The active construction of passive investors: roboadvisors and algorithmic "low-finance" *

Adam Hayes, Department of Sociology, University of Wisconsin-Madison, USA

1. Introduction

Electronic markets and algorithmic trading programs have exerted ever-increasing influence on financial markets over the past decades. Social scientists have aptly attended to these trends along the way, from Knorr-Cetina and Bruegger's (2002) study of the transition to screen-based currency trading to the rise of fully-automated high-frequency trading (HFT) algorithms, which now dominate securities markets.[1] High-frequency trading has proven to be a fruitful object of study, generating important insights into how human-machine relations are forged between traders and their "algos" (e.g. Borch, et. al 2016; MacKenzie, 2016), the socio-material infrastructures that it has enrolled (e.g. MacKenzie, 2018; Arnoldi, 2016) and how financial algorithms become construed as market subjects in their own right (e.g. Coombs, 2016; Lange, et al. 2016).

But how does algorithmic finance operate in society as it crosses the threshold of 'low-finance'; that is, into the hands of lay investors?[2] This question is imperative as consumer-ready financial platforms become increasingly popular, consummated wholly via mobile app or web interface. In this study, I analyze a recent and notable innovation in retail financial services known colloquially as the 'roboadvisors'. These are a new class of digital financial advisor that provides

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[1] According to NASDAQ, "it is estimated that 50% of stock trading volume in the U.S. is currently being driven by computer-backed high-frequency trading." (https://www.nasdaq.com/investing/glossary/h/high-frequency-trading, retrieved 11/05/2018).

[2] I use the term 'low-finance' (as opposed to 'high-finance') to refer to financial services aimed at individual (lay) investors, many of whom tend to have average to below-average levels of financial literacy and moderate to low levels of income and assets; for more, see: Hutton (2009) and Lazarus (2016). 'Lay' investors are differentiated from professional traders or practitioners and correspond to what Preda (2017:3-4) calls "retail" investors.

advice and automated investment management online with minimal human intervention, at little to no cost. Roboadvisors provide these services via algorithms to automatically allocate, manage, and optimize clients' assets based on personalized information that each client enters through a website or application.

Rather than transpose the active, complex, and often inscrutable strategies used by HFTs, the roboadvisors' algorithms embody a well-known model of passive indexed investing known as Modern Portfolio Theory (MPT), operating under the premise that it is impossible to systematically 'beat the market' (Markowitz, 1952). These algorithms are thus modified from an ethos of high- to low-frequency trading, and from operating as proprietary black boxes (Pasquale, 2015; Lewis, 2014) to enacting familiar financial models. From the viewpoint of studying algorithms, roboadvisors are not unfathomable "objects of ignorance" like the HFTs (Lange, 2016; Lange, et. al 2018) but are instead objects of cognizance — in the sense that they are knowable to an observer through direct interaction and via analysis of publicly available regulatory filings, and also alluding to the fact that they perform a well-understood model of financial economics.

This paper seeks to uncover how the socio-technological assemblages constituted by algorithmic 'high-finance' have been re-cast to fit a market paradigm compatible with non-practitioners – and moreover how the end-users of these systems similarly undergo a process of reconfiguration. While HFT traders employ self-disciplinary techniques to restrain emotional interference with their algorithms (Borch and Lange, 2016:3), roboadvisors actively pursue a program of corrective nudges to keep their users in line with the MPT strategy. Following Foucault's (1988:18) framework, Borch and Lange (2016) argue that HFT traders engage in technologies of the self (see also: Borch, 2017), which permit individuals to effect *by their own means* a way of self-control; whereas roboadvisors project technologies of power, which determine

the conduct of individuals and submit them to certain ends – "an objectivizing of the subject" (Foucault, 1988:18).[3] Yet, by actively constructing passive investors, the designers of roboadvisors seem to utilize this power in an arguably productive modality (Foucault, 1977), where they seek to promote financial wellness by approximating rational outcomes through algorithmic devotion to MPT, objectivizing the subject as the lauded *Homo economicus* (cf. Weiss, 2018).

This path to financial well-being (i.e. via MPT) is, nevertheless, an ideological choice discharged by the roboadvisors. While there is ample evidence that active strategies systematically fail to surpass their benchmark indices,[4] passive investing is coming under increasing criticism. As the practice has grown from a relatively unimportant niche strategy to the dominant way individuals now invest, "passive investors have become the giants [and] they have morphed from the good guys to the bad guys" (Authers, 2017). The moral infractions that are most cited for following a strategy like MPT label index investors 'free-riders' who benefit from the work of active traders involved in price discovery of the component stocks. Or, that through owning a broad index, shareholders have less of an incentive to take an active voice against a company's management, opening the door to corporate impropriety and a failure in the market for corporate control. On an individual level, a passive investor tacitly accepts that there is no hope to do better than the market, and so the desire to be exceptional (i.e. to earn excess returns) falls out. To structure this sort of economic action therefore is to import a moral character that may oppose

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[3] Foucault speaks of objectivizing the subject throughout his work, and especially in his *Lectures at the Collège de France, 1978-1979* (Foucault, 2008). He construes the *subject* as an entity with agency (but which is often framed by the control of and/or dependence upon another) – and that agency is curtailed through objectification. This curtailment can be achieved through distancing – for instance, by classifying and individual as 'criminal' or 'insane' they are excised from society and objectified through a loss of autonomy.

[4] Active investing is where traders or portfolio managers attempt to pick winning stocks or time trades in hope of beating the market.

contemporary ideals of competition and exceptionalism – the very things that HFT algorithms (which try to beat the market on a daily basis) tend to exemplify.

Contrasting the study of algorithms of high-finance with those of low-finance, the contribution of this paper is to explore for the first time the relations formed by the human-roboadvisor assemblage (cf. Lange, et. al 2018) and in particular, the disciplinary mechanisms adopted by these firms to construct and maintain passivity – that is, to keep users behaving 'rationally'. While HFT algos are certainly important, they will probably remain an apparatus of the Wall Street elite. Roboadvisors, on the other hand, are a rapidly growing segment of the retail financial sector, courting ordinary individuals for their very first investable dollar. This study helps us understand how individual investors will increasingly interact with markets in a new way, making roboadvisors a particularly interesting and important empirical object that has not yet been explored in the literature.

For this research, I undertook an ethnography of sixteen roboadvisors and their algorithms,[5] which consisted of three overlapping aspects. First, I became a participant user of their platforms, where I opened and funded an account at each roboadvisor. As a user I had direct access to the algorithms that were managing my finances, and I was able to interact closely and on a regular basis with the roboadvisors' websites, mobile apps, blog posts, and email correspondences. Second, I carried out a detailed archival analysis of each of their regulatory filings with the U.S. Securities and Exchange Commission (SEC). Finally, I conducted in-depth interviews with highly-placed individuals spread across these roboadvisor firms in order to gain a

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[5] see: Lange, Lenglet and Seyfert (2018), *On studying algorithms ethnographically.*

deeper understanding of what I was experiencing and to gather insights beyond what a roboadvised individual would glean from the user experience alone.

The paper proceeds with an overview of what roboadvisors are, including a short history of their emergence over the past few years, situating 'algorithms of low-finance' as objects of sociological interest situated within the broader literature on technology and markets. In Section 3, I describe the methodology and data used in this study. Section 4 introduces the model of Modern Portfolio Theory, showing that roboadvisors use this strategy as their guiding principle and briefly discussing the arguments that have been made in support of passive investing. Section 5 demonstrates how roboadvisors format their users through disciplinary techniques meant to keep them from straying from the model. In Section 6, I discuss some of the practical implications of roboadvisors and the ubiquitous use of passive investing on markets and robo-advised individuals. In the conclusion, I summarize my findings and propose directions for future research, including the broader potential for algorithms in structuring human behavior in other realms of economic decision-making and beyond.

2. What is a roboadvisor

What becomes of the economy — and indeed of society — when markets and most participants in them are computer algorithms? asks MacKenzie (2014:2). Wall Street has already been dominated by algorithmic trading for nearly a decade: by 2012, almost 84 percent of all trades executed on U.S. stock markets were placed algorithmically on behalf of human traders[6] – a trend toward what Lin (2012) calls "cyborg finance." As of mid-2018, roughly 90 percent of volume in the *global*

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[6] https://www.ft.com/content/da5d033c-8e1c-11e1-bf8f-00144feab49a#axzz1t4qPww6r; not limited to HFT.

equities markets are traded by algorithms.[7] Until recently, these algorithms mainly served Wall Street professionals or for the benefit of those situated within high-finance; however, with the introduction of the roboadvisors over the past few years, ordinary individuals are starting to plug in to the financial technoculture.[8] Indeed, the role of technology in financial markets has generated a great deal of scholarship in recent years; however, there remains an important gap in this literature that overlooks how lay financial technologies ("fintech") implicates non-professional market participants. To date, scholarly work on the technology and technicity of financial markets has emerged from the social studies of finance tradition, where it has focused mainly on traders located in Wall Street banks, trading rooms, hedge funds, or high-frequency trading shops (e.g. Knorr-Cetina and Bruegger 2000, 2002; Beunza and Stark, 2004; MacKenzie and Millo 2003; Svetlova 2012; Borch, et. al 2016; MacKenzie 2006, 2018; cf. Preda 2017). As stated in the introduction, lay financial technologies do not simply duplicate algorithms of high-finance; they operate with distinct logics and act on large populations of otherwise ordinary individuals. Situating roboadvisors within the broader literature on markets and market actors vis-à-vis financial technology is thus an important empirical task.

In June of 2010, a technology start-up called *Betterment* launched as the world's first roboadvisor with the aim of disrupting the traditional mode of financial planning. By embodying emblematic models of financial economics into their platforms, roboadvisors like *Betterment* hope to achieve optimal outcomes for their clients and at the same time make those outcomes accessible for nearly all.[9] Since 2010, the number of roboadvisors has grown to more than three hundred worldwide, including numerous start-ups as well as large incumbents like *Vanguard*, *Schwab*, and

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[7] https://www.technavio.com/report/global-miscellaneous-algorithmic-trading-market; not limited to HFT.
[8] Algorithmic trading entails computer-automated trading strategies and/or execution. Online self-directed trading would therefore *not* be considered algorithmic.
[9] All that is required is a bank account and an internet connection.

TIAA building out their own offerings. Far more than some niche phenomenon, in the U.S., 'robos' now collectively manage three-quarters of a trillion dollars of client money for 8.3 million users.[10] According to industry forecasts, by the year 2020 this amount will grow to more than $2 trillion, and by 2025 it is estimated that in excess of $7 trillion globally will be managed by roboadvisors, making up an impressive 15% of all retail investment in just a few short years (Kocianski, 2016; Srinivas and Goradia, 2015).

