

## Research Statement

My research is in empirical asset pricing, and centers on two main themes: investment and delegated asset management. All my work aims at improving our understanding of (i) what drives the stock returns in the cross section and time series and (ii) whether delegated asset management improves investor welfare, market efficiency, and social outcomes. I will first describe my work in investment and then move on to my work on delegated asset management.

### 1. Investment

My papers on this theme (i) provide fresh perspectives on some well-established asset pricing anomalies, (ii) apply new methods such as machine learning and model integration to address various challenges in asset pricing, and (iii) examine new developments in the market, such as sustainable investing and online data sharing.

#### *1.1. Asset Pricing Anomalies*

The economic notion of limits to arbitrage suggests that the profitability of anomaly-based trading strategies should be lower when markets are liquid. **“Time-Varying Liquidity and Momentum Profits” (Journal of Financial and Quantitative Analysis 2016)**, coauthored with Doron Avramov and Allaudeen Hameed, reports a perhaps initially surprising finding that momentum profits are markedly larger in liquid market states. The negative momentum-illiquidity relation is not explained by variation in liquidity risk, time-varying exposure to risk factors, or changes in market and macroeconomic conditions and investor sentiment, highlighting a unique role of market illiquidity in explaining the time-varying momentum profits. Our finding is consistent with the behavioral explanation of momentum. That is, investors overreact to private information due to overconfidence, which, together with self-attribution bias in their reaction to subsequent public information, triggers return continuation. In our context, when the stock market is liquid, we expect to see more excessive trading due to overconfidence and biased self-attribution, and therefore stronger momentum.

In **“Short-Term Reversals: The Effects of Past Returns and Institutional Exits” (Journal of Financial and Quantitative Analysis 2017)**, coauthored with Allaudeen Hameed, Avaniidhar Subrahmanyam, and Sheridan Titman, we show that short-term return reversals are much stronger for loser stocks in the previous quarter. This is because past stock price declines can induce exits by active institutional investors, and thus adversely affect liquidity provision. In addition, our results cannot be fully explained by price pressure resulting from fire sales or an increase in return volatility among past losers. While the prior work focuses on the selling pressure from institutional investors as a source of short-term reversals, namely, institutional investors as liquidity demanders, our paper contributes to the literature by making the novel point that active institutions also serve as liquidity providers. This is highly relevant for us to understand evolving market dynamics, especially with a growing number of quantitative traders having become market participants in recent years.

While the previously described paper focuses on the liquidity provision by active institutions, **“Investor Heterogeneity and Liquidity” (accepted in the Journal of Financial and Quantitative**

**Analysis**), coauthored with Kalok Chan and Allaudeen Hameed, further examines how the heterogeneity of a stock's investor base affects the liquidity provision. Institutional investors differ in their investment horizons, and short-term and long-term institutions trade on different signals and opportunities. As a result, if a stock has a heterogeneous investor base, the diverse investment strategies make it easier for different groups of investors to accommodate investor-specific liquidity shocks. We find that stocks held by institutions with more heterogeneous investment horizons are more liquid and have lower volatility of liquidity. Identification tests based on the 2003 Jobs and Growth Tax Relief Reconciliation Act confirm our findings. Additionally, extreme flow-induced trading by mutual funds has a bigger price impact when stocks have a less heterogeneous investor base. Finally, the premium associated with stock illiquidity is concentrated in stocks with low investor heterogeneity. Our paper adds to the literature by establishing a new connection between ownership structure and stock liquidity and stock price, with a focus on the heterogeneity of investment horizons.

### *1.2. New Methods in Asset Pricing*

My recent work in this area is motivated by the emerging challenges in empirical asset pricing. Financial economists have uncovered a plethora of firm characteristics that predict stock returns in the cross section. However, recent work has challenged the credibility of the evidence on stock return predictability (e.g., Harvey, Liu, and Zhu 2016; Hou, Xue, and Zhang 2020). Counter to this “anomaly-challenging” strand of literature, an emerging body of work reports phenomenal investment profitability based on machine learning signals.

