ESSAYS IN ASSET PRICING

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Abstract

This dissertation includes three essays in asset pricing. The first two essays explain the role of investor trust on mutual fund investor behavior and private fund capital raising, respectively. The third essay proposes a valuation model for bitcoin options.

In the first essay, I investigate the impact of investment adviser disciplinary actions on mutual fund performance and investor redemption behavior. After a regulatory disciplinary action initiation, funds experience a transitory performance loss in the next month. In contrast, I observe persistent fund outflows starting two months after the regulatory action disclosure and persisting for over one year. Adviser disciplinary actions have a remarkably more long-lasting effect on investor redemption than on fund performance. My evidence suggests that investors reduce investments in affected funds mainly because they lose trust in fund integrity rather than because they observe fund performance deterioration.

In the second essay, I examine the role of investor trust in the capital raising process of private funds by analyzing the impact of third party service providers and investment adviser disciplinary actions in the US. Using private fund's initial filings, I document that fund managers that use third party marketers raise less capital and have reduced shares of sophisticated investors even though these marketers can bring more investors. This finding indicates that investors do not trust third party marketers and prefer fund managers to be directly involved in the capital raising process. On the other hand, service providers such as auditors and bookkeepers that help regulate private funds' financials and increase investor trust are associated with more capital raised and investor ownership. Furthermore, I observe persistent decline in total assets managed, number of investors and sophisticated investor ownership following a criminal action, suggesting that

investors place a significant value on trust and more likely to respond specific disciplinary actions by withdrawing their assets.

In the final essay, I propose an equilibrium valuation model for bitcoin options traded on the Chicago Mercantile Exchange. By extending Cao (2001), I interpret bitcoin as a foreign currency in a small open economy where money generates utility to agents aside from consumption. Treating the money supply and aggregate dividend as exogenous, I embed both the diffusive and jump risks from these two processes into the bitcoin price which is just the exchange rate. Analytical option pricing formulas are obtained with the Merton's (1976) model as a special case. Static analysis reveals that the bitcoin price increases with both the diffusive and jump risks of the money supply and aggregate dividend. The value of a call (put) option on bitcoins increases (decreases) with the growth rate of money supply. Numerical analysis shows that, among other things, all risks lead to a positive premium in option prices relative to the benchmark Black-Scholes model, and the diffusive and/or jump risks of money supply accounts for a large portion of the bitcoin return volatility. This paper is co-authored with Prof. Melanie Cao (York University) and was published in *Journal of Futures Markets* on June 1, 2021. The copyright permission was granted on May 22, 2023 and sent to the Faculty of Graduate Studies of York University.

Dedication

For my family Eliazbeth, Huseyin, Tulin, Onur and Cupcake.

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Contents

Chapter I: Introduction

In this dissertation, I investigate two topics in asset pricing. Chapter 2 and 3 focus on investor trust in public and private funds, respectively, while Chapter 4 proposes an equilibrium model for bitcoin options.

Investor trust plays a crucial role in investment decision making. Extensive literature and industry surveys show that investors put great emphasis on trust for financial decisions. One way to measure the impact of trust on financial decisions is to investigate financial misconduct cases and their impact on investor behavior. Chapter 2 of this dissertation examines how investment adviser misconduct affects mutual fund performance and how investors respond to adviser misbehavior by investigating two competing hypotheses: performance reduction and trust impairment. The performance reduction hypothesis states that investors will withdraw capital due to their concern about mutual fund performance following disclosure of misconduct. Prior literature documents the negative consequences of fraud on investor trust (Gurun, Stoffman, and Yonker 2018) and how misconduct hurts firm performance (Karpoff et al. 2008). Additionally, illegal trading activities in mutual fund industry cause performance loss and higher investor redemptions (Houge and Wellman 2005; McCabe 2009). Thus, I test whether adviser misconduct leads to mutual fund outflows because investors observe fund performance deterioration. On the other hand, trust impairment hypothesis proposes that upon disclosure of adviser misconduct, investors withdraw capital from the affected funds because they lose trust in the integrity of such funds. The literature shows that household investment decisions are shaped by factors unnecessarily related to knowledge of the market and assets of interest, such as trust in the integrity of the market (e.g., Guiso, Sapienza, and Zingales 2008), home bias (Huberman 2001), corporate governance (Faber 2005), and fund ownership structure (Kostovetsky 2016). Therefore, following a misconduct, I test whether investor withdraw capital as a result of loss of investor trust, regardless of whether investors observe fund performance declines.

I find that funds experience performance decline in the month after a regulatory action is initiated. This corresponds to an average decline of 37 basis points in the next month. These effects are robust for fund characteristics such and fund fixed effects, However, they do not persist after one month. On the other hand, I find that regulatory actions cause significant investor redemptions. For example, starting from month 2 after an action is initiated, mutual funds experience outflows at the rate of $7.1 million per month. Investor redemptions continue up to 15th month ($4.5 million) after an action initiation. These results are persistent even after controlling for fund performance, meaning that investor redemption is caused by not because investors observe decreased fund returns, but because of loss in trust of the integrity of the funds. This supports the trust impairment hypothesis rather the performance reduction.

Chapter 2 highlights the importance of trust in the mutual fund industry. Prior literature shows that trust and consumer sophistication affect household investing behaviors and decisions. While prior literature uses an event study (Gurun et al. 2018), change in fund ownership structure (Kostovetsky 2016), or household surveys (Guiso, Sapienza, and Zingales 2008; Merkoulova and Veld 2022) to measure investor trust in financial markets, I use impairment of investor trust as a result of fund adviser misconduct filed to the SEC.

In Chapter 3, I extend my investigation on the role of investor trust and focus on its effects in private fund capital raising by investigating the effects of third party service providers and financial misconduct among sophisticated and foreign investors. Capital raise is one of the top challenges for private fund managers and trust is a significant factor in investors' decision making

(AIMA, 2021; CFA Institute 2022). Fund managers can raise money through their own marketing efforts or can hire third party marketers. Additionally, managers determine whether to have external bookkeepers and auditors for financial records and statements to gain investor trust. Moreover, investor sophistication and location can play a role in processing financial information and monitoring fund managers ((Rajgopal and Venkatachalam 1997; Ramalingegowda and Yu 2012; Gao, Haight, and Yin 2020; Gaver et al. 2020). Foreign investors might have limited control because of their distance from fund managers, and other cultural and political limitations (Ayers, Ramalingegowda, and Yeung 2011; Gao, Wong, Xia, and Yu 2013). By using a unique dataset, I first analyze these service providers' effects on the initial capital raise. Using external marketers increase number of investors in private funds, however, this increase does not reflect the overall capital raise amount. Fund managers that use third party marketers raise 37.94% less capital than the ones that raise by their owns efforts, corresponding to a loss of $27.91 million per capital raise to a fund with an average capital raise amount of $73.57 million in the sample. Further analyses also show that there is no evidence that marketers have a positive impact on the capital raise through funds' lifespan. Additionally, general advertising decreases the total amount raised (17.39%) and sophisticated investors tend to have less fund ownership (1.8%) in the presence of third party marketers. On the other hand, auditors have a positive effect on capital raise, number of investors and sophisticated investor ownership, meaning that service providers that help regulate funds help raise more capital from investors. These effects are robust for controlling fund characteristics and fixed effects such as fund type, date, and location.

The second part of Chapter 3 focuses on the financial misconduct and its effects on capital raise and investor trust. The literature documents that mutual fund performance and investor inflows decrease after the financial misconduct (Celik and Dong 2023; Liang, Sun, and Wu 2020).

Hedge funds with misconduct history are less profitable and have high operational risk (Brown set al. 2009). I find that, following a criminal action, number of investors declines by 3.8% in the first year, 2.5% in the second year, and 0.6% in the third year. The total capital managed drops by 16.5%, 7.5% and 6.7% in the first three years. Finally, both total investor and sophisticated investor ownership decrease after a criminal action is initiated. These results give support to my hypothesis that disciplinary actions affect capital managed and ownership, although the effects depend on the action type.

This chapter extends the literature on how third party service providers affect capital raise and ownership of private funds and how investor truest plays a role in private fund capital raise. I show that investors prefer fund managers to market their own funds and do not trust third party marketers. On the other hand, capital raise amounts and ownership increase in the presence of service providers that help regulate the funds such as auditors and bookkeepers. Furthermore, I document the effects of financial misconduct on private funds. Specific disciplinary actions cause less capital managed, a smaller number of investors and ownership as a result of investors losing trust.