Somebody looking to become an investor has typically had two main options: do it yourself using an online brokerage platform like E-Trade or TD Ameritrade; or hire a professional financial advisor to manage your assets. The problem is that do-it-yourselfers often employ sub-optimal investment strategies where they fall victim to cognitive and emotional errors such as those identified by behavioral economics (e.g. Barber and Odean, 2000; Benartzi and Thaler, 2007). In addition, self-directed investors tend to trade too much (Barber, et. al 2008), fail to diversify (Goetzmann and Kumar, 2008), and chase trendy stocks (Froot, et. al 1992) without undertaking proper due diligence. Hiring a financial advisor, on the other hand, may (or may not) produce better results, but this comes at a price – typically one percent or more in fees per year based on the amount of assets managed. Financial advisors, moreover, typically require opening balances of at least five- or six-figures, effectively barring a large percentage of potential investors who lack the minimum amount of assets, and so have little choice but to become a do-it-yourselfer if they want market exposure. These end up being the credulous investors who, in turn, generate the market "noise" (Preda, 2017) that feeds profits to professional trading desks and HFT firms.

The roboadvisors were created to solve both of these problems simultaneously, by offering state-of-the-art asset management but with very low starting balances and inexpensive fee

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[10] As of Q1 2019: https://www.statista.com/outlook/337/109/robo-advisors/united-states

structures. In fact, several roboadvisors today charge *zero* in annual fees (the modal fee structure is just 0.25% annually) and have *no* minimums, so that you can literally start investing with $1 where every cent is allocated to an optimally diversified portfolio.[11] This low-cost is achieved through the prodigious use of algorithms that make portfolio allocation decisions and execute them in the market. To be profitable, roboadvisors must attract a large number of small accounts, which necessitates a novel tactic of aggressively courting people in the realm of 'low-finance' for the first time. Through my interviews with roboadvisor executives (see the following section for a detailed description of my methods and data), I identified an intentional reorientation of advising toward low-net-worth investors; as the founder and CEO of one roboadvisor explained to me:

> The traditional advisors and to some extent the hedge funds have had decades of time spent to figure out how to get a $1 million or a $100 million client. And now for the first time, everybody is focused on how to get the $10,000 client, the $1,000 client. And if you're that $1,000 client, there's a whole new litany of companies trying to earn your business.

The head of operations at another large roboadvisor highlighted this new focus on 'low affluence' clientele:

> The truth is that for the affluent customer [there] is already an extremely competitive market for them. And roboadvisors are typically charging much lower fees, so the economics just don't work when you're going up against like a Morgan Stanley who can spend thousands of dollars acquiring a customer. So, it's not that we couldn't acquire that kind of higher affluence customer, but it's just much more difficult and so I think, in general, our model—the marketing— was for lower affluence customers. And I think that's true in general for the roboadvisor market.

Per industry reports, as of the second quarter of 2018 the average account balance for a client of a traditional (human) financial advisor was roughly $1 million.[12] Using public regulatory filings,

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[11] Roboadvisors also earn money through cash management, lending shares to short-sellers, selling order flow to institutional traders, and targeted marketing of other financial services.
[12] https://aboutschwab.com/images/uploads/inline/2017-RIA-Benchmarking-Study_Results-0717-7ZSV.pdf; https://clearingcustody.fidelity.com/app/literature/item/9882273.html

I was also able to determine that the average account size for roboadvised accounts in the U.S. during the same period was approximately $20,600 (48x smaller than accounts with traditional advisors). Some of these roboadvisors required an account minimum of $5,000 or larger, and so may be targeting a slightly more well-off demographic. Excluding these, the mean account size falls to $9,500 – (105x smaller than human advised accounts). The average account size at *Acorns*, the roboadvisor with the largest number of users (~2 million accounts), is just $424.[13]

According to data provided by FINRA, roboadvisors also tend to attract clients that are lower-income, younger, and more ethnically diverse than the typical investor.[14] The median age at the roboadvisors I followed was reported to be between 25-30 years old whereas the FINRA data indicates the median American investor is 55-60 years of age. It is telling that "Millennials" are specifically targeted in roboadvisors' advertising and marketing campaigns, which are carried out mainly via social media channels. The vice-president of growth and strategy at one medium-sized roboadvisor related, "We have for example, a lot of Uber and Lyft drivers as customers so they can start saving, and they feel comfortable already with digital platforms. With just $5 you can become an investor. It's very low barriers to entry."

3. **Methods and Data**

To understand roboadvisors and their algorithms as objects of sociological inquiry, my methodology employs a three-pronged approach: (1) participant observation by becoming a roboadvisor user; (2) an archival review of regulatory documents filed with the SEC; and (3) in-depth interviews with well-placed individuals at roboadvisor firms. These approaches overlapped

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[13] As of Q1 2019.
[14] http://www.usfinancialcapability.org/investor-survey.php

and supported one another throughout the study; for instance, in triangulating findings gathered from the user experience with interviews, and to confirm statements made by my informants with data found in regulatory documents. At the same time, my interviews pointed me to certain aspects of the user experience that were not initially salient, and SEC filings prompted particular lines of questioning related to my interviews. I will briefly discuss each of these approaches in turn.

Algorithms of high-finance tend to be inscrutable black boxes in order to preserve proprietary trading techniques as corporate secrets (Lenglet, 2011; Lewis, 2014; Pasquale, 2015; Lange, 2016). This makes direct interactions as a participant observer between the analyst and the algorithm untenable due to a clear lack of access. Such concerns do not apply to the algorithms at work within the roboadvisors, where I was afforded direct and unencumbered access simply by funding and opening an account. Recent scholarship has argued "that a multi-sited ethnographic approach would be most suitable to study algorithms as ethnographic objects in order to grasp the changing human–machine/trader-algorithm relation" (Lange, Lenglet and Seyfert, 2018:14; see also: Lange, 2016; Seyfert, 2016). Accordingly, I opened and funded individual taxable accounts at sixteen North American roboadvisors, which were chosen to reflect a popular cross-section of the most widely-used platforms in order to generalize as much as possible from my encounters. I opened these accounts using the minimum allowable balances [in brackets] at the following roboadvisors in August, 2017 where they remained open until July, 2018: *Acorns*[$1]; *Betterment*[$1]; *E-Trade Adaptive Portfolios*[$5,000]; *Ellevest*[$1]; *Fidelity Go*[$1]; *Hedgable*[$1]; *Future Advisor*[$10,000]; *M1 Finance*[$100]; *SigFig*[$2,000]; *SoFi*[$100]; *Schwab Intelligent Portfolios*[$5,000]; *TD Essential Portfolios*[$5,000]; *Stash*[$5]; *Wealthfront*[$500]; *Wealthsimple*[$1]; and *Wisebanyan*[$1].[15] After opening each account, I went

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[15]The $27,712 which I invested was transferred from an existing investment account that I had already established several years ago, and the funds were returned to that account at the conclusion of the study. On average, I earned an approximately 10%

through an onboarding process that scored my risk preference and I agreed to a portfolio allocation recommended by the algorithms. In practice, I logged on to each platform's mobile app or website at least once per week and interacted with as many parts of the site as possible including their portfolio analytics, financial tools, blog posts, company information pages, and help sections. My approach to participant observation of roboadvisors is closely aligned with analytic autoethnography (Anderson, 2006) in that I became an active participant in this research. What is novel, however, and which I will elaborate on in the sections that follow, is that my own participation had little influence on the roboadvisors that I studied. Indeed, each did evaluate my individual risk tolerance, investment time horizon, and subjective goals (e.g. am I saving to buy a house? To send a child to college?); yet, once my portfolios were constructed the remainder of my interactions turned out to be quite neutral in that my role was purposefully configured by these systems to that of a passive client (see Section 5 below). My observations and insights as a user were recorded both as field notes and through screen captures, which were subsequently entered into a qualitative data analysis (QDA) software package.[16]

Since all of the roboadvisors in my sample fall under SEC regulatory purview as registered investment advisors they are required to file *Form ADV*, which is publicly available on the Investment Adviser Public Disclosure (IAPD) website.[17] The Form consists of two parts: Part 1 requires information about the advisor's business practices, affiliations, number of clients, amount of money managed, and any disciplinary events of the advisor or its employees; Part 2 requires advisors to prepare narrative "brochures" written in plain English that contain information such as the types of advisory services offered, the adviser's fee schedule, the investment strategies and

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annualized return over the study period. As my goal was to be a participant observer, I see no conflicts of interest using personal funds.

[16] NVivo 12

[17] https://adviserinfo.sec.gov/

methodologies employed (such as the use of MPT), and the background of management and key advisory personnel. In the case of roboadvisors, this disclosure also clearly explains to what extent algorithms are used in day-to-day practice. Each Form ADV was imported into the QDA software where they were coded thematically, revealing patterns across the documents and other insights.

Beginning in September 2017, interviews were conducted by phone or Skype with twenty-eight well-informed roboadvisor executives, employees, or former employees, each lasting approximately sixty to ninety minutes. Interviews were open-ended and followed a semi-structured format, which became increasingly focused on particular topics as my interviews progressed. My sample frame included executives or other employees in management positions who could speak authoritatively about their platforms, their algorithms, and their investment strategies. Moreover, I was interested in speaking to individuals who had first-hand experience in designing and implementing both the user experience as well as the back-end trading and portfolio management systems. I made initial contact with my informants either through personal introductions, or else through unsolicited requests via LinkedIn (the response rate was surprisingly high – approximately 60%), with prospect names and affiliations garnered from the roboadvisors' websites or Form ADV. Further informants were then obtained through snowball sampling following these initial contacts. Interviews also included informants at four additional roboadvisors where I did not open accounts: *blooom* (which optimizes 401(k) accounts), *Personal Capital* (which has a $100,000 minimum), *Honest Dollar* (which only offers retirement accounts), and *Clarity Money* (which automates non-investment financial tasks). Three informants were interviewed on more than one occasion. Following Rubin and Rubin (2011), interviews were recorded, transcribed, and coded inductively in the QDA software, allowing me to identify themes and patterns across the transcripts.

Direct quotations excerpted from my interviews that appear in the following analysis refer only to the informant's job title, with names of informants and their employers withheld. In late-2017, I began pilot interviews with twelve roboadvisor users after primary data collection for this study was concluded, mainly drawing from personal acquaintances. The data collection among users is ongoing and intended for future study; nevertheless, it provided me with some subjective insight into the user experience outside of my own.

In line with the conceptual focus of this paper, the consolidated coding and mapping procedure utilized strategies inspired by abductive inference (Timmermans and Tavory, 2012) and a process of triangulation (Olsen, 2004), which encourages theoretical discovery and refinement as an ongoing process.[18] This combined approach moreover allowed for themes and trends that overlapped between different data sources to become apparent in order to verify that findings derived from one source were compatible with that from another. Therefore, in the analysis below, I do not distinguish between data sources but present thematic findings side-by-side.

4. Modern Portfolio Theory, passive investing, and low-frequency trading

By and large, roboadvisors follow passive investment strategies and construct portfolios exclusively from various exchange traded funds (ETFs), securities that mimic market indexes and offer passive exposure to roboadvisor users across several distinct asset classes.[19] The distinguishing feature of ETFs is that unlike index mutual funds, these securities trade on stock

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[18] Similar approaches have been used elsewhere to recover Foucauldian theory from ethnographic data, e.g. Zaloom (2006), Hill (2009), and Borch and Lange (2016).