However, our understanding of the economic significance of machine learning signals is inconclusive. “**Machine Learning versus Economic Restrictions: Evidence from Stock Return Predictability**” (accepted in *Management Science*), coauthored with Doron Avramov and Lior Metzker, comprehensively examines whether investors can harvest extra profits generated by various machine learning signals. We find that the predictability of deep learning methods weakens considerably after imposing sensible economic restrictions. Relative to the full sample evidence across all stocks, the value-weighted Fama-French six-factor-adjusted returns based on the three deep learning signals we analyze are 48% to 71% lower after excluding microcaps, 53% to 77% lower after excluding firms that do not have credit rating coverage, and 69% to 94% lower after excluding financially distressed firms that face deteriorating credit conditions. In addition, machine learning-based trading strategies are often more profitable during periods of high market volatility and low market liquidity. Machine learning signals also involve remarkably high turnover and often require taking extreme long-short positions in the tangency portfolio implied by the pricing kernel. Beyond economic restrictions, machine learning-based trading strategies nonetheless display less downside risk, yield considerable profit in long positions, and remain viable in the post-2001 period and the crisis period. Finally, black-box-like machine learning methods still generate economically interpretable trading strategies, and are more meaningful for stock selection than for industry rotation.

To the best of our knowledge, we are the first to provide large-scale evidence on the economic

significance of machine learning methods, and we hope it becomes part of the broader discussion on the adoption of machine learning techniques in asset management. Our analysis initiates a protocol for future work to demonstrate the feasibility of trading profits, and some recent studies have already responded to our findings and considered these economic hurdles when advocating new machine learning tools (e.g., Chen, Pelger, and Zhu 2020; Allena 2021; Cong, Tang, Wang, and Zhang 2021).

In **“Integrating Factor Models” (R&R in the Journal of Finance)**, coauthored with Doron Avramov, Lior Metzker, and Stefan Voigt, we turn to addressing another challenge in asset pricing, namely the uncertainty about the identities of asset pricing factors and macro predictors and the correct factor model. We propose a novel Bayesian model averaging (BMA) approach to formulate an integrated model that combines a large universe of candidate models using posterior probabilities as weights. Candidate models differ with respect to (i) the collection of cross-sectional factors, (ii) the set of macro predictors, and (iii) the factor model specifications, which either hold exactly or admit various degrees of mispricing. In addition, prior beliefs about the entire parameter space are economically interpretable and weighted against model mispricing and the inclusion of macro predictors.

Our empirical analyses are based on 14 asset pricing factors and 13 macro predictors, and cover more than 52 million candidate models. While the integrated model is weighted against deviations from the unconditional CAPM, we first show that the underlying return generating process exhibits considerable mispricing and model uncertainty, and is uniformly dominated by conditional factor models. Second, the post-earnings announcement drift, quality-minus-junk, and intermediary capital factors are competent in pricing other factors beyond the market factor. Third, the integrated model delivers a stable, superior, and admissible out-of-sample Sharpe ratio and mitigates the downside risk for both the tangency portfolio and the global minimum variance portfolio. The Bayesian approach is also instrumental in identifying competent individual models, while model selection based on top-ranked individual models could provide unstable forecasts. Finally, asset pricing models significantly disagree about expected stock returns at times of market crashes, and the spikes in aggregate model uncertainty are primarily driven by the market, management, and intermediary capital factors.

### *1.3. New Developments in the Market*

I am also interested in new developments in the market, and I want to highlight two recent papers in this area: one on sustainable investing, and another on online data sharing.

As the environmental, social, and governance (ESG) objective is becoming a primary focus in asset management, the reallocation of capital has major implications for portfolio decisions and asset pricing. However, ESG ratings from different rating agencies disagree substantially, and ESG investors confront pronounced uncertainty about the true ESG profile of a firm. In **“Sustainable Investing with ESG Rating Uncertainty” (forthcoming in the Journal of Financial Economics)**, coauthored with Doron Avramov, Abraham Lioui, and Andrea Tarelli, we analyze the equilibrium implications of ESG uncertainty for both the aggregate market and the cross section. Starting with the market portfolio as the single risky asset, we show that rating uncertainty leads to higher perceived market risk, higher

market premium, and lower investor demand. Next, we consider multiple risky assets and heterogeneous economic agents and derive an ESG-augmented CAPM for the cross section of stock returns. In particular, we propose that ESG uncertainty could tilt the ESG-CAPM alpha relation. When ESG uncertainty is not accounted for, the CAPM alpha exclusively reflects the willingness to hold green stocks due to nonpecuniary benefits, and the ESG-alpha relation is negative. When ESG uncertainty is accounted for, the equilibrium alpha increases with ESG uncertainty, and the ESG-alpha relation weakens.