In chapter 4, I provide an equilibrium valuation model for bitcoin options. Despite a few trade articles explaining how crypto derivatives work (Lielacher 2019, Shome 2020 and Söylemez 2019), a widely accepted valuation model doesn't exist. The objective of the paper is to propose a sensible valuation model for bitcoin derivatives. By extending Cao (2001), I interpret bitcoin as a foreign currency in a small open economy where money generates utility to agents aside from consumption. Treating the money supply and aggregate dividend as exogenous, I embed both the diffusive and jump risks from these two processes into the bitcoin price which is just the exchange rate. I show that the bitcoin price increases with both the diffusive and jump risks of the money supply and aggregate dividend. The value of a call (put) option on bitcoins increases (decreases) with the growth rate of money supply. Numerical analysis shows that, among other things, all risks lead to a positive premium in option prices relative to the benchmark Black-Scholes model, and the diffusive and/or jump risks of money supply accounts for a large portion of the bitcoin return volatility.

Chapter II: Adviser Disciplinary Actions, Mutual Fund Performance and Redemption

1 Introduction

A large literature has examined the effects of corporate misconduct on fraud conductors, the firms and investors involved, labor market consequences, and asset prices (e.g., Agrawal, Jaffe, and Karpoff 1999; Povel, Sign, and Winton 2007; Karpoff, Lee, and Martin 2008). However, relatively few papers have explored how misconduct in the mutual fund industry impacts fund performance and investor behavior. In this paper, we investigate how investment adviser misconduct affects mutual fund performance and how investors respond to adviser misbehavior.

We focus on the role of trust on investor behaviors and financial decisions. Recent literature has documented that trust affects household capital allocation decisions (e.g., Gennaioli, Shleifer and Vishny 2015; Guiso, Sapienza, and Zingales 2008; Gurun, Stoffman, Yonker 2018; Merkoulova and Veld 2022). While prior literature uses major scandals, changes in fund ownership structure, or household surveys to measure the effects of investor trust, we gauge the impact of trust on investor behavior by examining the investor redemption decisions in mutual funds. More specifically, we measure the impairment of trust as a result of fund adviser disciplinary actions filed to the Security Exchange Commission's (SEC). Crucially, we employ a large sample of over one million fund-month observations over the period 1995-2021. To our knowledge, our study uses by far the largest sample in investigating the role of investor trust in financial markets.

We retrieve information about investment adviser misconduct from the SEC's Form ADV, a required submission from investment advisers who have received regulatory, civil, or criminal disciplinary actions. Regulatory actions are monetary and/or disciplinary penalties initiated by the

SEC and state regulatory authorities and civil actions are civil lawsuits initiated by private plaintiffs, SEC/State, or district attorneys. We focus on regulatory and civil actions because criminal actions have a negligible number of observations in the sample and existing cases are not related to the mutual fund operations of the advisory firms.

It is reasonable to expect that adviser disciplinary actions will damage mutual fund reputation and investor trust, and may also hurt fund performance, both of which can lead to investor redemption of funds. We distinguish two competing hypotheses about whether fund adviser misconduct affects fund performance and investor redemption. According to the *performance reduction hypothesis*, investors are concerned about mutual fund performance deterioration as a result of adviser misbehavior and withdraw funds accordingly after the disclosure of the misconduct. The corporate misconduct literature documents negative consequences of fraud on investor trust (e.g., Gurun, Stoffman, and Yonker 2018). The literature also finds that misconduct hurts firm performance (e.g., Karpoff et al. 2008) and investor sensitivity of outflows to bad performance is stronger in illiquid funds than in liquid funds (e.g., Chen, Goldstein, Jiang, 2010). For example, prior literature shows the negative outcomes of mutual fund industry scandal in 2003 that illegal trading activities have caused performance loss, negative announcement-period returns and higher investor redemptions (Houge and Wellman 2005; McCabe 2009). We therefore empirically test whether adviser misconduct leads to mutual fund outflows because investors observe fund performance deterioration.

Alternatively, the *trust impairment hypothesis* posits that upon disclosure of adviser disciplinary actions, investors withdraw money from the affected funds because they lose trust in the integrity of the mutual funds. The literature finds that household investment decisions are shaped by factors unnecessarily related to knowledge of the market and assets of interest, such as trust in the integrity of the market (e.g., Guiso, Sapienza, and Zingales 2008), home bias (Huberman 2001), corporate governance (Faber 2005), and fund ownership structure (Kostovetsky 2016). We therefore test whether investors withdraw money from the affected funds because they lose trust in the fraudulent funds, irrespective of whether investors observe fund performance declines after the action disclosure.

We first examine whether adviser disciplinary actions affect mutual fund performance. We find that funds suffer an immediate performance decline in the month after regulatory action is initiated and managers are notified for the first time. Funds with regulatory actions experience a loss of fund return of 37 basis points in the next month. These effects are robust to controlling for fund characteristics and fund style and time fixed effects. However, the effect of regulatory action on fund performance is short-lived and does not persist after one month. One possible explanation can be that managers experience panic and high stress as a result of being informed for first time that an action is initiated against their mutual fund activities, causing a temporary performance loss.

To test whether adviser wrongdoing affects investor decision to withdraw money from their funds, we examine the effect of disciplinary action on fund flows. We find that disclosure of an adviser regulatory action is followed by significant fund outflows. Starting from month 2 after the misconduct disclosure, mutual funds experience outflows at the rate of $7.1 million per month for a fund with the average AUM.[1] In contrast with the immediate and transitory loss of fund performance, these outflows persist for at least half a year, so that 15 months after the disciplinary

[1] The SEC requires that the investment adviser (i.e., the advisory firm) update the SEC with any disciplinary action information by filing Form ADV within 30 days of the action initiation date. Therefore, the finding that investor redemptions start from the second month after the action initiation date means investors react to Form ADV immediately after they get informed of the regulatory actions.

action, investor redemptions continue at a rate of $4.5 million per month. Furthermore, in regressions that control for fund performance, we continue to observe redemption after regulatory actions, suggesting that investors withdraw money from the affected funds not because they observe decreased fund returns, but because of a loss in trust of the integrity of the funds. This evidence gives support to the trust impairment hypothesis rather than the performance reduction hypothesis.

One concern in our test is that the effect of adviser misconduct is correlated with fund characteristics; funds with disciplinary actions are substantially older and larger than their non-fraudulent counterparts. Possible explanations why the older and larger funds experience financial misconduct could be the abuse of established trust and the long duration of misconduct investigations. Funds that are larger and older might start conducting misconduct after gaining trust by investors and the public. Additionally, misconduct investigations typically take multiple years before initiations of actions. We address size and age issue using a matching test: for each treatment fund, we find a control fund matched on fund characteristics including past fund performance, age, and AUM. We continue to find that regulatory actions are followed by fund outflows, particularly among larger and older funds, for which redemptions continue at least 15 months after regulatory action initiation. To further rule out the possibility that the fund outflows are caused by omitted variables related to the disciplinary actions, we conduct a falsification test and find no evidence of abnormal outflows prior to the regulatory actions.

The sharp contrast between the effect of regulatory action on fund performance and the effect on fund flows helps to distinguish our hypotheses. One the one hand, the effect on fund performance is immediate and only limited to one month after the action initiation date. On the other hand, we observe the strongest effect of regulatory action on investor redemption two months after the action initiation, and this effect declines until month 15. This suggests that the outflows are triggered by loss of investor trust rather than by declines in fund performance resulting from the regulatory actions.

Finally, while we observe persistent investor redemption and short-term fund performance deterioration following regulatory actions, we do not find similar effects from civil actions. A possible interpretation is that regulatory actions are initiated from the SEC or government entities and are more visible, causing stronger investor reaction than civil actions that are often initiated from individuals.

Our paper is related to the literature on financial fraud and misconduct (e.g., Dimmock and Gerken 2012; Egan, Matvos, and Seru 2019). Our paper differs from the prior literature in several ways. First, we focus on the consequences of mutual fund adviser misconduct rather than on the prediction and dissemination of fraud. Second, we provide evidence that both fund performance and fund flows are affected by disciplinary actions. By comparing the intensity and duration of the effects of adviser misconduct on fund performance and redemption, we reveal the importance of trust on investor behavior. Finally, we show that funds and investors do not treat all disciplinary actions equally. They respond more strongly to actions initiated by the SEC and State Regulatory Authorities than by private plaintiffs.