[19] Roboadvisors build optimized portfolios across multiple asset classes including various subsets (e.g. by market capitalization) of foreign and domestic stocks and bonds, commodities, real estate, alternative investments, etc. The number of distinct asset classes varies by roboadvisor from as few as four (e.g. *Vanguard*) to more than a dozen (e.g. *Schwab*). Some roboadvisors offer optional active or 'tactical' portfolios, but passive indexing remains by far the largest strategy and in the majority of cases is also the default option.

exchanges as if they were ordinary shares, making them highly liquid, low-cost instruments. Buying and selling ETFs often incurs no trading commissions and the management costs for these funds can be as little as 0.02% per year. Braun (2016:7) argues that the introduction of ETFs "completed the socio-technical *agencement* of the 'passive investor' [and] the transformation of the investment industry into a low-cost, 'universal owner' system."

Passive investing, broadly, is a strategy of buying and holding a diversified portfolio across a variety of asset classes over a long time horizon. Passive investors do not seek to 'beat' the market by picking individual stocks or timing the market. Rather, passive investors seek to replicate the performance of the entire market, where asset classes are represented by broad benchmark indexes (e.g., the S&P 500 is often the benchmark used for large-capitalization U.S. stocks). Active investment, on the other hand, operates under the premise that investors make specific trades with the goal of outperforming a benchmark index. For example, they may seek to buy supposedly undervalued shares or try to time near-term market lows and highs as points of entry and exit. At the extreme end of active management is high-frequency trading. While an HFT trader may make tens of thousands of trades in a day, passive investors may only make *tens* of trades over the course of a year.

There are several reasons to consider passive strategies as the optimal choice for most lay investors. Practically, as they are long-term buy-and-hold portfolios, transaction costs are greatly reduced and research into individual securities is minimized. In terms of theory, the efficient market hypothesis (EMH) states that markets are for the most part efficient – that current prices reflect all available information, and thus are fairly-valued. If the EMH is correct then there is no way to systematically exploit mispricings in the market since they rarely exist (or if they do, they are very quickly arbitraged away by professional traders) (Ellis, 2016). While the theoretical

soundness of the EMH is still an unsettled matter, abundant empirical evidence collected over several time spans shows consistent support that passive (indexed) investing is indeed favorable to active strategies.

Malkiel (2005:1) shows that active mutual fund managers, both in the U.S. and abroad, consistently underperform their benchmark index, and "provides evidence that by and large market prices do seem to reflect all available information." Swenson (2005) showed that between 86 and 95 percent of actively managed mutual funds did not fulfil their goal of beating the market on an after-tax basis in the early 2000s. More recently, Soe and Poirier (2017) find that over the fifteen-year period from 2002 to 2017, only about 8% of active funds were able to outdo passive indexes. After accounting for taxes and the trading costs generated by active management, the number of successful funds drops to just 2%. In another study of 70,000 self-directed individual brokerage accounts, the average investor's return for the year 2016 lagged the S&P 500 index by more than seven percentage points.[20] Several other studies report similar findings (e.g. Fama and French 2010; Cremers, et. al 2006). The evidence is extensive and compelling that for most long-term investors a passive strategy will end up being best.

Given a passive strategy, an algorithm requires a set of rules with which to implement it. Harry Markowitz, in 1952, introduced his Nobel prize-winning framework known as Modern Portfolio Theory, outlining the concepts of the risk return trade-off, correlations of returns between different assets, and diversified portfolio selection for investment optimization. In an overview of Markowitz's work on MPT, Kaplan (1998:267) explains, "A basic premise of economics is that… all economic decisions are made in the face of trade-offs. Markowitz identified the trade-off facing the investor: risk versus expected return. The investment decision is not merely which securities

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[20] https://www.cnbc.com/2017/01/04/most-investors-didnt-come-close-to-beating-the-sp-500.html

to own, but how to divide the investor's wealth amongst securities." Following Markowitz, MPT is a theory which provides a solution for investors by showing what is the best combination of available assets to build a portfolio with in order to maximize the total expected return for a given risk preference. This process of *mean-variance optimization* thus delivers the ideal asset class weights for a passive portfolio.

From my analysis, it is clear that roboadvisors code MPT into their core algorithm. The head of investments and strategy at one prominent roboadvisor explained to me the influence of Markowitz's equations:

> I think you can say robos' use of Modern Portfolio Theory, mean-variance optimization,…that we're making the argument that that's how you should be investing. That that is the model you should be using and it's the rational way to go about it.

Reviewing the web sites and regulatory filings of the roboadvisors in my sample, *each one* of them directly or indirectly mentions that MPT is employed in their practice.[21] For instance, one prominent roboadvisor's investment methodology states: "Optimal portfolios are identified using Modern Portfolio Theory (MPT) and combine a broad set of asset classes, each usually represented by a low-cost, passive ETF."[22] Another's website declares: "We determine optimal asset class combinations based on a common-sense application of Modern Portfolio Theory (MPT)."[23] The following text is found in another's Form ADV: "Our strategy focuses on Modern Portfolio Theory ('MPT'), which provides the framework for combining securities in a portfolio to generate the highest returns possible at a given level of risk."[24] Yet another's explains: "We manage client

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[21] Some roboadvisors enhance MPT using e.g. the Black-Litterman model or a factor-model, which allows for views on the market's direction to be incorporated into expected return assumptions.

[22] https://research.wealthfront.com/whitepapers/investment-methodology/

[23] https://www.personalcapital.com/wealth-management/investment-strategy

[24] https://adviserinfo.sec.gov/IAPD/Content/Common/crd_iapd_Brochure.aspx?BRCHR_VRSN_ID=493823

portfolios…with strategies based on Modern Portfolio Theory...Then, initial allocations are determined by the software-based algorithm, which selects among the target asset allocations based on information from clients about their financial situation and risk profile."[25] The investment strategies carried out by roboadvisors' allocation and execution algorithms could not be more plain.

Interestingly, roboadvisors that demand larger or smaller minimum balances displayed no fundamental difference in terms of portfolio selection – the end result was effectively an algorithmic implementation of MPT in all cases. In the early days, roboadvisors that catered to higher-net-worth individuals offered additional features such as automated tax minimization, favorable yields on cash balances, and the ability to speak to a human financial advisor on demand. Due to the high level of growth and competition in the space, however, many of these perks are now included standard across the board.

A roboadvisor is, in fact, an assemblage of interrelated algorithms. To determine proper MPT allocations, each roboadvisor conducts a risk assessment of their users. At account opening, clients provide age, financial condition, employment status, investment objectives or goals (e.g. saving for retirement or a down-payment on a home), time horizon, and they typically will complete an online risk tolerance questionnaire – all of which an algorithm considers for selecting and then executing target allocations (see Figures 1a and 1b) .[26] Algorithms also generate advice regarding other investment decisions, including (but not limited to) transactions related to deposits and withdrawals, automatic rebalancing, account type selection, and tax-loss harvesting. For instance, algorithms continuously monitor and review clients' accounts to ensure their portfolios are within a set range of their target allocation. If a portfolio deviates from this range, the algorithm

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[25] https://adviserinfo.sec.gov/IAPD/Content/Common/crd_iapd_Brochure.aspx?BRCHR_VRSN_ID=530981
[26] When circumstances change, users can re-do the risk-assessment process and receive a new portfolio allocation.

will automatically place orders to restore its target allocation. Or, when clients receive dividends or make deposits or withdrawals from their accounts, an algorithm will determine the specific securities to trade based on the client's asset allocation and current tax lots.

<Figures 1a and 1b>

Prior to the launch of software-based financial advisory services, it was not practical to offer rigorous and complete MPT to everyone because delivering a complete solution was too costly and complex. Historically, the sort of comprehensive MPT-based financial advice that roboadvisors provide has been available exclusively through certain high-end financial advisors, whose cognitive bandwidth would be limited to servicing perhaps a few dozen well-paying clients apiece. The number of calculations required to identify an optimized asset allocation, pinpoint the ideal securities used to represent each asset class, and assess an individual's true risk tolerance are beyond the ability of most individuals as well as the scope of free, web-based investment tools. The job becomes even more difficult when continuously monitoring and periodically rebalancing a portfolio to maintain a desired level of risk. Taken together, an algorithmically-guided investment strategy that conforms to MPT can construct, on a large scale, objectively rational portfolio choices. But, in order to maintain such model-driven rationality, lay investors must be objectified in ways that conform to the algorithms' direction.

5. **The active construction of passive investors**

One of the most striking findings from this study is that roboadvisors construct passive investors in two ways: first by building passive, indexed portfolios that follow MPT; and *second* by

automating processes that keep users at a distance from their investments. A former head of analytics described this doubly-passive orientation to me:

> It's kind of more passive than self-directed passive investing, that, you know, you're not managing your own taxes and the tax implications of buying and selling…you don't have to reinvest your dividends, you don't have to— really if you don't want to you don't have to know *anything* about investing…I really see it as an extension of passive investing and kind of a *more passive version of passive…*

Financial algorithms can produce extraordinary results, but only if their users are prepared to participate in the working of the model – and in this case participation suggests, to use Woolgar's (1990) terminology, *configuring* users to explicit *non*-participation. Satisfying this double-passivity upholds compliance with the prescripts of portfolio theory; consequently, roboadvisors utilize technology to discipline their users.

Most of the informants I spoke with acknowledged the wayward role emotions play in thwarting investor success and saw it as part of their duty to remove the influence of that affect from their users. Research that has looked at the trading behavior of ordinary investors finds that there is a countervailing tendency among individuals to trade too often and display pernicious overconfidence in their trading decisions (Barber and Odean, 2000; Grinblatt and Keloharju, 2001) – a problem that is particularly pronounced among those using self-directed online brokerages (Odean, 1999). [27] Indeed, the contemporary incarnation of self-directed brokers are new fintech apps like *Robinhood* that tempt lay investors with free stock trading. Such a business model relies on a user interface that encourages trading rather than discipline. It purposefully exploits human propensities to over-trade, playing upon emotions like fear and greed and the thrill of gambling

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[27] Emotional factors are stubbornly present even among market professionals (Pixley, 2004), who routinely tinker with and override financial models (Svetlova, 2012) – where HFT traders may even become emotionally attached to the algorithms that they design and code (Borch and Lang, 2016).

(Albarrán-Torres, 2018:222). In fact, active customers check the *Robinhood* app ten times per day, on average, often in response to push notifications (Harris, 2017).

For lay investors, Weiss (2018) recounts how financial literacy seminars endorse emotion-curbing practices and the necessity for self-discipline under the rubric "you are your own worst enemy." This appears to align with discourses aimed at professional traders; however, market professionals regularly employ self-restraint in conjunction with algorithms of high-finance that figure into a calculative assemblage (Borch and Lange, 2016). "Rather than equipping investors with calculating skills and an enterprising élan," ordinary investors are instead taught to discard any hope of achieving the ideal of rational calculation in the market (Weiss, 2018). The roboadvisors are fundamentally unique in that they equip calculative capacity while also doing away with self-discipline. Through this study, it became clear that roboadvisors believe the best way of ensuring emotional and cognitive detachment is to automate or systematize investment behavior – for the user to keep their hands off *rather than to instruct in self-restraint*; to set-it-and-forget-it. In contrast to market professionals who are taught to follow a self-disciplinary doctrine of "don't think" (Zaloom, 2006), algorithmic low-finance requires that individuals "don't *do*." Thus, in a departure from discourses of trader subjectivity (the ways that participants think about the market), roboadvisors describe a regime of investor objectification (that investors are removed from market decisions). Through distancing the individual, investors are ultimately portrayed as mindless things instead of a thinking and doing subjects.