Employing the standard deviation of ESG ratings from six major providers as a proxy for ESG uncertainty, we provide supporting evidence for the model predictions. First, ESG uncertainty reduces investor demand for stocks, especially for ESG-sensitive investors (i.e., norm-constrained institutions) in their ESG investment (i.e., green stocks). Second, brown stocks outperform green stocks only when rating uncertainty is low, and the negative return predictability of ESG ratings does not hold for the remaining firms.

Our study makes a few important contributions. First, prior literature shows weak return predictability of the overall ESG rating and mixed evidence based on different ESG proxies. Our paper suggests that ESG uncertainty could serve as a potential mechanism to explain the mixed evidence. Second, our findings echo the growing concerns regarding the lack of consistency of ESG information disclosure and ratings provided by different rating agencies. In the presence of rating uncertainty, investors are less likely to make ESG investments and actively engage in corporate ESG issues. This could increase the cost of capital for green firms and further limit their capacity to make socially responsible investments and generate real social impact.

Another new development in the market is that data have become the most important asset in the digital era. In **“Third-Party Cookies, Data Sharing and Return Comovement” (Working Paper 2021)**, coauthored with Yupeng Lin, Ruichang Lu, and Xiaojun Zhang, we examine the capital market consequences of online data sharing via cookies. Companies allow data brokers to install cookies on their websites so they can obtain supplemental information to facilitate ad retargeting and behavioral advertising. As a result, firms with common cookies, i.e., data-sharing firms, can reach out to the same set of tracked users, leading to common attention shocks. This research is ongoing, but our initial analysis reveals that the daily stock returns of data-sharing firms comove significantly with each other, especially for consumer-related industries and more frequently installed cookies. We do not detect any reversal effect, suggesting that the cookie network enhances the information diffusion between data-sharing firms. Identification test based on the enactment of the California Consumer Privacy Act confirms the causal link.

Using the log files from U.S. Securities and Exchange Commission (SEC)’s Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system to identify investors’ information acquisition activities, we find that data sharing also leads to joint EDGAR search, and the effect on human search is considerably stronger than the one on machine downloads. In addition, we find a uniformly significant

comovement in retail trading among data-sharing firms, especially when retail investors are net buyers of the data-sharing firms instead of net sellers. Finally, we show stronger return comovement when firms display more correlated human search on EDGAR and correlated retail buying. Collectively, online data sharing alleviates the limited attention of investors, and their enhanced information acquisition activities help incorporate the new information into stock prices.

To the best of our knowledge, our study is the first to empirically examine how online data sharing impacts stock market participants, and our evidence suggests that it leads to comovement in financial information acquisition, retail trading, and stock returns. Such rational response to attention shocks contrasts with prior studies showing that retail attention leads to transitory price pressure and then reversal, possibly due to more dynamic, interactive, and personalized information dispersal via the cookie network.

## 2. Delegated Asset Management

As of December 2020, the total net assets managed by 9,027 U.S. mutual funds and 2,296 U.S. exchange-traded funds (ETFs) exceeded 23.9 trillion and 5.4 trillion dollars, respectively (ICI 2021). Meanwhile, retail investors hold most of the fund net assets, and rely on professional asset managers to meet long-term personal financial objectives. I am particularly interested in the welfare implications of delegated asset management. My papers in this area examine (i) fund strategies and incentives and the subsequent reactions from fund investors, (ii) how human analysts and financial technology (fintech) affect the capital allocation and investor welfare, and (iii) how financial globalization affects the asset management industry and society.

