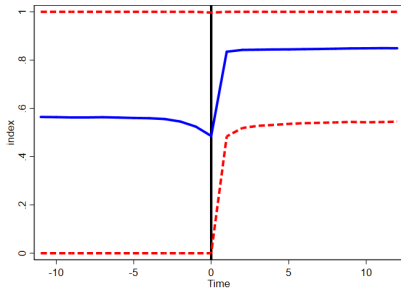
Before approval, clients interact with human who explains the plan

After approval, PAS trades automatically and rebalances quarterly



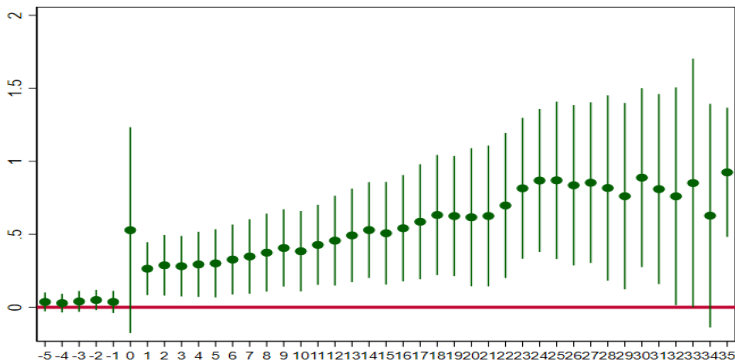
## Case 2. Main findings

Large effects on portfolio indexation & international diversification



## Case 2. PAS & Performance Changes

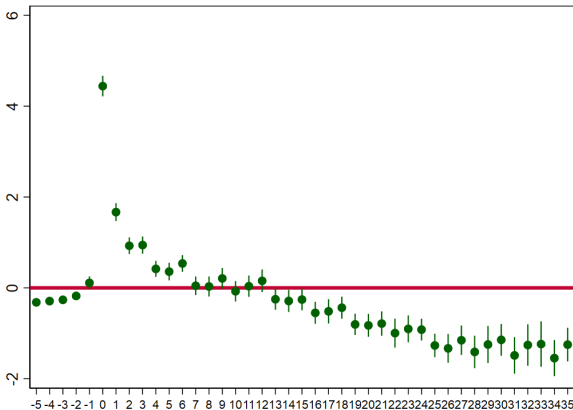
$$Sharpe_{i,t} = \alpha_i + \beta_t + \sum_{j=-5}^{35} \gamma_j ROBO_{i,j,t} + \epsilon_{i,t}$$



Large effects on performance for already diversified investors

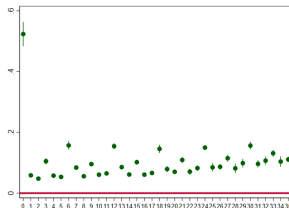
## Case 2. Attention and Robo-advising

$$Attention_{i,t} = \alpha_i + \beta_t + \sum_{j=-5}^{35} \gamma_j ROBO_{i,j,t} + \delta X_{i,t} + \epsilon_{i,t},$$

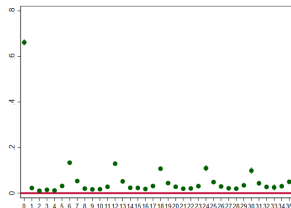


(a) Total (Days with Logins per month)

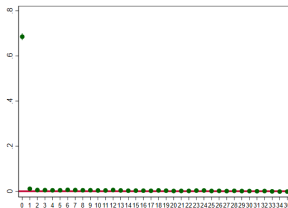
## Case 2. Interaction with Human Advisors