Among my interviewees, there was a strongly held view that roboadvisors must *impose* restraint since ordinary investors lack the necessary self-discipline and market savvy. "I don't think people can stay the course, they don't have the time or the discipline – and you need a certain level of mathematical competence too. A lot of people just don't have those skills," remarked one

executive. Said another, "the data show time and time again that left to our own devices people make bad decisions – I mean, not everyone obviously, but most people are not going to have the necessary discipline." Here, the roboadvisor becomes a technology of power (Foucault, 1988), shaping the conduct of individuals and submitting them to certain ends of objective rationality. This power is deployed with arguably good intentions (Foucault, 1977) – to help investors do better in the market and to mechanize tasks whereupon computers can do things that a human being simply cannot.

The first layer of discipline is enacted at account opening and involves constraining the amount of risk that a user can take on. Clients are able to choose their time horizon or financial goals, but once the algorithm has selected an allocation several roboadvisors do not allow users to increase their risk even if they want to.[28] Others only allow the assigned risk score to be modified by plus or minus one tick, or they limit users from re-taking the risk assessment to once every thirty days. I encountered this impediment when, based on my level of income and savings, the algorithms at some of the roboadvisors I studied assigned me to a moderate portfolio when I thought myself more willing to take risk. This restriction is often unidirectional — when I expressed my frustration about being limited to the head of business development at one of these roboadvisors, he explained: [29]

> You know, we won't let them if they say, 'you put me in moderate, but I want to be in aggressive.' We allow them to be more *conservative* than our suggestion, so if they're aggressive we allow them to invest in moderate or conservative portfolios. But if you're conservative that is *all* you can invest in – we don't want to encourage our users to take more risk than what we think is optimal for them.

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[28] It should be pointed out that roboadvisors often encourage users to contribute more money to their portfolios in order to achieve their goals. But users do not have a say in how that money is allocated among investments.
[29] Five of the roboadvisors in my sample would not allow me, or made it difficult, to override the algorithm for a more aggressive portfolio.

Once a portfolio has been built, the core financial algorithms that will drive performance embody a model built on mainstream financial theory. Algorithms that discipline otherwise exemplify the lessons learned by behavioral economics. Rather than operating under the belief that the standard models of economics are flawed, the corrective use of behavioral economics by roboadvisors insinuates that the models are fine, and it is the human users who are in need of reform. To this end, efforts to dissuade emotion and regulate behavior are built directly into the user experience with a sort of Foucauldian governmentality. The head of behavioral finance and investing at a large roboadvisor commented, "it's our job to sort of help manage the psychological side of things so that you can do the rational thing." A big part of the design elements that lead to "better behavior" are involved around either diverting or re-targeting a person's motivation. This often involves initiating targeted paternalistic nudges aimed at adjusting specific responses (see: Thaler and Sunstein, 2009).

Take the case of how roboadvisor platforms attempt to correct for loss-aversion and availability bias, psychological errors that undermine self-control (see: DellaVigna, 2009). Behavioral economics teaches that people tend to overweight the present and are prone to make snap decisions based on the recent past – all at the expense of future well-being (e.g. Loewenstein and Prelec, 2009). Unlike the focus of self-directed brokerage platforms (such as *E-Trade* or *Robinhood*) that offer clients reams of backward-looking information to induce buying and selling – what the change in price has been since yesterday in both graphic and numeric form, with flashing colors around that historical information to get visceral reactions in terms of profit or loss – roboadvisors attempt to keep clients focused on the *future*. The design thus frames the client's present to her future self to the exclusion of the past or contemporary alternatives, crafting what Beckert (2016:131,217) refers to as imaginaries of profit opportunities – "fictional expectations"

that help regulate the present state of being. That means not putting up historical returns and not focusing on short-term gains, and instead concentrating on staying the course and realizing future accomplishments. Figure 2 illustrates some of these stark design differences between three popular self-directed apps and three popular roboadvisors. The design elements utilized by the latter are specifically employed to keep users from tinkering with their portfolios and to stave off behavioral errors before they can transpire in the first place.

<Figure 2>

Another element shared by some roboadvisors is the availability of basic financial tools or calculators for users to interact with. These tools again tend to serve a disciplinary purpose to keep investors docile and divert them from the algorithmic processes that are actually governing their portfolios day-to-day. For instance, several roboadvisors offer a retirement calculator that, given some inputs from the user such as time to expected retirement and earnings assumptions through that date, will generate a probability of being able to achieve that retirement goal (see Figure 3). This calculation, however, has no practical bearing on the portfolio allocation assigned to that user (although it may encourage them to increase the amount of money under management). The informants I spoke with recognized that while technology is increasingly ubiquitous and dependable, many people still feel uneasy about completely handing over the financial reigns to software. One interviewee directly cited the work of Dietvorst, Simmons, and Massey (2015) on *algorithm aversion*, whereby people believe that algorithms are too unyielding and thus seek some degree of control over the process. "So, if you give them some agency over the platform, they're much more likely to go ahead with it," that informant remarked. This is reminiscent of so-called 'placebo-buttons' found in places like pedestrian crosswalks or elevator cars. These are buttons that we commonly encounter that we think do things but actually do nothing (McRaney, 2013);

the changing of traffic lights or closing of elevator doors are in fact coupled to timers. According to Moore (2016), placebo-buttons confer a sense of agency in a technologically-mediated world: "we feel in control of these interactions." Roboadvisors design their platforms with this sort of research in mind to 'empower' people, letting them toggle meaningless levers and dials of inert financial tools so that they trust the platform and are more likely to work well with the algorithms rather than view them as a limitation.

<Figure 3>

One of the interesting things that a roboadvisor can do is leverage the technology platform to identify which clients are most at risk to behave 'badly' and respond accordingly. For instance, by proactively messaging *only* those users who are detected to have logged on frequently to the platform during a market downturn 'to stay the course' while refraining from messaging 'calmer' users, avoids creating unnecessary anxiety. In February 2018, when The Dow Jones index fell more than 3,200 points, or 12%, in just two weeks, I was able to confirm this targeted response where I received several "remain calm" emails from the roboadvisors I was most engaged with (some examples appear in Figure 4), while those I had not interacted with sent far fewer unsolicited messages.

<Figure 4>

Overall, the majority of disciplinary features are introduced to keep users from the temptation of straying from the model. As an example, when one roboadvisor began to progressively introduce a new feature showing users how much of a tax impact they would generate from modifying their portfolios away from the algorithmically recommended one, they were able to conduct a quasi-randomized experiment comparing the behavior of those who had

and had not yet received the roll-out. The developer who designed that functionality spoke to its

effectiveness:

> I think it's something around 70% of users that get shown [the tool] as opposed
> to those who don't – they do not go through with the allocation change…If we
> show people that the tax impact of a change will cost them $50 or more, the rate
> of those who don't go through with it goes up to around 90%. So, it's very
> effective in terms of counterbalancing their emotional decisions with more
> rational ones.

Surprisingly, an additional corrective element that I found common in approximately half

of the roboadvisors I surveyed is the re-introduction of human financial advisors. However, the

role and duties assigned to these actants would be unfamiliar to what is commonly thought of as a

'financial advisor'. In most cases these human advisors cannot actually turn any dials: they cannot

change portfolio allocations; adjust risk tolerances; or make specific investment recommendations.

Instead, their role is reformatted to act as a 'counselor' or a 'coach' in order to suppress users'

propensity to tinker or to keep their emotions (in particular, fear and greed) in check. According

to one executive:

> Our advisors are not there to decide what strategy somebody should be in or to
> build a portfolio *or anything like that*, they are there to help make sure the client
> feels comfortable and sticks with it.

As a roboadvisor user, I reached out to several on-staff advisors and reached a similar conclusion.[30]

The most candid response was the following email sent to me by one of my advisors when I asked

if he could make my portfolio somewhat more aggressive:

> Our role as advisors is to answer questions around our investment
> strategies/methodologies, portfolios, our services etc… We as advisors *are not
> able change portfolio allocations.* This is done through our questionnaire and
> the corresponding recommendation made by our algorithm.

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[30] At two roboadvisors the advisors did have some discretion in making portfolio changes or recommendations, but the large
majority did not.

The human advisor is there to help keep users adhering to MPT. But, more than an agent of discipline, the human advisors also create a familiar social relation between the end-user and the unfamiliar calculative equipment at their disposal. Even if the advisor is just a 'face' that users can associate with the rest of the assemblage, the presence of a responsive human (i.e. a "translator" or "spokesman" of the entities he represents [Callon, 1986:25]) keeps the assemblage stable. A manager in charge of the advisory piece at one robo explained that people sometimes call in just to have "a sort of a cathartic experience:"

> We [advisors] don't say anything that we couldn't send out via email or that we couldn't put at the end of a recording so that they can get the same answer. But they [users] just want to know that there's a human being, kind of as a therapist, on the other side of it. So, the facts and the concepts of what you would think of as the rational component of investing don't change but talking to a person is far more cathartic and interactive.

For the most part, these measures collectively do result in discipline. According to several informants, about 80-90% of users comply with the algorithms' direction at any point in time: "by far, the vast majority take our advice, on allocations and transactions and things of that nature."

The choices recommended by theory-laden algorithms, too, need to be situated in a relational context in which certain goals are highlighted – for instance, the technocratic operation of maximizing an investment's risk-adjusted return must be constrained by the context of the social and subjective goal of (e.g.) retirement saving, where the prescripts of financial models are made compatible with human behavior at the same time that human behavior is made compatible with the model. Mean-variance optimization requires risk and return assumptions and sometimes when these are plugged into the model, the results makes little practical sense. When using historical returns as inputs, the MPT approach favors allocating greater weights to negatively correlated asset classes or those that experienced superior performance over some period. For example, an MPT strategy based on historical data spanning only the years 2000-2008 would have resulted in an

unreasonably heavy weighting to real estate, commodities, and emerging markets stocks. A portfolio concentrated in Latin American shares and real estate investments would not be considered good judgement, where a competent financial advisor would immediately recognize such imprudence. "In real life the [algorithm's] output is not very satisfying much of the time, so you have to limit it in some way that you and your client can live with," explained one vice-president of portfolio management. Thus, at every roboadvisor sits an investment committee, made up of three to five market experts, who oversee the algorithmic processes. This group is tasked with updating model inputs and assumptions and has the final say on whether the algorithm's output is satisfactory or needs to be overruled.