### 2.1. Fund Strategies and Incentives

Identifying skilled mutual fund managers is crucial for investors to optimize their capital allocation. As mutual funds typically undertake long-only positions, stock selection skills involve actively overweighting undervalued stocks and underweighting overpriced stocks. **“Mutual Funds and Mispriced Stocks” (Management Science 2020)**, coauthored with Doron Avramov and Allaudeen Hameed, develops a new measure of fund investment skill, active fund overpricing (AFO), measuring the active deviation of mutual fund investment in overpriced stocks relative to the benchmark portfolio. AFO is the product of three elements: (i) the fund’s active stock selection skill, (ii) the degree of activeness of the fund, and (iii) the potential investment opportunities among mispriced stocks. We find strong evidence of low-AFO funds outperforming high-AFO funds in the subsequent quarter. In particular, funds that rank in the top AFO decile underperform those in the bottom AFO decile by 2.27% in benchmark-adjusted return and by 1.80% in Fama-French-Carhart four-factor-adjusted return per annum. The performance gap widens considerably during episodes of high market sentiment. Furthermore, the first component that proxies for active stock selection skill is the strongest and most consistent predictor of fund performance. Finally, high-AFO funds attract more investor capital, especially during periods of high sentiment, when fund flows are less sensitive to past performance.

We see our key contribution to the literature on managerial skills as follows: Prior studies debate

the relation between active share and fund performance (e.g., Cremers and Petajisto 2009; Frazzini, Friedman, and Pomorski 2016). Our results highlight the notion that a high-active-share fund may earn high or low future returns depending on whether the fund is actively underweighting or overweighting overpriced stocks. Our AFO measure accounts for the quality of the fund's active investment, hence improving the active share measure.

My second paper under this theme examines a new phenomenon: mutual funds' increasing investment in private startups. The prices of private equity (PE) holdings are set by mutual fund families and affect the fund net asset value (NAV) at which investors buy and sell fund shares. Therefore, the quality of PE valuation practices by fund families can affect the fund returns that individual investors receive. In **“Private Company Valuations by Mutual Funds” (R&R in the Review of Finance)**, coauthored with Vikas Agarwal, Brad Barber, Allaudeen Hameed, and Ayako Yasuda, we develop three working hypotheses related to the valuation practice: (i) information costs and access, (ii) litigation risk, and (iii) strategic behavior. Consistent with the hypothesis (i), families with lower information costs (proxied by larger PE holdings) and better information access (proxied by larger participation in funding rounds) update valuations more frequently in the absence of public information releases, and their valuation updates comove less with other families. In addition, the fund returns of mutual funds that hold private securities are predictably large after a follow-on funding round by a private startup, but the return predictability diminishes for more informed families. We find no support for hypotheses (ii) or (iii). Next, we show that investors do not take advantage of deflated private security prices by buying fund shares before the follow-on rounds. In contrast, fund investors respond more sharply to negative fund returns by redeeming the fund shares when funds are more heavily exposed to private startups and the overall venture capital market performs poorly.

Our paper enriches academic and policy discussions on the fair valuation of securities by (i) identifying information costs and access as key drivers of private startup valuation practices across fund families and (ii) showing that stale pricing and valuation uncertainty of startups exacerbate the run risk of mutual funds holding private securities in declining markets. An earlier version of our paper was cited in a new rule related to fair valuation of securities proposed by the SEC.<sup>1</sup>

The following two papers in this area turn the emphasis from the U.S. to the global asset management industry. **“Tax Evasion and Market Efficiency: Evidence from the FATCA and Offshore Mutual Funds” (Working Paper 2021)**, coauthored with Massimo Massa and Hong Zhang, explores a novel setting to study the endogenous choices of fund managers to acquire information and deliver performance. We analyze the implementation of the Foreign Account Tax Compliance Act (FATCA), which targets the offshore tax evasion of U.S. persons. The FATCA exogenously reduces the tax advantages of offshore funds sold to U.S. investors (i.e., affected funds), changing the incentives of