Our study highlights the importance of trust in the mutual fund industry. Prior literature shows that trust and consumer sophistication affect household investing behaviors and decisions. While prior literature uses an event study (Gurun et al. 2018), change in fund ownership structure (Kostovetsky 2016), or household surveys (Guiso, Sapienza, and Zingales 2008; Merkoulova and Veld 2022) to measure investor trust in financial markets, we employ impairment of investor trust as a result of fund adviser misconduct filed to the SEC.

Kostovetsky (2016) uses a large sample of mutual funds which experience a change in ownership to study the impact of trust on investor redemptions. Rather than examining changes in ownership which may be caused by a host of strategic, risk management, and style-related decisions, we focus on clearly defined trust-impairment events: advisor disciplinary actions. Our approach of using a large sample of funds that file disciplinary action information provides a more direct measure of investor trust tied to capital allocation decisions than using alternative means. By contrasting the transitory fund performance loss with the persistent investor redemptions subsequent to adviser disciplinary actions, we reveal that investors withdraw investments from fraudulent funds not merely as a result of decreased fund returns, but more in response to impairment of trust in the funds. Therefore, our evidence suggests that trust has a more long-lasting effect on investor behavior than does the more tangible metric of fund performance.

2 Data

2.1 Data Sources

We have multiple data sources. For disciplinary actions, we used Form ADVs from the U.S. Security Exchange Commission's (SEC) Investment Advisor Public Disclosure (IAPD) website. The website provides investors with search tools for individual registered adviser representatives and registered investment adviser firms. According to the SEC, Form ADV is a mandatory form that must be filed annually within 90 days following the end of firm's fiscal year. Additionally, if there is an important change such as new registration, adding/removing a relying adviser or information change in specific section, advisory firms must amend their updated Form ADVs immediately after the change happens (see Appendix A for the SEC requirements, specifically for disciplinary actions).

Disciplinary action information is among the specific sections mentioned in the SEC's general Form ADV instructions.[2] Thus, registered adviser firms must update their disciplinary action history annually and immediately after a change. We collected disciplinary actions from Part 1 of the Form ADV of each registered adviser firm (see Appendix A for information, description of data collection and merge). The data contains information of filing and action initiation dates, firms' and/or their affiliates' involvement, action initiator, sanction types, resolutions, final decisions, court information, and penalty types.

There are three disciplinary action classifications: Regulatory, Civil and Criminal. Regulatory actions include actions taken against the adviser firms by the SEC or states' regulatory authorities. These actions can be monetary and/or disciplinary penalties such as censures, bars, and suspensions. These actions are usually resolved without lawsuit initiations. Civil actions are private lawsuits that are filed against the advisory firms. These lawsuits can be filed by the SEC, state regulatory authorities, investors or any other private plaintiffs. Similar to the Regulatory actions, Civil actions are concluded with monetary and/or disciplinary penalties. Criminal actions are lawsuits filed by state and can include any kind of offense such as financing terrorism, money laundering, DUI or theft. We used only regulatory and civil actions as criminal charges are extremely rare. Another reason is that criminal penalties are not technically related to the mutual fund specific actions after manually checking the allegations and summaries of each case. We then filtered the actions by the principal product as "Mutual Fund(s)" and only included initial filings as the initial shock to the advisory firms. Figure 1 shows the types of the actions and examples of the descriptions when an action is related to the mutual fund business of the advisory firms.

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[2] General Instructions, Section 4: "*When am I required to update my Form ADV?*" *https://www.sec.gov/about/forms/formadv-instructions.pdf (last accessed November 11,2022)*

Figure 2 illustrates the annual number of actions by each action type. Not surprisingly, the number of regulatory actions is higher than the number of civil actions. The majority of regulatory actions happened between 2003-2009 and 2013-2021 while the majority of civil action cases took place between 2001 and 2005. There is a clustering of both regulatory and civil actions around 2003, consistent with the well-documented mutual fund scandals during that time (Houge and Wellman 2005; McCabe 2009). Figure 3 shows the distributions of total number of actions per firm. The majority of the firms have been faced with 1 or 2 actions during their lifespan, with the maximum number of actions per firm being 15.

The second source is the Center for Research in Security Prices (CRSP) survivorship bias-free database of mutual funds where we obtained monthly fund returns, total assets, fees, fund flows and contact information including fund websites. We removed index funds as described in Alok et al. (2020). We then used firms' website domains to match funds with disciplinary actions. Finally, we dropped the funds that does not have website information in the CRSP database. Our sample period is from January 1995 (which is the first available date to match CRSP and Form ADV data) to December 2021.

The third source Kenneth French's Data Library where we collected the Research Factors for manager skill calculations.

2.2 Merging of Form ADV and Other Data

SEC's IAPD website allows users to obtain information about Specific Investment Advisers and Investment Advisor Representatives through its search links. We first obtain the names and identification numbers from Investment Adviser Data section.[3] Then, we use R to perform web scrapping and collect all registered advisor firms' Part 1 information that includes firms' identification, disciplinary actions, and website information.

We used CRSP's "*Contact_Info*" dataset to collect mutual funds' website information. We gathered websites' domain names as the key variable to merge disciplinary actions and fund returns as well as fees. Domain names are unique and must be assigned to a single owner.

2.3 Key Variables

We combined these datasets to derive key variables used in our analysis. The first set of variables are number of disciplinary actions for both regulatory and civil actions. For each action type, we first defined indicators that show whether an action is initiated in a month as *DIS_reg* = 1 or *DIS_civil* = 1, and 0 otherwise. The initiation date is the date when a fund is informed (served) legally by the authorities and/or courts that an action is initiated against the fund. Thus, initiation date is the first time that a fund is aware that an action has started against it (initial shock). We also define a continuous version of this variable, the number of actions that happened in last quarter (*DIS_reg_q* or *DIS_civil_q*) and last year (*DIS_reg_y* or *DIS_civil_y*) per fund, to analyze long-term effects of the actions. Tables 1 and 2 provide additional details about the funds with disciplinary actions as well as funds without an action.

[3] https://adviserinfo.sec.gov/compilation (Last accessed October 21, 2022)

The second set of key variables defines mutual fund manager skills.[4] We use CAPM, Fama-Frech-3 alpha and Carhart-4 alpha as three traditional measures of average excess returns after controlling for the risk factors. The alphas are calculated for each fund manager over a 5-year rolling window, where we regressed each fund manager's returns over the window against excess market returns, Fama and French (1992) 3 factors and Carhart (1997) 4 risk factors to find monthly alphas (excess return). Then, we ranked the fund managers each month based on their alpha from highest to lowest and defined the top quartile (25%) of fund managers as high skilled (*SKILL* = 1). The reason why we use quartiles is to ensure that we have enough sample size of high-skilled managers and to avoid results being driven by outliers.

The third variable is to define monthly flows for each fund. We calculated monthly fund flows (see Appendix B) as the ratio of the net cash involved in inflows and outflows to the total AUM of the previous month. About 1% of the AUM data is missing. We were able to fill the missing values by extending with the previous month AUM if the data is available at least a month for a fund in a fiscal year.

3 Results

3.1 Summary Statistics and Univariate Tests

Table 1 shows the summary statistics for all funds, funds with regulatory actions and civil actions over the sample period. Panel D compares funds with no actions with funds with regulatory

[4] We use "adviser" to denote a Registered Investment Advisers (RIA) in the US that registers with both the SEC and state securities authorities. We use "manager" to refer to an individual who make operational and trade decisions of a mutual fund.

and civil actions, respectively. Fund with actions have larger AUMs, higher returns, management fees and turnover ratios over the sample period. Additionally, there is a significant age difference between funds with actions and those without actions. The average age of funds without an action is 12.85 years while those with regulatory and civil actions are 21.56 and 21.03 years, respectively. Funds without actions have slightly lower net flow ratios than funds with actions. Funds with civil actions have lower flows than those with regulatory actions.

Table 2 shows the investment style characteristics of the funds. Large-cap growth and core funds are more susceptible to have an action during their lifetimes. For regulatory actions, growth funds mostly appear as having an action followed by various core funds. On the other hand, funds with civil actions have more diversified styles including debt funds, value funds and yield funds.