Algorithms are also constrained by the circumstances of their human end-users, each of whom has a unique combination of risk tolerance, time horizon, financial goals, and so on. To become optimized through a roboadvisor does not mean to be made homogenous – each user-algorithm combination must be configured in different ways to optimize portfolio selection against individual preferences and goals. This is an important distinction that sets the likes of roboadvisors apart from other passive indexed strategies such as target-date mutual funds, which take a far more static and one-size fits all approach. The roboadvisor and its relation to the human user may be encapsulated by the following quotation from a senior robo executive: "[A] good way of thinking about it is that it's working with their existing eyesight and we're like a pair of glasses. But their eyes are still their eyes, we're just going to change the way they see the world so that it's a little bit clearer."

6. Algorithmic low-finance and society

6.1 The governed investor

Roboadvisors are not just user-algorithm assemblages, they are also for-profit firms that seek to enlarge their market share. Unlike the loosely regulated domain of HFT (Coombs, 2016; Lenglet and Mol, 2016), in order to grow, this new category of financial firm must convince both users and regulators that they are legitimate, trustworthy, and competent fiduciaries of client assets; but how is one to enlist trust in the absence of a track record? Rather than wait patiently to develop and test proprietary investment models (which may or may not succeed), they draw on an existing framework that they can tout to give some confidence to their allocations. In order to operate in the domain of low-finance, roboadvisors must further satisfy the incumbent responsibilities outlined by strict legal and regulatory frames intended to protect small investors, and the safest way to achieve that is by pre-establishing a basis in "Nobel-prize winning research." The economic model is used as a tool to convince others (e.g. regulators) that their interests align, where the persuasive power of MPT helps bring roboadvisors into existence. Therefore, the want to create optimal client portfolios is in fact borne out of the requirement to fulfill a fiduciary duty – as the former CEO of one roboadvisor explained, "I'd say we used MPT probably 80% from a regulatory standpoint, and then 20% because we felt it's the best kind of investment strategy." Another CEO similarly admitted, "I'm no mean-variance optimization devotee; frankly, a lot of what we put out there in terms of portfolio management is because its defensible against popular literature." The organizational politics of roboadvisors are thus intrinsically bound up with the social forces and larger political structures that allow them to operate and manage (lay) client money, as well as from a practical aversion to potential lawsuits claiming irresponsible portfolio management.

The passive actors shaped by roboadvisors thus align with state regulators' ideal for lay investing that equates rational with responsible, as a form of governmentality. In particular, actively constructing passive investors in this way is consistent with a neoliberal manner of rationality that is not only instrumental with calculation but also "intensely constructed and governed," tasked with enhancing portfolio value across all endeavors and venues (Brown, 2015:10). Contrary to Adam Smith's *Homo economicus* as self-interested commodity producer guided by an invisible hand and a propensity to "truck and barter," Foucault (2008:226) recognized that neoliberalism has brought to bear a version of *Homo economicus* defined by competition rather than exchange, an entrepreneur in search of profit. For Brown (2015:32), contemporary logics of financialization have further reshaped *Homo economicus* as "human-turned-capital". Just as capitalism for Marx alienated humans from their productive capacity in the transformation into labor, roboadvisors seem to accommodate the alienation of our financial selves in the conversion of humans to capital. While it is unlikely that automated investment algorithms alone will have a significant impact, this conversion, Brown cautions, can remake a society of political citizens into one of economized automatons, with the ultimate consequence being the potential undoing of democracy itself.

For individual users, roboadvisors furthermore invoke the possibility of imputing interests to people (Callon and Law, 1982; Latour, 1999). I conducted some preliminary interviews with users of roboadvisors, finding that none of them cared very much about emulating a rational economic actor or following a passive strategy. Users are far more responsive to the fact that these platforms are inexpensive, require very low account balances, and manage investments automatically with minimal user input. Using these factors as lures and with the tacit encouragement of regulatory bodies, roboadvisors subtly persuade individuals that they ought to

be following MPT. By becoming a passive indexed investor, one must accept that there is no expectation to come out ahead of the broader market, which means there is no opportunity for market excellence in the form of excess returns (what practitioners call 'alpha'). Enrollment in a roboadvisor does not come with the promise of being a Warren Buffett or George Soros. Rather, it comes with the modest goal of replicating market indexes. To construct this sort of economic action guided by MPT therefore is to import a moral character that may oppose contemporary dictates of individual exceptionalism – one has to accept that being 'rational' is indeed to be 'average'. Put differently, the objective choices determined by can, in some cases, conflict with individual interests inculcated through cultural norms and societal values that incentivize being above average. That *Homo economicus* can exist does not imply in all cases he wants to.

6.2 The perils of passive

By the year 2023, it is projected that more than 147 million people worldwide will use a roboadvisor (dominated by American and Chinese investors).[31] What happens if algorithms of low-finance succeed in enrolling a mass of followers into passive investing? A preponderance of actors following the rules of MPT could actually produce systematic market failures, one of which derives from a corporate governance concern: that index funds and ETFs become large shareholder blocs of firms, and they cannot, however, sell their shares, since they must replicate the index at its given component weights. This is a relatively new concern since over the past decade the growth of passive has far outpaced any other strategy (in part due to roboadvisors, but also target-date funds in retirement accounts, standalone index mutual funds, etc.). The result is that passive funds now collectively own an average of 17% of each component of the S&P 500, per Goldman Sachs

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[31] https://www.statista.com/outlook/337/100/robo-advisors/worldwide#market-users

data (the range is as little as 10%, and as much as 35%), whereas passive ownership was merely "a rounding error" a decade ago.[32] Vanguard alone, the largest index fund provider, has at least a 5% stake in 468 components of the S&P 500, according to a 2017 report in The Wall Street Journal, up from just three components in 2005.[33] Fichtner and Heemskerk (2018) refer to the incredible growth of passive shareholding as a fundamental shift in contemporary capitalism toward "new permanent universal owners". Several structural problems have been identified that could arise from this paradigm, what Elhauge (2016:1267) calls horizontal shareholding: "when a common set of investors own significant shares in corporations that are horizontal competitors in a product market." An index fund may own a sizeable stake in both Delta and United Airlines, in both Coca Cola and PepsiCo. What Elghauge (2016) and others like Schmalz (2018) argue is that horizontal ownership incentivizes anti-competitive practices. What is good for Pepsi (say, a new product line) could be bad for Coke; a 5% owner in both companies would prefer to see the industry overall succeed rather than gains in Pepsi offset by losses in its main competitor.

The long-run implications of this new buy-and-hold-everything structure on corporate governance are yet unclear – on the one hand it may favor managerial strategies of 'patient capital' focused on long-run stability and growth (Braun, 2016), as opposed to the short-term share price focus that has defined the 'managerial revolution/shareholder maximalist' dogma. On the other hand, it suggests that managers might not have to be accountable to shareholders who cannot threaten to sell their ownership stake, breaking the market for corporate control and leaving a vacuum in terms of principal-agent responsibility (see e.g. Fligstein, 1996; Dobbin and Zorn, 2005). In a recent paper, Fichtner and Heemskerk (2018) study how the "Big Three" index fund managers (*Vanguard, Blackrock*, and *State Street*) vote on shareholder issues, finding that these

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[32] https://www.goldmansachs.com/insights/public-policy/directors-dilemma-f/report.pdf

[33] https://www.marketwatch.com/story/passive-investing-is-changing-the-stock-market-in-ways-investors-dont-realize-2017-09-25

concentrated centers of shareholding are not flexing their voting power toward a long-term (patient) management orientation. At the same time, there does not seem to be moral hazard arising from corporate managers exploiting the fact that index funds cannot 'exit' their positions. Fichtner, et al. (2017:318) reveal that the Big Three seem to exert "hidden power" via informal private engagements with corporate managers of invested companies, highlighting a relational strategy that keeps the interests of managers and index funds aligned.

The roboadvisors could actually serve as a modest check against the concentration of shareholding in the Big Three since they employ algorithms that constantly scan the market for the lowest-cost ETF for a given asset class and choose accordingly.[34] Fund characteristics such as expense ratio, liquidity, dividend yield, and tracking error are all involved in the calculus for choosing ETFs – and it turns out that for certain asset classes *Schwab*, *Wisdom Tree*, or *Invesco* prove to be the most suitable index fund. Even if the ETFs provided by one of the Big Three end up being the most cost-effective, most roboadvisors now engage in tax-loss harvesting as a standard service, an automated tax-minimization strategy that offsets capital gains in one security with capital losses in another, very similar but not identical, security. Therefore, roboadvisors maintain a stable of two or three ETFs for each asset class: if, for instance, small-cap stocks flounder, the algorithm will sell the (e.g.) *Vanguard* ETF and replace it with the *Invesco* equivalent.

A final issue that has been highlighted casts indexed investors as 'free-riders'. The logic goes that if everybody passively owns an index of stocks, then nobody is left to actively price the shares of the individual companies that make up that index. With nobody looking out for the share values of the index's components they will tend to become mis-priced and thus markets will ultimately turn out to be more *in*efficient. If the efficient markets hypothesis breaks down, then

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[34] The only exception would be roboadvisors that also market their own index ETFs, such as Vanguard and Schwab who will prioritize their own by default.

MPT will also fail to describe optimal portfolio weights, an example of what MacKenzie (2006) calls *counter*performativity.[35] The Nobel-prize winning economist Robert Shiller responded to the rise of passive investing in a 2017 interview:

> It's kind of pseudoscience to think these indexes are perfect, and all I need is some kind of computer model instead of thinking about businesses…[P]assive indexing…is something that is really free-riding on other people's work…So people say, 'I'm not going to try to beat the market. The market is all-knowing.' But how in the world can the market be all-knowing, if nobody is trying— well, not as many people— are trying to beat it?[36]

The head of investment research for one of the roboadvisors I interviewed similarly agreed:

> If you take the limiting case where every single market participant uses a mean-variance model and that's it, then the market *cannot* be efficient, because somebody still needs to do the fundamental research to work out what the fair value of each stock is.

Along these lines, when Vanguard launched the first index fund in the 1970s it was branded as "un-American" (Fichtner, et al. 2017), and more recently Fraser-Jenkins, et al. (2016) assert that indexed investing is "worse than Marxism" in the sense that passive markets cannot possibly allocate capital efficiently, arguing that an abundance of active strategies are a social necessity for the stability of financial markets. If this reasoning is correct, there must be some inflection point where it becomes no longer socially responsible to invest in an index, and that means at some point roboadvisors may actually promote financial *weakness* through performing MPT *en masse*.

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[35] i.e. the practical use of a theory or model alters economic processes so that they conform *less well* to the theory or model.
[36] https://www.cnbc.com/2017/11/14/robert-shiller-passive-investing-is-a-dangerous-chaotic-system.html

7. Conclusion

In his book on algorithmic high-finance, *Flash Boys,* Michael Lewis (2014:3) depicts how "the stock market now trades inside black boxes."[37] But, as roboadvisors bring algorithmic trading to the realm of 'low-finance', that market paradigm is upended. In this article, I have shown that the type of algorithmic finance used by roboadvisors instead embodies market logics suited for ordinary investors; in particular, popular strategies of *low*-frequency trading, i.e. passive indexed investing derived from Modern Portfolio Theory. Thus, while HFT algorithms are highly-secretive objects of ignorance, roboadvisors are highly-regulated entities couched in well-understood models of mainstream finance, making them objects of cognizance. From a methodological perspective, this makes roboadvisors particularly well-suited for studying algorithms ethnographically.