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<sup>1</sup> See, SEC (2020), “Good Faith Determinations of Fair Value,” <https://www.sec.gov/rules/proposed/2020/ic-33845.pdf>

fund managers to deliver performance. We document that affected funds significantly improve their performance, and that the effect is stronger among tax-sensitive funds and skilled funds. Moreover, affected funds manage their portfolios more actively to improve performance, especially via better-selected stock holdings. In generating additional performance, affected funds enhance the price efficiency of their invested stocks, especially in terms of more timely responses to local market information. Interestingly, affected funds do not seem to resort to fee reduction or dividend-related portfolio tax management as an immediate substitute for the loss of offshore tax evasion. Finally, the FATCA nevertheless induces outflows for affected funds, which justifies the choice by affected funds to use improved performance to offset this effect. Using index funds as a benchmark to gauge the counterfactual flow impact of the FATCA in the absence of additional performance, we find that the enhanced fund performance is at least partially successful in mitigating the outflows. Collectively, our results suggest that offshore mutual funds can deliver better performance when they need to.

Our analysis has important normative implications by showing that fighting against tax evasion could affect the behaviors of both investors and their fund managers, as well as the efficiency of both the global mutual fund industry and stock markets. Our paper also contributes to the literature by making the novel point that, although mutual funds do not seem to beat the market on average, the reason may not be that the market is efficient, but that mutual funds optimally choose not to do so.

My fourth paper in this area explores the rich features in the global ETF industry. While ETFs have long been regarded as a more liquid, lower-cost, lower-risk alternative to mutual funds, many ETF sponsors may seek alternative investment techniques of active management, such as synthetic replication with affiliated bank conglomerates, active divergence from the benchmark, and security lending. In **“The Unexpected Activeness of Passive Investors: A Worldwide Analysis of ETFs” (Review of Asset Pricing Studies 2019)**, coauthored with Massimo Massa and Hong Zhang, we examine whether and how incentives related to information, subsidization, and security lending may give rise to ETF activeness. First, ETFs exhibit considerable stock selection ability on (i) stocks that have a lending relationship with their affiliated banks, (ii) affiliated bank stocks, and (iii) stocks with high ownership of affiliated open-end mutual funds (OEFs). Second, ETFs also engage in cross-trades with affiliated OEFs. Cross-trades are negatively related to the future performance of ETFs, but positively associated with the future performance and flows of affiliated OEFs, suggesting a cross-subsidization from ETFs to affiliated OEFs in promoting the flows of the latter. The stock selection and cross-subsidization effects are more prevalent in ETFs domiciled in Europe. Third, ETF investors are exposed to both costs and benefits from ETF activeness. Specifically, security lending activity benefits ETF investors via reduced fees and lower tracking errors, the informational advantage may expose investors to higher tracking errors without direct benefit in terms of fees, and the subsidization needs may even impose higher fees. Finally, ETF investors withdraw capital when affiliated banks benefit from the off-benchmark activities of ETFs, or experience a decline in credit rating or profitability.

To the best of our knowledge, our study is the first to formally show that the global ETF industry is

much more complicated than a simple offering of index trackers might indicate. Our findings echo the recent regulatory concerns on the incentives of ETFs using alternative strategies to replicate their benchmarks, and have important normative implications in terms of both consumer protection and financial market stability.

The previously described papers focus on fund strategies and incentives and their welfare implications for investors. **“What Should Investors Care About? Mutual Fund Ratings by Analysts vs. Machine Learning Technique” (Working Paper 2021)**, coauthored with Ruichang Lu and Xiaojun Zhang, investigates two real-life mutual fund rating products from Morningstar: the analyst rating produced by human analysts and the quantitative rating generated by a machine learning technique. Both ratings are forward-looking and aim to help investors make investment decisions. First, we find that the analyst rating successfully identifies outperforming funds, while the quantitative rating fails to do so. To understand the economic forces underlying the differences in return predictability and ensure a fair comparison, we replicate the machine learning method adopted by Morningstar and reconstruct the quantitative ratings for all funds. We show that among analyst-covered funds, the machine learning-predicted rating is on par with the analyst rating in identifying superior funds, suggesting that the analyst rating outperforms the quantitative rating mostly due to the selection of analyst coverage rather than the informational advantage. Second, while the analyst rating merely accounts for observable fund characteristics, the tone in the analyst report contains unique and incremental information for predicting mutual fund performance, especially when the tone is at odds with the analyst rating. Last, retail investors do not react to the analyst rating; instead, they rely on past performance, the star rating, and the quantitative rating. In contrast, institutional investors take advantage of the informational value of the analyst rating and report. Furthermore, investors react strongly to the tone of the summary section and title, not the tone of the full analyst report, although only the tone of the latter predicts future performance.