3.2 Fund Performance

According to our first hypothesis (performance deterioration hypothesis), investors withdraw their invested funds from fraudulent funds because they observe fund performance losses from misconduct. We therefore test whether there is an effect of the disciplinary actions on future fund performance.

We conduct regression analysis to examine how fund performance relates to disciplinary action, controlling for observable and unobservable differences in the funds. In the regression model, we introduce a combination of firm fund, and investment style × month (and year month) fixed effects to help control for these observable and unobservable variables. We also control for fund characteristics for additional analysis. Our first regression equation is:

$$VRET_{i,t+1} = \alpha + \beta_1 DIS_t + \boldsymbol{b}\ Controls + \delta_{i,lipper} \times \theta_t + \gamma_{portno} + \varepsilon_{i,t}, \quad (1)$$

where $VRET_{i,t+1}$is future aggregate return for fund *i* at month *t+1*. *DIS* is an indicator variable equal to one when either regulatory or civil action is initiated in a month. $\delta_{i,lipper} \times \theta_t + \gamma_{portno}$ indicates fund style × month and portfolio fixed effects. This specification is in line with the mutual fund return regression model used in prior literature (e.g., Au, Dong, and Zhou 2021).

We also include a variety of fund characteristics as controls to ensure that the results are not due to other causes such as investor flows, fund size, fund fees, or fund trading behavior. *Flow* controls for investor flows over the month to ensure that the results are not driven by a large inflow (or outflow) of investor funds. *Log_AUM* and *Log_Age* are controls for fund size an age. *Fund_Mgmt_Fee* and *Fund_expense* control for any fund fees. *Fund_Turnover* is to control for funds likelihood to buy or sell shares. Finally, in one version of the model we use *Return_5yr*, the annualized fund return in the past five years, to control for past fund performance.

The results in Table 3 show that fund performance and return are negatively affected by the regulatory actions initiated by the SEC or state regulatory authorities. Judging from *DIS_reg* in column 1, funds receive regulatory actions experience a decrease of 37.2 basis points ($p = 0.000$) in the next month. This effect is moderately reduced to 34.7 basis points when past 5-year return is added to the control. It appears that managers experience a temporary disruption associated with regulatory actions. However, such behavior is transitory because we do not find any significant relation between *DIS_reg* (measured in month-*t*) and fund return in month *t*+2 and beyond.

We also analyzed the longer time horizons by checking the number of events that happened in the past quarter and year. The results are significant and consistent with the instant effects.

However, the effects (coefficients) tend to be smaller than the instant reactions to the disciplinary actions. For the number of regulatory actions that happened in the past quarter, or over the past year, the effects are smaller. This means that initiation of a regulatory actions has a very short-term effect on the manager performance. The results are similar and robust when we introduce control variables, change *year_month* fixed effect to month fixed effect and change the skill threshold from quartiles to terciles or halves. We also run subsample analysis by fund characteristics such as fund size, age, expense ratios, fees and turnover ratios to ensure the results are not driven by selection bias. These results are also consistent with our findings.

These results are not due to size or momentum. In unreported tests, we add, as additional control, manager skill measured by the "alpha" of the fund using either the CAPM or the Fama-French three-factor model (which includes momentum) and obtain similar results. In addition, mutual fund investors may chase returns and move into funds with high returns in the past. Therefore, we control for previous month's fund flow. The results remain similar with these controls.

Interestingly, manager performance does not change when there is a civil action. Our results (Table 5) indicate that overall, the managers are not affected by the civil actions, and this is consistent with the top quartile managers. One possible explanation can be that only around 12% of the cases are initiated by the SEC, District Attorneys or State Regulatory Authorities. These cases are usually initiated by private plaintiffs. This might mean that private lawsuits might not significantly affect the mutual funds' activities. Moreover, in more than 20% of the cases, the mutual funds either deny or state that the allegations are without merit, meaning they are confident with their trading activities as no wrongdoing has happened. Additionally, as we showed in the

Figure 1, not all allegations can be attributed to the specific mutual fund activities but overall mutual fund industry in some jurisdictions.

In summary, these results are in line with our hypothesis for the regulatory actions. Managers appear to be badly affected by the regulatory actions initiated by the SEC or state authorities. The effect is more nuanced for the high skilled managers causing major drops in returns relative to the top managers without a regulatory action. On the other hand, civil actions do not cause a performance decrease.

3.3 Fund Flows

In the previous sections, we find a immediate but transitory effect of regulatory disciplinary action on fund performance. In this section, we test our second hypothesis (trust impairment hypothesis) which states that investors withdraw funds because they lose trust in the integrity of the funds with fraudulent managers.

As we mentioned in the Data section, Form ADVs must be filed annually and if there is an important change such as a disciplinary action against the firm, firms must notify the SEC and update the amended Form ADVs immediately. Once the SEC is notified, the SEC updates their database (it is not mentioned when they exactly update). Additionally, firms must update their fund brochures accordingly for their existing and prospective investors. One can assume this process can be completed within a couple of months as filing an amendment is relatively easy and quick. Apart from form ADVs, investors might access this information from news or even insider information. Because we do not know the exact timing when the investors can access the updated information, we decided to run multiple regressions for investor *FLOWs* as dependent variable and observed the past 15-month period to see whether there is a consistent reaction from the investors. The regression equation (3) is:

$$FLOW_{i,t+k} = \alpha + \beta_1 DIS_t + \boldsymbol{b}\ Controls + \ \delta_{i,lipper} \times \theta_t + \gamma_{portno} + \varepsilon_{i,t}, \qquad (2)$$

where $FLOW_{i,t+k}$ is the proportional net flow for fund *i* during month *t*+1, … *t*+15. DIS_t is the (regulatory or civil) disciplinary action indicator equal to 1 if the action was initiated in the indicated month prior to month *t.* The control variables are similar to equation (1) and adjust for fund characteristics that may drive the fund flows (such as fund flows, fund size/age or fees). We also consider a control for past fund performance (Return_5yr, the annualized 5-year past fund return). However, to the extent that advisor disciplinary actions are caused by poor past fund performance, this variable may partly absorb the effect of action we aim to capture. Therefore, in the baseline model (the first model for each regression), we do not include this control, but we provide a second model for each monthly flow regression with this control included.

Tables 4 and 5 show the disciplinary action effects on investor flows through the past 15-month period. The results are presented for each of the three months subsequent to the action initiation month, as well as each quarter month thereafter (*t+1, t+2, t+3, t+6, t+9, t+12 and t+15*) rather than each month in the 15-month period because of space limitations. For regulatory actions, Table 4 results indicate that there is a strong and inverse relationship between disciplinary actions and the net flows. Funds with regulatory actions tend to experience more outflows than inflows from the investors. This relationship starts after the second month once the action is realized by the investors. Columns 1 and 2 show that within one month, the action is not observed by the investors which is consistent with the expected time frame to update the Form ADVs and inform the investors. This is sharp contrast to the negative effect of regulatory action on fund performance, which happens only for month *t*+1 and disappears thereafter. The strongest reaction by the investors is observed in month *t*+2, two months after the initiation of an action, meaning investors tend to react almost immediately after they are informed of advisor wrongdoing. However, the effect stabilizes after month *t*+2 and stays even after 15 months once an action initiated.

In terms of magnitude, the month *t*+2 slope coefficient for the *DIS_reg* is -0.314 (p = 0.001), which indicates that a disciplinary action causes a 0.314% decrease in monthly investor flows 2 months after the disciplinary action disclosure, corresponding to $7.1 million per month for an average fund with a net asset of $2.264 billion in our sample. As a comparison, in the second model for each monthly regression where the past 5-year fund return is controlled for, the slope coefficient of *DIS_reg* is only slightly reduced to -0.289 (p = 0.003), indicating that the fund outflows are not driven by past fund performance. Even after 15 months, the outflows continue. The *DIS_reg* coefficient of -0.2 (p = 0.017) suggests that 15 months after the action disclosure, investors withdraw funds at the rate of $4.5 million per month.

On the other hand, Table 5 shows the civil actions and their effects on the investors' flows. Most surprisingly, investors do not react to the civil actions like fund managers do not experience performance decrease (as we demonstrated in the Performance section). The reasons that we discussed in the Performance section might possibly explain why investors do not react to the civil actions against the mutual fund firms. These are civil lawsuit initiators are mostly private plaintiffs which might not cause a significant concern for investors; mutual funds deny the allegations in more than 20% of the cases; and some cases can be filed against all mutual fund industry rather than a specific one which downgrades the effect of the action.