If any piece of the roboadvisor is subject to ignorance (not-knowing), it is the end-user, who fully delegates investment choices to the algorithms – individuals who are actively constructed as 'doubly-passive' investors. From this, other important contrasts arise: HFT traders who tend to be subjectivized as they adapt to evolving market-forms, and roboadvised clients who are instead objectified and detached from the market. To become competent market subjects, HFT traders engage in curative techniques of the self ("don't think"), while roboadvisors impose technologies of power to discipline their users ("don't *do*"). Techniques of discipline used by roboadvisors include behavioral nudges and design elements that draw from the findings of behavioral economics – to keep emotions in check and hands off, with human financial advisors who are brought back in to the assemblage, not to advise on financial matters but to remind users to trust in algorithmically-made decisions.

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[37] quoted in Lange (2016:3)

There is also an implicit understanding of the change of agency that is undertaken – a condition where actors are calculative *yet never themselves calculating*. Roboadvised clients are not individually performing agency but are to some extent being performed by the roboadvisors' calculative intervention. However closely the client of a roboadvisor may approximate rational economic man 'on paper', he need not have *any* inkling of financial literacy, never has to make a single investment decision, and can remain perfectly alienated from the market. Thus, individuals themselves become detached from the behavioral ideal of *Homo economicus* and only achieve rational outcomes through outsourcing agency to machines.

The rise of algorithmic low-finance, and the roboadvisors in particular, has important implications on the socio-technological structuration of securities markets and on investor behavior. As more lay investors become roboadvised, and thus passive (who are moreover chastened if they want to pick stocks or time the market), there is less "noise" in the market (Preda, 2017) for the algorithms of high-finance to respond to. And while this may seem like a step toward increased market efficiency, too much passive investing can itself lead to market failure and raise problems of corporate governance and concentrated shareholding.

This work is among the very first to study roboadvisors from the lens of social science, and so several new directions for future work present themselves. While this study focused on the organizational side of roboadvisors, much can still be learned from research oriented to their users – who they are, how they form relations with their digital 'advisor', how they respond to being disciplined, and how they feel about being objectified. Or, to explore the extent to which roboadvisors promote financial inclusion and help democratize markets. Another strand could pick up on the performativity of economics thesis proposed by Callon (1998) and extended by MacKenzie (2006), where an economic theory comes to *make* the economy rather than simply

describe it. Algorithms that perform MPT on a large scale could bring markets in line with the model's prescriptions and reproduce lay investors in ways consistent with financial theory.

Consumer-facing financial technology is already branching out beyond the sphere of investments and is a worthy extension of these lines of research. Algorithms now exist that automate quotidian household finance activities like optimizing which credit cards, bank accounts, and loan products and individual gets. Others are in the business of robotically cancelling old or unused subscriptions, or automatically saving loose change into high-yield bank accounts. Still more monitor budgets and spending behavior, alerting consumers to potential credit score impacts based on purchasing patterns. Beyond finance and economics, studying these technologies from different perspectives could also inform the broader study of algorithms in society – describing a constructive class of algorithms, in opposition to those that victimize or exploit individuals like O'Neil's (2016) "Weapons of Math Destruction". Roboadvisors appear to benefit and enhance their human user who is "formatted, framed and equipped with prostheses which help him in his calculations" (Callon, 1998:51), albeit through coercive techniques of discipline and a loss of autonomy.

References

Anderson, L. (2006).Analytic autoethnography. *Journal of Contemporary Ethnography*, 35(4):373-395.

Arnoldi, J. (2016).Computer Algorithms, Market Manipulation and the Institutionalization of High Frequency Trading, *Theory, Culture & Society*, 33:29–52.

Authers, J. (2017).How passive investors morphed into the bad guys. *Financial Times* https://www.ft.com/content/8c44c31a-b02b-11e7-aab9-abaa44b1e130, retrieved 10/20/2018.
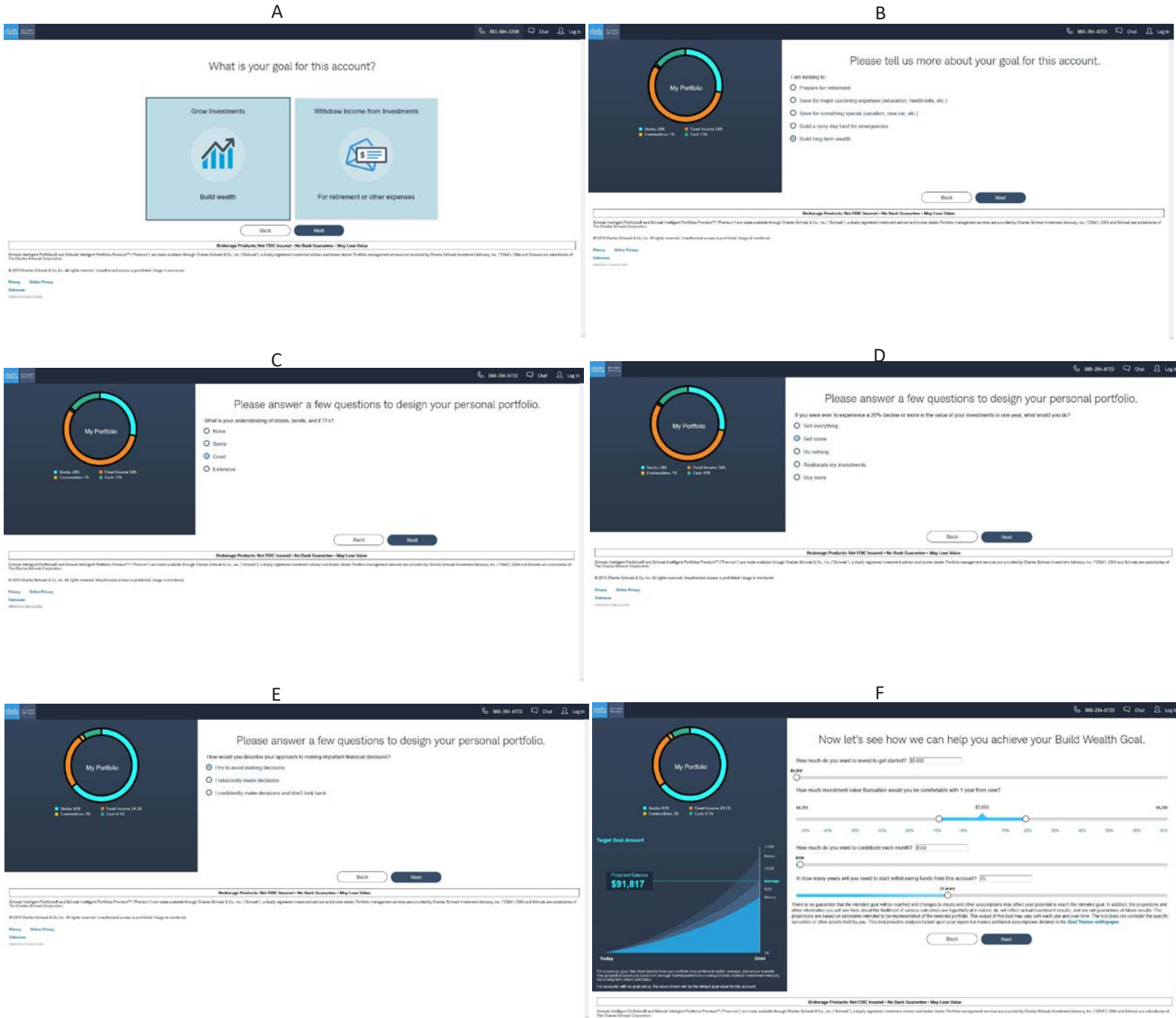
Barber, B.M.,& Odean, T. (2000).Trading is hazardous to your wealth: The common stock investment performance of individual investors. *The journal of Finance*, 55(2):773-806.

Barber, B.M., Lee, Y.T., Liu, Y.J.,& Odean, T. (2008).Just how much do individual investors lose by trading?. *The Review of Financial Studies*, 22(2):609-632.

Beckert, J. (2016).*Imagined futures*. Harvard.

Benartzi, S.,& Thaler, R. (2007).Heuristics and biases in retirement savings behavior. *Journal of Economic perspectives,* 21(3):81-104.

Borch, C. (2017).Algorithmic finance and (limits to) governmentality: On Foucault and high-frequency trading. *Le foucaldien,* 3(1):1-17.

Borch, C.,& Lange, A.C. (2016).High-frequency trader subjectivity: emotional attachment and discipline in an era of algorithms. *Socio-Economic Review*, 15(2):283-306.

Borch, C., Hansen, K.B.,& Lange, A.C. (2015).Markets, Bodies, and Rhythms: A Rhythm Analysis of Financial Markets from Open-Outcry Trading to High-Frequency Trading. *Society and Space*, 33:1080–1097.

Braun, B. (2016).From performativity to political economy: index investing, ETFs and asset manager capitalism. *New Political Economy*, 21(3):257-273.

Brown, W. (2015).*Undoing the demos: Neoliberalism's stealth revolution*. MIT.

Beunza, D.,& Stark, D. (2004).Tools of the trade: the socio-technology of arbitrage in a Wall Street trading room. *Industrial and Corporate Change*, 13(2):369-400.

Callon, M. (1986).The sociology of an actor-network: The case of the electric vehicle. In *Mapping the dynamics of science and technology* (19-34). PalgraveMacmillan.

_____. (1998).Introduction: the embeddedness of economic markets in economics. *The Sociological Review,* 46(S1):1-57.

Callon, M.,& Law, J. (1982).On interests and their transformation: enrolment and counter-enrolment. *Social studies of science*, 12(4):615-625.

Coombs, N. (2016).What is an algorithm? Financial regulation in the era of high-frequency trading. *Economy and Society*, 45(2):278-302.

Cremers, M., Ferreira, M.A., Matos, P.,& Starks, L. (2016).Indexing and active fund management: International evidence. *Journal of Financial Economics,* 120(3):539-560.

DellaVigna, S. (2009).Psychology and economics: Evidence from the field. *Journal of Economic literature,* 47(2):315-72

Dietvorst, B.J., Simmons, J.P.,& Massey, C. (2015).Algorithm aversion: People erroneously avoid algorithms after seeing them err. *Journal of Experimental Psychology*, 144(1):114.

Dobbin, F.,& Zorn, D. (2005).Corporate malfeasance and the myth of shareholder value. In *Political power and social theory*.(179-198). Emerald.

Elhauge, E. (2016).Horizontal Shareholding. *Harvard Law Review*, 129(5):1267-1317.

Ellis, C.D. (2016).*The Index Revolution: Why Investors Should Join It Now*. Wiley.

Fama, E.F.,& French, K.R. (2010).Luck Versus Skill in the Cross-Section of Mutual Fund Returns, *Journal of Finance.* 65(5):1915–1947.