Our paper adds to the burgeoning literature on fintech adoption and suggests that a new man-plus-machine model could be more effective, i.e., analysts could exploit the advantage of machine learning techniques in processing publicly available information while allocating more effort to collect and analyze private, soft information. Our findings also inform investors about the potential limitations and pitfalls of fintech products.

## *2.2. Impact of Financial Globalization*

Financial liberalization and its associated cross-border capital flows are at the heart of international finance. Efficient financial globalization should reward high-skilled financial institutions and punish low-skilled ones. In **“Catering through Globalization: Cross-border Expansion and Misallocation in the Global Mutual Fund Industry” (Working Paper 2020)**, coauthored with Massimo Massa and Hong Zhang, we show that the globalization of the mutual fund industry has exhibited the opposite pattern: low-skilled companies can benefit from globalization by catering to the demand of unsophisticated investors for foreign investment. Specifically, mutual fund companies engage in



catering-oriented expansion, i.e., launch new funds in foreign markets that have more indices unexplored by the global mutual fund industry. New funds launched in this way and other affiliated domestic and foreign funds managed by the same fund company also deliver lower future performance. Furthermore, cross-border capital flows managed by catering-oriented fund companies reduce the price efficiency with respect to both local and global information, and worsen the general liquidity conditions of a market. Finally, catering-oriented expansions do not enhance the degree of diversification for investors.

Our main contribution is to propose a novel behavioral and market friction-based mechanism of financial globalization, i.e., the weaknesses of investors allow the catering incentives of financial intermediaries to engender economic frictions and distort market efficiency in the short term. The optimal policy regulating global capital should consider the heterogeneity in incentives among foreign institutions instead of relying on one-size-fits-all policies.

The last paper included in my research statement, **“Financial Globalization vs. Income Inequality: The Surprising Role of Foreign Portfolio Flows in Taming the Top 1%” (Working Paper 2021)**, coauthored with Massimo Massa and Hong Zhang, aims to uncover the potential social impact of financial globalization. In contrast to the foreign direct investment that boosts income inequality, e.g., due to the outsourcing of jobs and technology diffusion, we document that foreign capital inflows delegated through global mutual funds reduce income inequality. To rationalize this observation, we trace income inequality to its micro origins, i.e., the skewed distribution in cash flow rights, proxied by the sales revenue accrued to rich families. We find that large delegated foreign inflows induce local rich families to sell concentrated yet profitable assets, consistent with a diversification channel for financial globalization to influence income inequality. This process reduces the portion of future income that rich families can reap from the sales revenue of companies, and reduces the degree of income inequality. In addition, our findings mostly originate from domestic rich families as opposed to foreign families, and are economically larger in emerging markets because of the more prominent role of foreign capital flows in these markets. Finally, alternative mechanisms such as market timing, industry upgrades, corporate governance, taxation, labor market conditions, technology shocks, education, and financial development fail to explain our results.

To the best of our knowledge, we are the first to analyze how delegated cross-border portfolio investment affects income inequality. Our evidence is grounded in Piketty’s (2014) intuition of inequality as the interplay between the rate of return on capital and the economic growth rate. A properly designed financial globalization of delegated portfolio investment can mitigate inequality when it helps reduce the former rate via diversification or promote the latter. We show that the first diversification effect occurred in our testing period, and contribute to the policy debate on globalization and inequality.

In summary, my research interests cover a wide range of topics related to investment and delegated asset management in both the U.S. and international financial markets. My work also evolves over time to keep up with the exciting themes of financial research, such as financial innovation, machine learning,

and ESG investing. I expect to continue exploring more interesting topics in the upcoming years and focusing on issues that are relevant for academics, practitioners, and policy makers.

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