Overall, our results indicate that investors tend to react negatively to the regulatory actions meaning overall flow decreases once the action is initiated. On the other hand, there is not a significant relationship between investor flows and civil actions.

4 Robustness

Table 1, Panel D reveals that the funds with disciplinary actions have substantially different characteristics from those without actions. For example, funds with actions are much larger and older than funds without actions; the mean AUM of funds that filed regulatory actions have a mean AUM of $3.83 billion and a mean age of 21.56 years, compared to the mean AUM of $1.52 billion and mean age of 12.85 years for non-action funds. Also, the funds with regulatory actions have lower past 5-year performance than non-action funds (7.98% versus 8.89% on an annualized basis). Therefore, we perform propensity score matching regression analysis to confirm that the results are not driven by any selection bias.

Specifically, we perform both generalized linear and generalized booted models separately and use the nearest matching method. The matching characteristics include fund past 5-year return, age, AUM, fund flows, management fee, expense ratio, and turnover ratio. All matchings are conducted without replacement. Figure 4 shows the distribution of propensity scores for regulatory actions. All treated units have successfully matched with control units and there is a satisfactory overlap in the propensity score distribution. Table 6 shows regulatory action effects on fund flow for treated and control units. Similar to our main analysis, Table 6 shows that the effect of regulatory action on investor redemption is strongest in month t+2 and declines over time till month *t*+15. This is strong evidence that the outflows start almost immediately after investors discover the adviser misconduct and persist for more than one year (see footnote 1).

We also provide regression tests with propensity score matching for age and size subsamples in Tables 7 and 8. These results show that for subsamples sorted by age and size, outflows all start after the second month and continue up until the 15^{th} month. For the age subsamples, there is some indication that younger funds see stronger outflows triggered by regulatory actions for as long as 12 months after the action initiation. However, based on evidence from the size subsamples, it appears both small and large funds observe investor redemption after such actions. These results further support the conclusion based on the propensity score matching analysis (Table 6) that the effects of advisor misconduct on investor redemption is not caused by fund characteristics.

To rule out the possibility that the effects of disciplinary actions on fund flows are caused by fund characteristics associated with actions rather than the actions themselves, we conduct a falsification test where we regression fund flows prior to the action initiation date (from month *t* to month *t*-15). The falsification test in Table 9 shows that none of the *DIS_reg* coefficients is significant in the flow regression before the action initiation date. Although we only report results when the 5-year past fund return is omitted in the control variables, our results remain unchanged when we include this control. This means that the results are not riven by certain omitted variables associated with the disciplinary action variable, confirming that the effect of regulatory action on fund redemption is not due to selection bias caused by other fund characteristics such as age, size, fund expense, fees, or turnover ratios or omitted bias.

Our results are similar and robust when controls are added and with different settings such as *month* fixed effects rather than *year_month* fixed effects and high return quartiles rather than terciles. Subsample analysis in Table IA.1 confirms that the results are robust to controlling for past fund performance.

To further gauge the economic significance of the effect of regulatory actions on investor redemption, Table IA.3 and IA.4 show the subsample analysis for the effect of regulatory actions on fund flows for the above median age and size funds. Even when we conduct our tests on the economically important subsamples of larger and older funds, we continue to find that advisor misconduct has a long-lasting effect on investor redemption over one year after the action initiation date.

5 Conclusion

This paper examines the effects of disciplinary actions on mutual fund performance and fund flows. By contrasting the differential effects of adviser misconduct on fund performance and redemption, we document the role of investor trust on capital allocation decisions. We contribute to the literature by using a large sample of mutual funds over a period of 27 years to study the importance of trust on investor behavior.

We show that when mutual funds face regulatory actions, their performance significantly decreases within a short period of time. This effect is more prominent for skilled fund managers. Furthermore, we examine investor fund withdrawal decisions after the action initiation dates. We show that investors react negatively by reducing investments in the funds after regulatory actions. In sharp contrast to the transitory effect on fund performance, the effect of regulatory actions on fund flows is persistent. The redemptions start from month 2 after the action initiation date and last at least 9 months; for large and old funds, the redemptions last until month 15.

Interestingly, managers appear to have been able to ignore the civil action effects in terms of performance. Investors also tend to ignore the civil actions, presumably because investors pay more attention when an action is initiated by a governmental organization such as the SEC. Additionally, mutual funds tend to deny the allegations of wrongdoing or claim the civil actions as without merit. This might make investors less concerned for the outcomes of civil actions.

The effect of adviser regulatory actions on investor redemption is asynchronous to the effect on fund performance: the former starts with a delay of one month after the initiation of the fraud, while the latter occurs only in the month subsequent to fraud disclosure. Moreover, the fund outflows following disciplinary actions persistent long after the transitory loss of fund performance. Therefore, our evidence suggests that investors' decision to withdraw money arises more in response to lost trust in the affected funds than from reduced fund returns.

6 Appendix A. Form ADV

Form ADV Information

This information is excerpted from U.S. Securities Exchange Commission's website available at https://www.investor.gov/introduction-investing/investing-basics/glossary/form-adv

Form ADV is a mandatory and uniform form used by Registered Investment Advisers (RIA) in the US to register with both the SEC and state securities authorities. The form includes three parts (Part 1, Part 2, and Part 3) and publicly available on the SEC's IAPD website.[5]

Part 1 requires information about the investment adviser's business, ownership, clients, employees, business practices, affiliations, and any disciplinary events of the adviser or its employees. Part 1 is organized in a check-the-box, fill-in-the-blank format. The SEC reviews the information from this part of the form to manage its regulatory and examination programs.

Part 2 requires investment advisers to prepare narrative brochures that include plain English disclosures of the adviser's business practices, fees, conflicts of interest, and disciplinary information. The brochure is the primary disclosure document for investment advisers and must be delivered to advisory clients.

Part 3, the "relationship summary," requires SEC-registered investment advisers that offer services to retail investors to prepare a brief plain English summary about the types of services the adviser offers, the fees and costs clients will have to pay for those services, the conflicts of interest the adviser may have, the required standard of conduct, any legal and disciplinary history, key

[5] https://adviserinfo.sec.gov/ (last accessed October 21, 2022)

questions to ask the adviser, and references to where clients can find more detailed information about the adviser and the services they offer.[6]

Additional Information for Reporting Disciplinary Actions

This information is excerpted from U.S. Securities Exchange Commission's website available at https://www.sec.gov/oiea/investor-alerts-bulletins/ib_formadv.html

Investment advisers must provide their prospective and existing clients with a narrative brochure written in plain English. Part 2A of Form ADV contains 18 separate items, each covering a separate disclosure topic, to be included in the brochure. To make it easier for investors to compare the brochures of different investment advisers, advisers must respond to each item in Part 2A in the order listed in the form, using the same headings provided by the form. Much of the disclosure required in Part 2A addresses an investment adviser's conflicts of interest with its clients, and is disclosure that an investment adviser, as a fiduciary, must make to clients. The required disclosures include:

Disciplinary Information

An investment adviser must disclose in its brochure material facts about any legal or disciplinary event that is material to a client's evaluation of the advisory business or of the integrity of its management personnel. Certain disciplinary events are presumed to be material if they occurred within the last 10 years. An investment adviser must deliver promptly to clients updated

[6] https://www.investor.gov/introduction-investing/investing-basics/glossary/form-adv (Last accessed October 21, 2022)

information regarding disciplinary events if it is updating a brochure to add a new event or to change material information about a disciplinary event.