Fichtner, J.,& Heemskerk, E.M. (2018).The New Permanent Universal Owners: Index Funds, (Im)patient Capital, and the Claim of Long-termism. *Available at SSRN 3321597.*

Fichtner, J., Heemskerk, E.M.,& Garcia-Bernardo, J. (2017).Hidden power of the Big Three? Passive index funds, re-concentration of corporate ownership, and new financial risk. *Business and Politics,* 19(2):298-326.

Fligstein, N. (1996).Markets as politics: A political-cultural approach to market institutions. *American sociological review*.656-673.

Foucault, M. (1977).*Discipline and Punish*. Pantheon.

_____. (1988).Technologies of the self. In *Technologies of the self: A seminar with Michel Foucault* (16-49).

_____. (2008).*The birth of biopolitics: lectures at the Collège de France, 1978-1979.* Springer.

Fraser-Jenkins, I., Gait, P., Harmsworth, A., Diver, M.,& McCarthy, S. (2016).*The Silent Road to Serfdom: Why Passive Investing is Worse Than Marxism*. Sanford C. Bernstein.

Froot, K. A., Scharfstein, D.S.,& Stein, J.C. (1992).Herd on the street: Informational inefficiencies in a market with short-term speculation. *The Journal of Finance,* 47(4):1461-1484.

Goetzmann, W.N.,& Kumar, A. (2008).Equity portfolio diversification. *Review of Finance*, 12(3):433-463.

Grinblatt, M.,& Keloharju, M. (2001).What makes investors trade? *The Journal of Finance*, 56(2):589-616.

Harris, A. (2017).How brokerage app Robinhood got millennials to love the market. *Fast Company,* 14th-August.

Hill, M. (2009).Ways of Seeing: Using Ethnography and Foucault's "Toolkit" to View Assessment Practices Differently. *Qualitative Research*, 9(3):309–330.

Hutton, W. (2009).High stakes, low finance. *The Guardian, Saturday Review*, 2nd-May.

Kaplan, P.D. (1998).Asset allocation models using the Markowitz approach. *Frontiers of Modern Asset Allocation.* 267-274.

Knorr-Cetina, K.,& Bruegger, U. (2002).Inhabiting technology: the global lifeform of financial markets. *Current Sociology,* 50(3):389-405.

Kocianski, S. (2016).The Robo-Advising report: Market forecasts, key growth drivers, and how automated asset management will change the advisory industry*, Business Insider.*

Lange, A.C. (2016).Organizational ignorance: An ethnographic study of high-frequency trading. *Economy and Society*, 45(2):230-250.

Lange, A.C., Lenglet, M.,& Seyfert, R. (2016).Cultures of high-frequency trading: Mapping the landscape of algorithmic developments in contemporary financial markets. *Economy and Society,* 45(2):149-165.

_____. (2018).On studying algorithms ethnographically: Making sense of objects of ignorance. *Organization*, 1350508418808230.

Latour, B. (1999).*Pandora's hope: essays on the reality of science studies*. Harvard.

Lazarus, J. (2016).The issue of financial literacy: Low finance between risk and morality. *Economic Sociology (European Electronic Newsletter)* 17(3):27-34.

Lenglet, M. (2011).Conflicting Codes and Codings: How Algorithmic Trading Is Reshaping Financial Regulation. *Theory, Culture & Society* 28(6):44–66.

Lenglet, M.,& Mol, J. (2016).Squaring the speed of light? Regulating market access in algorithmic finance. *Economy and Society*, 45(2):201-229.

Lewis, M. (2014).*Flash boys: a Wall Street revolt*. W.W.Norton.

Lin, T.C. (2012).The new investor. *UCLA Law Rev*.,60:678.

Loewenstein, G.,& Prelec, D. (1992).Anomalies in Intertemporal Choice: Evidence and an Interpretation. *Quarterly Journal of Economics*. 107(2):573–597.

MacKenzie, D. (2006).*An engine, not a camera: How financial models shape markets*. MIT.

_____. (2014).A sociology of algorithms: High-frequency trading and the shaping of markets. Unpublished.

_____. (2016).How algorithms interact: Goffman's 'interaction order' in automated trading. Unpublished.

_____. (2018).Material signals: A historical sociology of high-frequency trading. *American Journal of Sociology*, 123(6):1635-1683.

Malkiel, B.G. (2005).Reflections on the efficient market hypothesis: 30 years later. *Financial Review,* 40(1):1-9.

Markowitz, H. (1952).Portfolio selection. *The journal of finance*, 7(1):77-91.
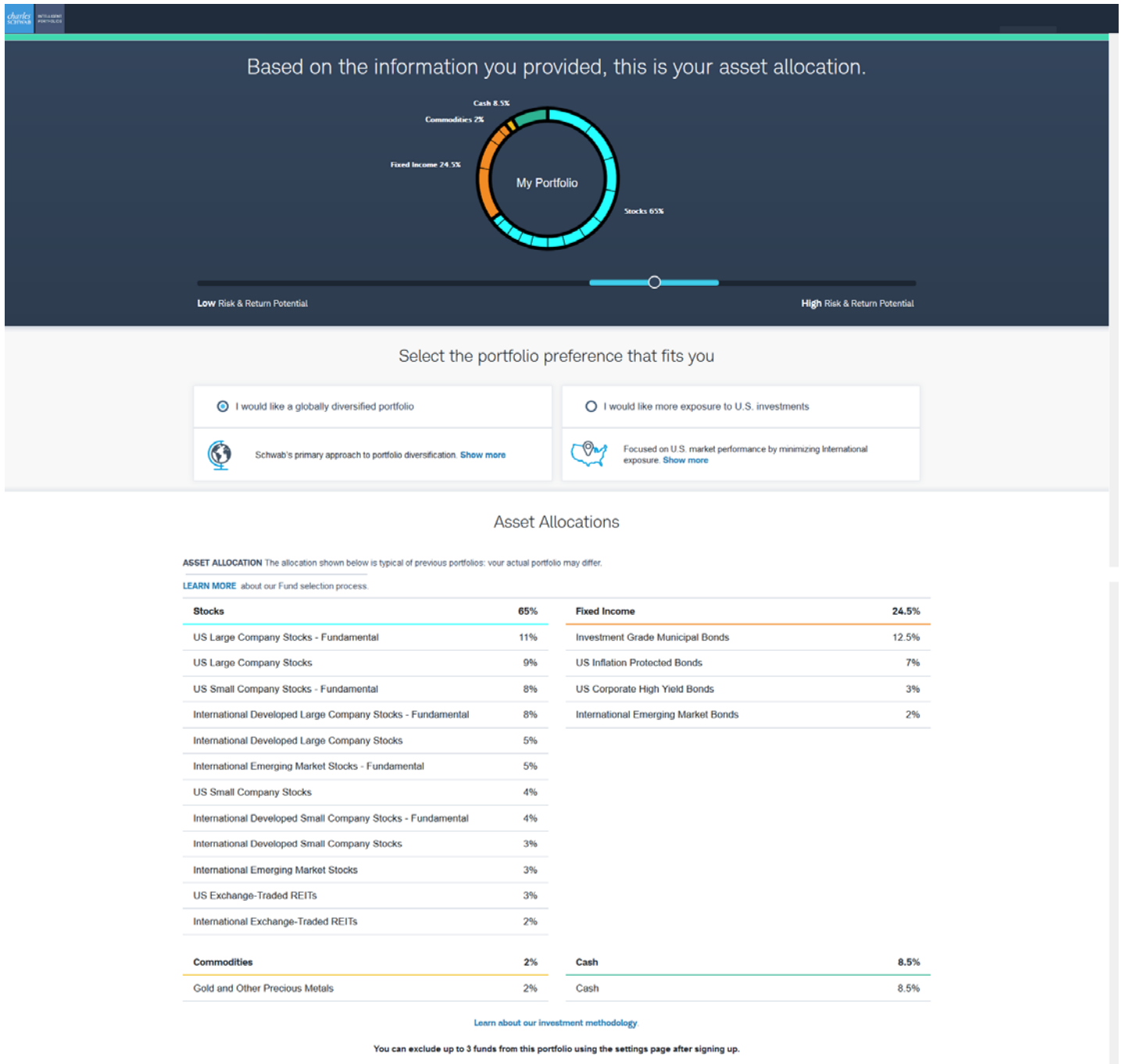
McRaney, D. (2013).*You Can Beat Your Brain: How to Turn Your Enemies Into Friends, How to Make Better Decisions, and Other Ways to Be Less Dumb*. Oneworld Publications, London.

Moore, J.W. (2016).What is the sense of agency and why does it matter?. *Frontiers in psychology*, 7:1272.

Odean, T. (1999).Do investors trade too much?. *American Economic Review*, 89(5):1279-1298.

O'Neil, C. (2017).*Weapons of math destruction: How big data increases inequality and threatens democracy.* Broadway Books.

Pasquale, F. (2015).*The Black Box Society: The Secret Algorithms That Control Money and Information.* Harvard.

Preda, A. (2017*).Noise: Living and Trading in Electronic Finance*. Chicago.

Rubin, H.J., & Rubin, I.S. (2011).*Qualitative interviewing: The art of hearing data*. Sage.

Schmalz, M. C. (2018).Common-ownership concentration and corporate conduct. *Annual Review of Financial Economics,* 10:413-448.

Seyfert, R. (2016).Bugs, Predations or Manipulations? Incompatible Epistemic Regimes of High-Frequency Trading, *Economy and Society* 45(2):251–77.

Soe A.,& Poirier, R. (2017).SPIVA U.S. Scorecard 2017, Standard&Poors.

Srinivas, V.,& Goradia, U. (2015).*The future of wealth in the United States*. Deloitte Center for Financial Services, 9th-November.

Svetlova, E. (2012).On the performative power of financial models. *Economy and Society,* 41(3):418-434.

Swensen, D.F. (2005).*Unconventional success: A fundamental approach to personal investment*. Simon and Schuster.

Thaler, R.H.,& Sunstein, C.R. (2009*).Nudge: Improving Decisions about Health, Wealth, and Happiness*. Penguin.

Timmermans, S., & Tavory, I. (2012).Theory construction in qualitative research: From grounded theory to abductive analysis. *Sociological Theory,* 30(3):167-186.

Weiss, H. (2018).Popfinance: From the economic man to the Swabian housewife. *HAU: Journal of Ethnographic Theory*, 8(3):455-466.

Woolgar, S. (1990).Configuring the user: the case of usability trials. *The Sociological Review*, 38(1_suppl):58-99.

Zaloom, C. (2006).*Out of the Pits: Traders and Technology from Chicago to London*, Chicago.