(a) Level 3

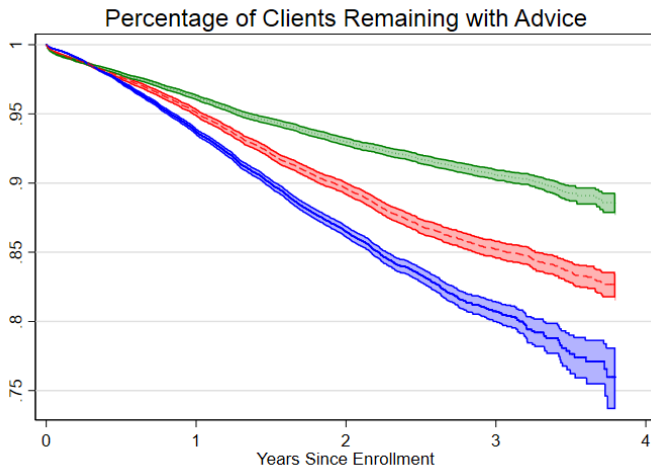


(b) Level 2



(c) Level 1

## Case 2. Attrition



(a) Level 3; Level 2; Level 1

## Case 2. Conclusions from this Research

- ETF-based robo-advisors can improve portfolio allocations of already diversified investors
- Simple forms of robo-advice can be successful
- Communicating value of advice is difficult for robo-advisors
- Significant attrition
- Forms of hybrid robo-advising are more expensive, but retain more customers
- Significant benefits unrelated to financial performance

# Common Perception of Robo-advising

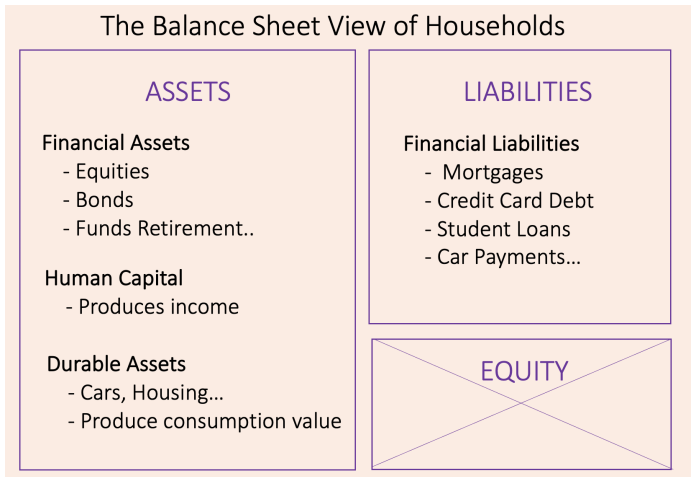
- 1 Robo-advising = automated advice for portfolio allocation



|| PERSONAL CAPITAL

## Balance-Sheet View of Households

**BUT** individuals decisions are more complex!



(D'Acunto and Rossi, 2021)



## Balance-Sheet View of Households

Significant advances along several areas.

Examples:

- Robo-advising and the **consumption-saving** choice
- Robo-advising and **borrowing** decisions
- Robo-advising and **P2P lending** investments

## Robo-advising and the consumption-saving choice

Difficult to determine the optimal consumption and spending


Even for expert economists!

Solutions implemented. Use big data and robo-advice to:

- Provide balance-sheet view of household  
(Olafsson and Pagel, 2018, 2019; Baker, 2016)
- Provide understandable rules of thumb  
(D'Acunto, Rossi and Weber, 2019; D'Acunto et al, 2020)
- Provide motivation and reinforcement  
(Gargano and Rossi, 2020)

# Robo-advising and the consumption-saving choice-I

Use big data to construct spending of peers as benchmarks

You		Your Peers	9.9K people
Age		Age Range	
42		40 – 49	
Income		Income Range	
\$140K		\$100K – \$150K	
Location		Location	
New York, NY		New York, NY	
Location Type		Location Type	
Urban		All	
Credit Score		Credit Score Range	
769		720 – 779	
Housing Type		Housing Type	
Pay Rent		Pay Rent	

(D'Acunto, Rossi and Weber, 2019)

# Robo-advising and the consumption-saving choice-II

Provide motivation and reinforcement using goal-setting

The image displays three sequential screenshots of a mobile application interface for setting a goal, all with an orange background.