7 Appendix B. Variable Definitions

Variable	Definition
AUM	Total equity assets under management of a mutual fund, calculated using the equity assets in the CRSP universe.
cm_ret	Past 5-year cumulative return.
DIS_reg	Indicator variable set to 1 if regulatory disciplinary action happens within a month; 0 otherwise.
DIS_civil	Indicator variable set to 1 if regulatory disciplinary action happens within a month; 0 otherwise.
DIS_reg_q	Continuous variable that shows the number of regulatory actions within last quarter.
DIS_civil_q	Continuous variable that shows the number of civil actions within last quarter.
DIS_reg_y	Continuous variable that shows the number of regulatory actions within last year.
DIS_civil_y	Continuous variable that shows the number of civil actions within last year.
Flow	Net flow into the fund scaled by previous quarter AUM. $$Flow_{i,t} = \frac{AUM_{i,t} - AUM_{i,t-1} \times \left(1 + R_{i,t}\right)}{AUM_{i,t-1}}$$
Expense_Ratio	Fund expense ratio. Ratio of total investment that shareholders pay for the fund's operating expenses. Fund expense may include waivers and reimbursements, causing it to appear less than the fund management fee.
Fund_Turnover	Fund turnover ratio. Minimum of aggregated sales or aggregated purchases of securities, divided by the average 12-month Total Net Assets of the fund.
Log Age	The natural logarithms of 1 + the Fund's age in years.
Mgt_Fee	The fee is calculated using ratios based on the line items reported in the Statement of Operations. The management fee can be offset by fee waivers and/or reimbursements which will make this value differ from the contractual fees found in the prospectus. Reimbursements can lead to negative management fees.
Return_5yr	Annualized fund return in percentages in the 5-year period preceding the current month.
SKILL_capm	Indicator variable for high fund manager skill defined similarly to *Perform* with historical alpha estimated using the CAPM model instead of Fama-French 3 factors or Carhart 4 factors.
SKILL_f3	Indicator variable set to 1 if a fund is in the top quartile of alpha in the previous period. The alpha is measured using returns adjusted for the Fama and French (1992) 3 factors over the rolling past 5 years using monthly data.
SKILL_f4	Indicator variable set to 1 if a fund is in the top quartile of alpha in the previous period. The alpha is measured using returns adjusted for the Carhart (1997) 4 factors over the rolling past 5 years using monthly data.

Vret	Fund return in percentages at the end of the current month which is calculated as the value weighted return of each fund class, using *AUM* as the weight.

8 Figures and Tables

Figure 1

Examples of Disciplinary Actions in Form ADVs

This figure illustrates examples of the disciplinary actions in Form ADV's.

REGULATORY ACTION	
Filed Against	Advisory Firm
Initiated By	SEC
Principal Sanction	Cease and Desist
Date Initiated	2004-08-02
Principal Product	Mutual Fund(s)
Status	Final
Summary	
THE U.S. SECURITIES AND EXCHANGE COMMISSION ANNOUNCED THAT REGISTRANT HAS AGREED TO PAY $50 MILLION DOLLARS AND UNDERGO COMPLIANCE REFORMS TO SETTLE CHARGES THAT IT ALLOWED <u>RAPID IN-AND-OUT TRADING, KNOWN AS MARKET TIMING,</u> IN MUTUAL FUNDS IT MANAGED, CONTRARY TO FUND PROSPECTUS LANGUAGE. UNDER THE SETTLEMENT, REGISTRANT WILL PAY $50 MILLION. THESE AMOUNTS WILL BE DISTRIBUTED TO SHAREHOLDERS OF MUTUAL FUNDS AFFECTED BY THE MARKET TIMING. REGISTRANT WILL ALSO UNDERTAKE COMPLIANCE MEASURES DESIGNED TO PROTECT AGAINST FUTURE VIOLATIONS.	

CIVIL ACTION	
Filed Against	Advisory Firm
Initiated By	Peter D.
Relief Sought	Money Damages (Private/Civil Complaint)
Principal Sanction	-
Date Initiated	2003-10-31
Principal Product	Mutual Fund(s)
Court	U.S. District Court for the Southern District of New York
Status	Pending
Summary	
PLAINTIFF SEEKS TO BRING A CLASS ACTION IN THE SOUTHERN DISTRICT OF NEW YORK SEEKING MONETARY AND OTHER RELIEF AS AN OFF-SHOOT OF THE THE NEW YORK ATTORNEY GENERAL'S AND THE U.S. SECURITIES AND EXCHANGE COMMISSION'S WIDESPREAD INVESTIGATION INTO TRADING IN THE MUTUAL FUND INDUSTRY. THIS MATTER IS CURRENTLY PENDING; A CLASS HAS NOT BEEN CERTIFIED.	

CIVIL ACTION	
Filed Against	Advisory Firm
Initiated By	Private Plaintiff
Relief Sought	Money Damages (Private/Civil Complaint)
Principal Sanction	-
Date Initiated	2001-06-29

Principal Product	Mutual Fund(s)
Court	U.S. District Court for the Southern District of Mississippi
Status	Pending

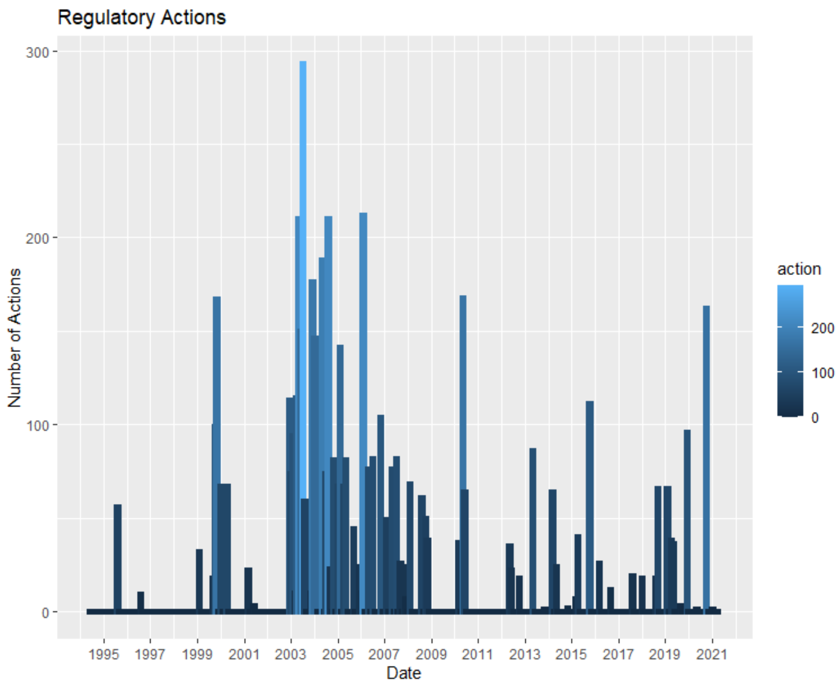
Summary

PLAINTIFFS ALLEGE THAT DREYFUS BREACHED ITS FIDUCIARY DUTY BY FAILING TO ENSURE THAT THE OTHER DEFENDANTS PAID COMMISSIONS OWED TO PLAINTIFFS ON FUNDS INVESTED IN DREYFUS MUTUAL FUNDS AS PART OF AN INVESTMENT PROGRAM TO WHICH DREYFUS WAS NOT A PARTY. ***DREYFUS BELIEVES THAT THE CLAIM IS WITHOUT MERIT AND PLANS TO DEFEND THE ACTION VIGOROUSLY.***

Figure 2

Distribution of Regulatory and Civil Actions Over the Sample Period (1995-2021)

This figure displays annual distribution of regulatory and civil actions over the sample period.