Figure 1A: Sample Roboadvisor Account Opening

Note: These six panels represent, in general, what the risk assessment process entails for opening a roboadvised account. These screen shots were taken from *Schwab Intelligent Portfolios*, and displays six out of thirteen question items. What is interesting about this particular risk profiling questionnaire is that it updates the recommended general asset class allocation (on the left of each panel) as users respond to each prompt. Ultimately, the portfolio recommended based on my responses had a moderate level of risk exposure (see Figure 1B for the portfolio recommended based on my risk assessment). Some questions in the risk assessment require objective input (e.g. panels A, B, and C) while others elicit subjective responses (panels D and E). Panel F illustrates how investment goals (objectives) also play into the overall measurement of risk.
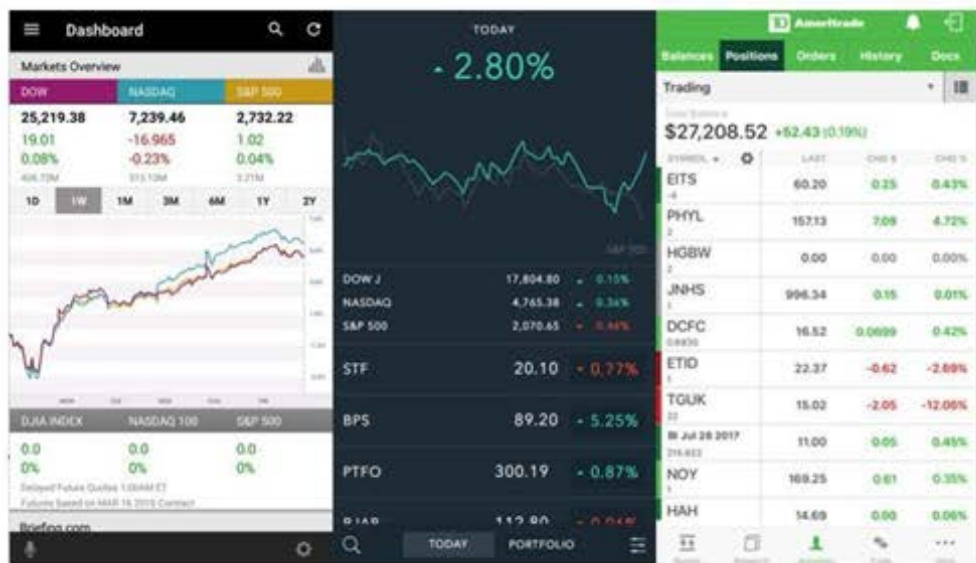
Figure 1B: Recommended portfolio allocation

Note: This screenshot depicts the actual asset allocation recommended by *Schwab Intelligent Portfolios* based on the user-inputted responses to its risk assessment questionnaire after a process of mean-variance optimization, following the principles of Modern Portfolio Theory. This portfolio is broadly constructed as 65% stocks, 25% bonds, 2% commodities and 8.5% cash. It consists of 12 equity asset classes, 4 fixed-income asset classes, precious metals, and cash. Each of the asset classes is represented by an ETF in the actual portfolio.

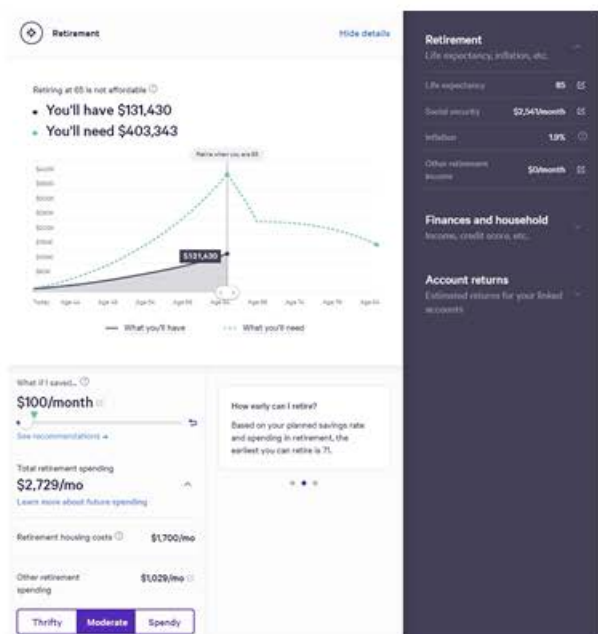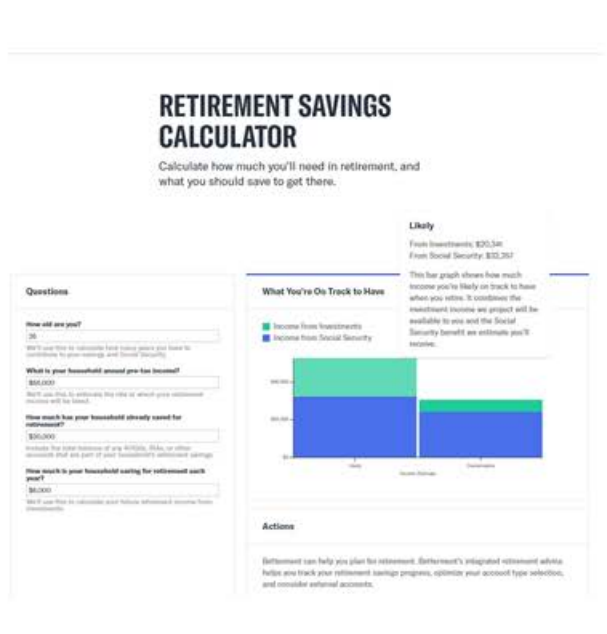**Figure 2:** Roboadvisor vs self-directed user experience

A B

Note: This figure shows side-by-side screenshots from three widely used self-directed investing apps (Panel A): E-Trade, Robinhood, and TD Ameritrade; and three widely used roboadvisor apps (Panel B): Acorns, Schwab Intelligent Portfolios, and Wealthfront. Note the striking similarities within each panel and the differences between them. Note the striking similarities within each panel and the differences between them. Self-directed apps show how some external reference has done – for example how a stock market index has changed in price historically, in both graphic and numeric form. Self-directed platforms highlight winners and losers using green and red fonts and show the prices of individual stocks. Roboadvisors, on the other hand, do not refer to how the market has done, rather you see how your own account has performed (and here, only for Schwab), and each show how your account is projected to grow into the future. There are no stock prices, green or red text, or market history - and there is no button to make a trade. These design elements are specifically employed to keep users from tinkering with their portfolios and to stave off behavioral biases such as recency bias and myopic loss aversion

Figure 3: Retirement calculators

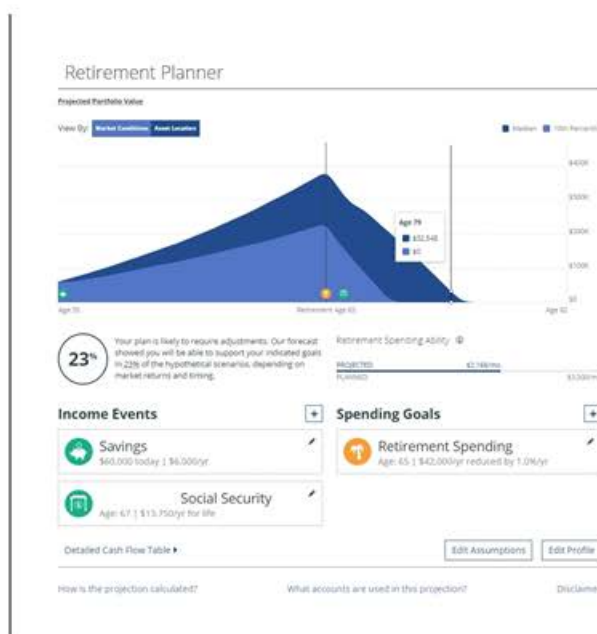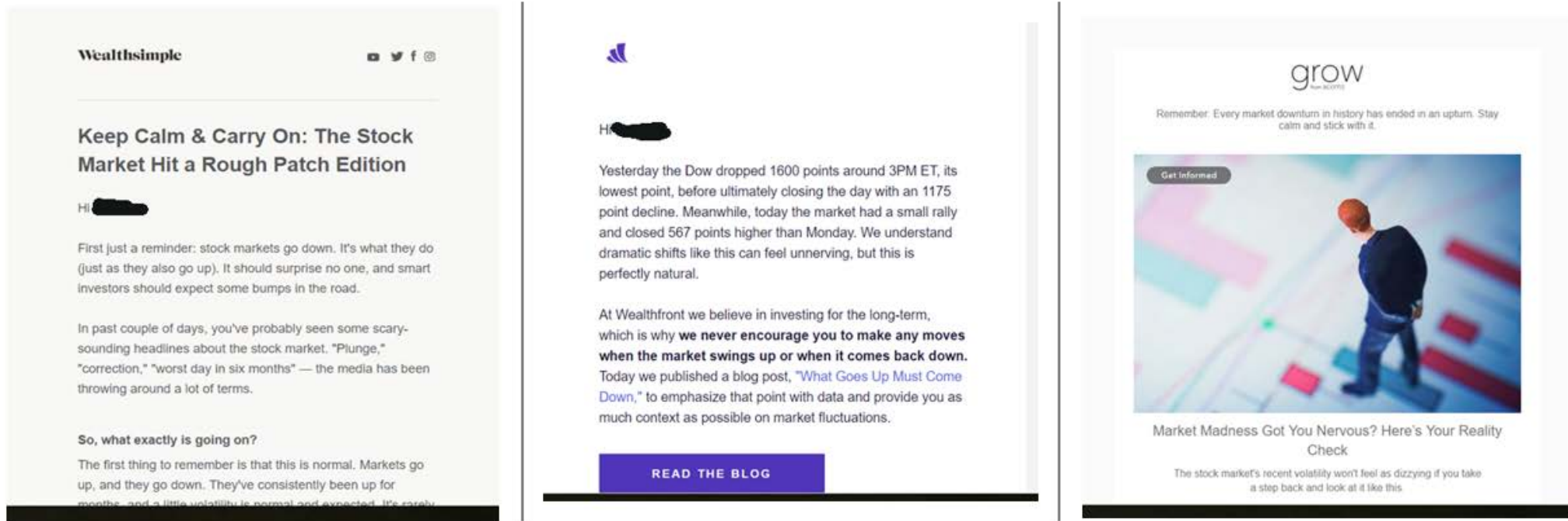A   B   C

Note: These three retirement calculators illustrate the type of financial tools available to roboadvisor users (panel A is from *Betterment,* panel B from *Personal Capital,* and panel C from *Wealthfront*). Users input some basic information and their desired income at retirement, and the tool provide a likelihood of generating enough assets to support that retirement income over time. While these financial planning tools are often informative, they have no bearing on the actual portfolio allocations generated by the roboadvisor (although they may encourage a user to put more money into their investment account in order to achieve their retirement goal), and so serve the primary goal of making individuals feel more at ease with algorithmic asset management.

Figure 4: Pro-active roboadvisor correspondence following a stock market decline

Note: This figure provides three examples of pro-active email correspondence sent on February 6th, 2018 by Wealthsimple, Wealthfront, and Acorns, following a steep decline in the stock market the previous day. These roboadvisors were among the ones that I logged in often before and during the market decline. In fact, on February 5th, I logged in to each of these roboadvisors around once every hour. Because my frequent log-in activity flagged me as a potentially "badly behaving" user, I received these, while I did not receive corresponding emails from platforms that I had not frequented during the same period. Notice that each message is instructing me to "stay the course," to "keep calm," and that market dips are typically followed by gains. In each case, the purpose of the message is to keep the user from reacting emotionally and from tinkering with the model. Wealthfront and Acorns further allow the user to click on a directed link providing further information.