- First Screenshot:** The title bar reads "CREA NUOVO OBIETTIVO" with a "SALTA" button. The main text asks "Qual è il nome dell'obiettivo?". The user has entered "Viaggio in USA". Below this is a section "SCEGLI LA CATEGORIA >" with a progress indicator of four dots, the first of which is filled. Below the category selection is a keyboard with a custom top row containing "«USA»", "USARE", and "USATO".
- Second Screenshot:** The title bar is the same. The main text asks "Seleziona la categoria d'appartenenza\*". The user has selected "Risparmio". Other visible categories are "Veicoli", "Casa", "Tempo Libero", "Viaggi", and "Altro". At the bottom is a button "INSERISCI L'IMPORTO DA RAGGIUNGERE >" with a progress indicator of four dots, the second of which is filled.
- Third Screenshot:** The title bar is the same. The main text asks "Inserisci l'importo totale del tuo obiettivo". The user has entered "3000€". There are "-5€" and "+5€" buttons on either side of the input. Below this is a section "Data entro cui vuoi raggiungere l'obiettivo\*" with the date "30/08/2019" and a calendar icon. At the bottom is a "PROSEGUI >" button with a progress indicator of four dots, the third of which is filled.

(Gargano and Rossi, 2020)

## Robo-advising and borrowing decisions

Major problem for a large part of the population:

- Excessive debt
- High interest rates (Credit cards, payday loans)
- Difficult to optimize debt repayment
- Difficult to provide financial literacy effectively

Robo-advisors for managing debt repayment can be a solution  
(D'Acunto et al., 2020)

# Robo-advising and borrowing decisions

**Debt Repayments**

This month you have £1,500 set aside to pay off some of your debts. How will you split this payment across your debts to minimise interest and fees?

	Balance	Interest rate	Minimum payment	Fee for missed minimum payment	This month I will pay off...
Overdraft	£506.45	32.9% APR	£0.00	£0	
Bank loan	£1,658.10	71.9% APR	£204.15	£25	
Credit card	£898.16	31.5% APR	£20.21	£12	
Bank loan	£1,012.50	8.5% APR	£99.87	£50	
Credit card	£318.27	44.9% APR	£7.16	£12	

Amount still to allocate: £1500

**Confirm**

(D'Acunto et al., 2020)

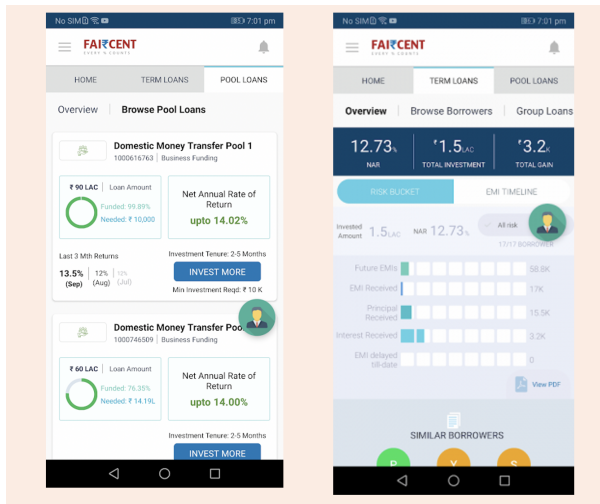
## Robo-advising and P2P lending investments

P2P lending could not a viable asset class for small investors

- High default rates
- Difficult to make diversified investment decisions
- Difficult to monitor the investment decisions

Automated algorithms can help individuals make P2P decisions  
(Manconi et al, 2020; D'Acunto, Ghosh, and Rossi, 2020)

# Robo-advising and P2P lending investments



(D'Acunto, Ghosh, and Rossi, 2020)



## New frontier of robo-advising: the holistic investor view

*"Robo advisers have great potential but the technology is still immature; they're the rotary phones to today's iPhone."* Andrew Lo

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PEFIN: First AI-based Financial Advisor. Not sure if realistic yet

Neural Networks Stay on Top of 2-5 Million Data Points 24/7

Neural networks analyze a complex web of financial relationships, including:

- changes in your spending patterns
- your account balances and trends
- the markets and risk exposure
- federal, state, and payroll taxes
- social security and govt rules
- inflation and cost-of-living
- property taxes and closing costs
- mortgage and refinance rates
- college tuition and cost increases
- childcare costs in your area
- and more...

By keeping on top of all the details, the advice you receive is accurate, up-to-date, and anything but generic. Even a human advisor, simply cannot manage the level of details in your life that Pefin's AI is capable of handling with ease.



## Open challenges for the future of robo-advising

- Can separate robo-advisors be integrated into a holistic one?
- Algorithmic aversion: Is hybrid Robo-Advising a solution?
- Will robots democratize financial advice or exacerbate Inequalities?
- What are the systemic implications of Robo-advisors?