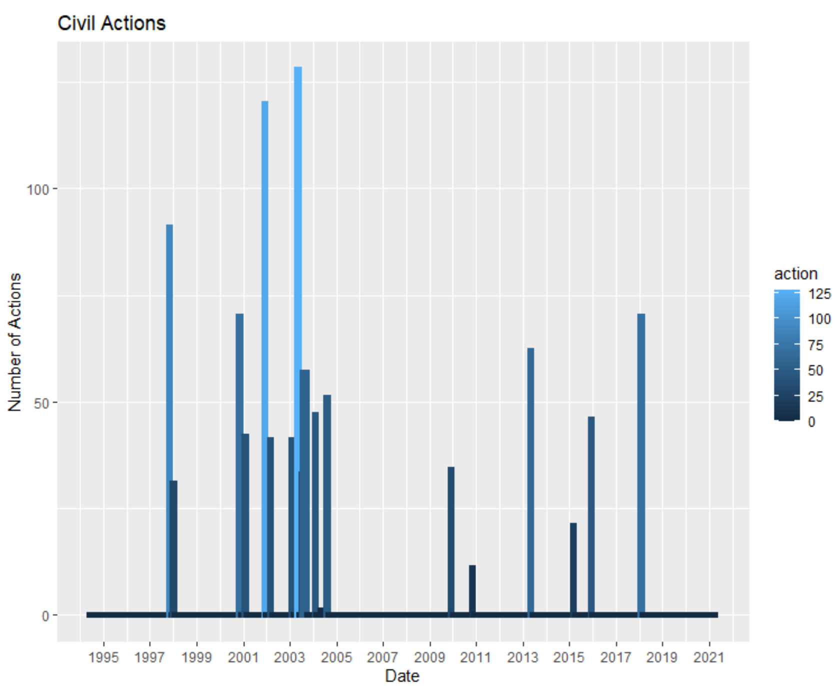
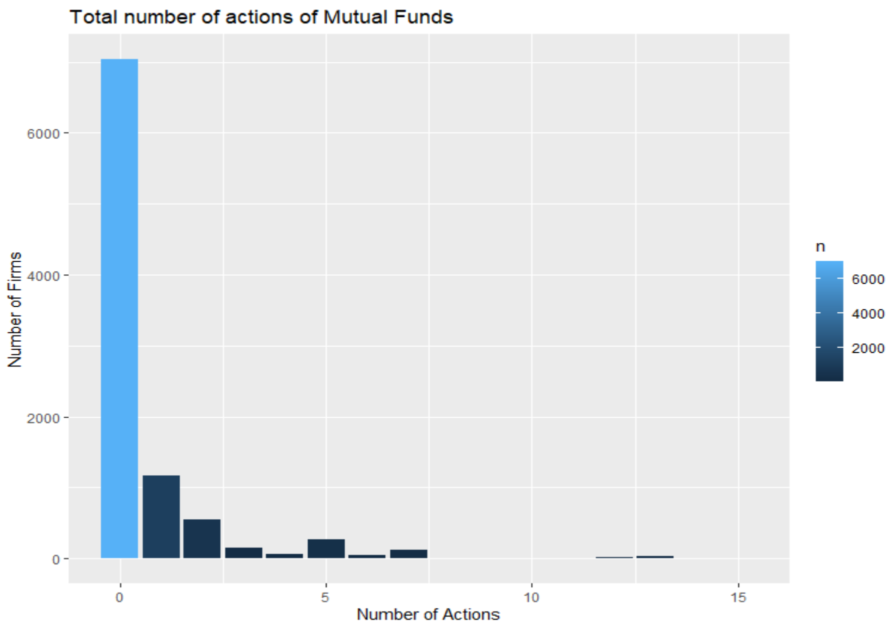


Figure 3

Distribution Total Number of Actions per Fund Over the Sample Period (1995-2021)

This figure displays annual distribution of the total number of actions of fund faces over its lifetime between 1995 and 2021. First chart includes funds that have not faced any disciplinary action during the sample period. Second chart shows the funds with any action during the sample period (no-action funds are removed).



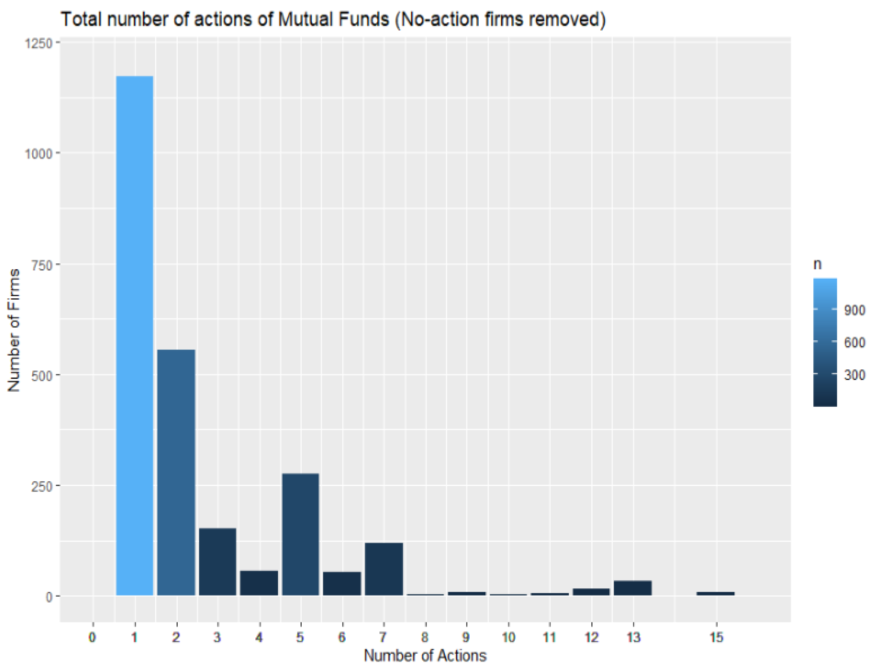


Figure 4

Distribution of Propensity Scores for Regulatory Action Funds

This figure illustrates the distribution of propensity score in the matched treated group, matched control group and the unmatched control group.

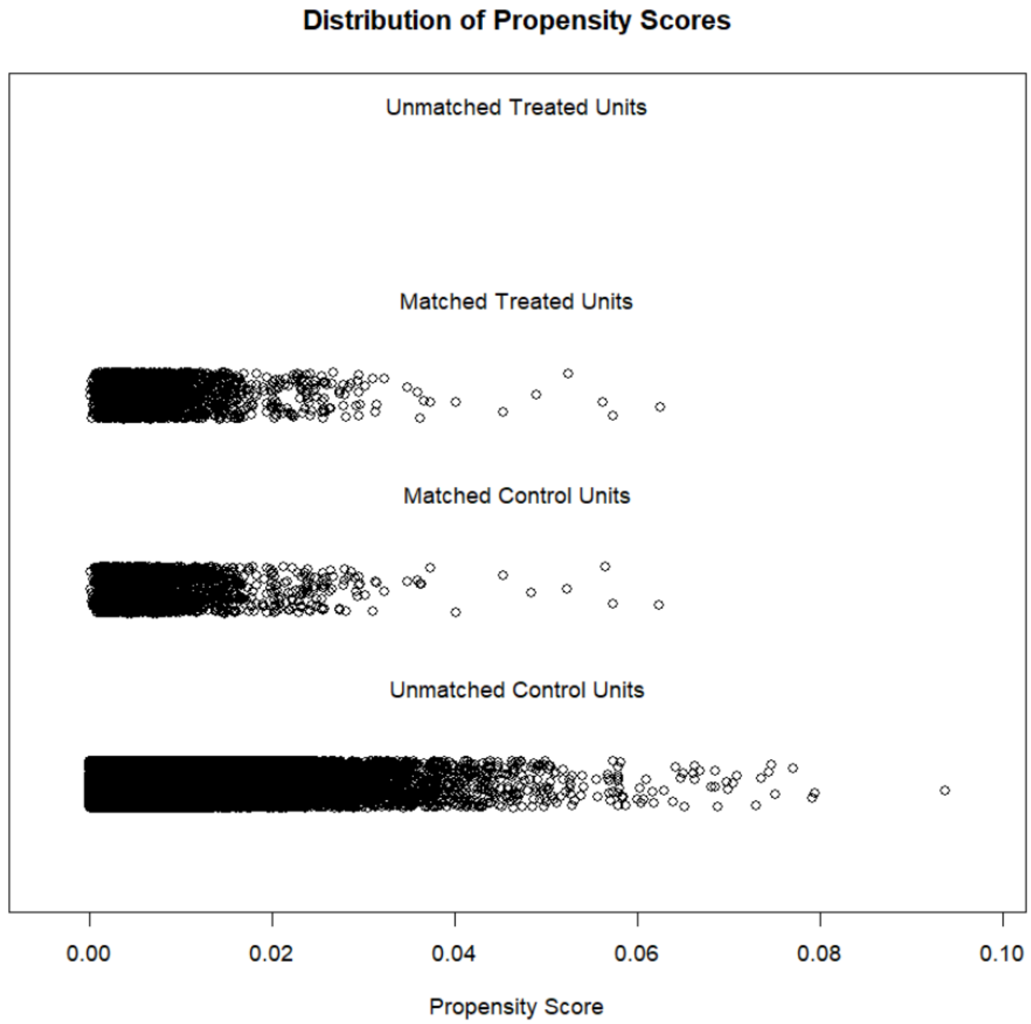


Table 1

Summary Statistics

This table reports the summary statistics for the key variables. The variables are defined in Appendix B. Panel A includes the full sample between 2000Q1 and 2021Q4. Panel B and C include the funds with Regulator and Civil actions separately. Panel D includes the comparison of the summary statistics among funds without an action and funds with regulatory and civil actions. Port No's are portfolio numbers is the unique identifier for a security or a group of securities held in a fund's portfolio

	N	Mean	Std. Dev	P25	Median	P75
Panel A: Full Sample						
Fund AUM or TNA ($Million)	1,001,529	2264.36	32451.49	96.60	345.30	1213.70
Fund 1-month Excess Return (winsorized) (%)	1,001,554	0.69	4.00	-0.86	0.49	2.41
Management Fees (%)	1,001,554	0.54	0.35	0.35	0.56	0.78
Fund Expense (%)	1,001,554	1.00	0.50	0.60	1.00	1.30
Fund Turnover	1,001,554	0.76	1.06	0.20	0.45	0.90
Return_5yr (Annualized) (%)	89,238	8.63	13.51	1.05	6.47	15.05
Fund Age (Years)	1,001,554	14.25	6.87	8.33	13.00	19.26
Flow (%)	993,903	0.00	0.04	-0.02	0.00	0.01
Mutual Fund Firms (Port No's)	7,557					
Panel B: Firms with Regulatory Actions						
Fund AUM or TNA ($Million)	324,026	3830.19	56219.60	226.40	664.30	1919.00
Fund 1-month Excess Return (winsorized) (%)	324,095	0.64	3.91	-0.83	0.45	2.22
Management Fees (%)	324,095	0.53	0.28	0.39	0.54	0.70
Fund Expense (%)	324,095	1.00	0.50	0.70	0.90	1.20
Fund Turnover	324,095	0.78	1.03	0.22	0.47	0.90
Return_5yr (Annualized) (%)	23.586	7.98	13.53	0.77	5.88	14.07
Fund Age (Years)	324,095	21.56	5.57	16.66	23.17	26.92
Flow (%)	322,432	0.00	0.04	-0.02	-0.01	0.01
Mutual Fund Firms (Port No's)	1,589					
Panel C: Firms with Civil Actions						
Fund AUM or TNA ($Million)	89,519	6668.59	106280.04	210.80	610.30	1605.00
Fund 1-month Excess Return (winsorized) (%)	89,589	0.59	3.83	-0.80	0.42	2.11
Management Fees (%)	89,589	0.58	0.28	0.46	0.57	0.75
Fund Expense (%)	89,589	0.90	0.40	0.70	0.90	1.20
Fund Turnover	89,589	1.01	1.27	0.30	0.61	1.14
Return_5yr (Annualized) (%)	7.730	7.58	13.17	0.76	5.78	13.36
Fund Age (Years)	89,589	21.03	5.58	16.33	22.83	26.68
Flow (%)	89,076	0.00	0.04	-0.02	-0.01	0.01
Mutual Fund Firms (Port No's)	440					

Panel D: Comparisons of Action vs No-Action Funds

	No Action		Reg Action		Civil Action	
Fund AUM or TNA ($Million)	650,650	1515.37	324,026	3830.19	89,519	6668.59
Fund 1-month Excess Return (winsorized) (%)	650,606	0.72	324,095	0.64	89,589	0.59
Management Fees (%)	650,606	0.55	324,095	0.53	89,589	0.58
Fund Expense (%)	650,606	1.00	324,095	1.00	89,589	0.90
Fund Turnover	650,606	0.75	324,095	0.78	89,589	1.01
Return_5yr (Annualized) (%)	63,388	8.89	23.586	7.98	7.730	7.58
Fund Age (Years)	650,606	12.85	324,095	21.56	89,589	21.03
Flow (%)	644,765	0.00	322,432	0.00	89,076	0.00
Mutual Fund Firms (Port No's)	5,821		1,589		440	
Number of total actions (per fund)			14		3	

Table 2

Summary Information about Investment Style (Lipper Class) of the Mutual Funds

This table shows the investment style classifications that has most appeared in the sample period. Panel A includes the full sample period. Panel B includes the funds with regulatory actions. Panel C inludes the funds with civil actions.

Panel A: Full Sample (2000Q1 to 2021Q4)

	N	Lipper Class Code	Lipper Class Name
1	41807	LCCE	Large-Cap Core Funds
2	37093	MLCE	Multi-Cap Core Funds
3	35987	SCCE	Small-Cap Core Funds
4	32678	LCGE	Large-Cap Growth Funds
5	29322	SCGE	Small-Cap Growth Funds
6	25246	MLGE	Multi-Cap Growth Funds
7	25121	HY	High Current Yield Funds
8	24642	IID	Intermediate Investment Grade Debt Funds
9	23034	MCGE	Mid-Cap Growth Funds
10	21649	LCVE	Large-Cap Value Funds

Panel B: Firms with Regulatory Actions

	N	Lipper Class Code	Lipper Class Name
1	13211	LCCE	Large-Cap Core Funds
2	10937	LCGE	Large-Cap Growth Funds
3	9659	HY	High Current Yield Funds
4	9103	MLCE	Multi-Cap Core Funds
5	8965	SCCE	Small-Cap Core Funds
6	8598	GM	General & Insured Municipal Debt Funds
7	8062	IID	Intermediate Investment Grade Debt Funds
8	8034	MLGE	Multi-Cap Growth Funds
9	7828	SCGE	Small-Cap Growth Funds
10	7045	MTAG	Mixed-Asset Target Allocation Growth Funds

Panel C: Civil Actions

	N	Lipper Class Code	Lipper Class Name
1	4915	LCCE	Large-Cap Core Funds
2	4271	LCGE	Large-Cap Growth Funds
3	3490	IID	Intermediate Investment Grade Debt Funds
4	2793	GM	General & Insured Municipal Debt Funds
5	2715	SCGE	Small-Cap Growth Funds
6	2401	MTAG	Mixed-Asset Target Alloc Growth Funds
7	2379	LCVE	Large-Cap Value Funds
8	2372	HY	High Current Yield Funds
9	2239	MCGE	Mid-Cap Growth Funds
10	2125	MLCE	Multi-Cap Core Funds

Table 3

Fund Future Monthly Return Regressions for Disciplinary Action Firms

This table reports results of the panel regressions of future fund returns (*Vret_t+1*, monthly returns over the next month) between 2000Q1 and 2021Q4, conditioning on disciplinary action type (Regulatory Actions (col 1-2), Civil Actions (col 3-4). The dependent variable is the value-weighted return of the fund on month *t+1* (*Vret_t+1*). *DIS_reg/DIS_civil* are indicator variables set to 1 if an action is initiated against fund. 5yr Return is the fund return in the past 5 years. *Log AUM, Log Age, Flow, Mgmt.Fee, Exp. Ratio, Turn. Ratio and Return_5yr* are control variables for fund size, age, fund flow, fund management fee, fund expense ratio, fund turnover ratio and fund return in the past 5 years. Refer to Appendix B for detailed variable definitions. Standard errors are double clustered by fund and year_month, with *t*-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Action Type (DIS)	**DIS_Reg**		**DIS_Civil**	
	(1)	**(2)**	**(3)**	**(4)**
DIS	-0.372***	-0.349***	-0.054	-0.047
	(0.000)	(0.000)	(0.398)	(0.487)
Log AUM	-0.101***	-0.097***	-0.101***	-0.098***
	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-0.005	0.027	-0.005	0.027
	(0.678)	(0.171)	(0.644)	(0.179)
Flow	0.000	0.000	0.000	0.000
	(0.147)	(0.397)	(0.148)	(0.397)
Mgmt. Fee	0.109***	0.086***	0.110***	0.087***
	(0.000)	(0.000)	(0.000)	(0.000)
Exp. Ratio	-0.036*	-0.016	-0.036*	-0.017
	(0.087)	(0.492)	(0.081)	(0.475)
Turn. Ratio	-0.017***	-0.011*	-0.017***	-0.011*
	(0.000)	(0.0059)	(0.007)	(0.059)
Return_5yr		0.388***		0.388***
		(0.000)		(0.000)
Observations	986,177	985,828	986,177	985,828
Adj. R2	0.88	0.89	0.88	0.89
Controls	No	Yes	Yes	Yes
Fund Style x Yr_Month FE	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes

Table 4

Fund Future Monthly Flow Regressions for Firms that have Regulatory Actions

This table reports results of the panel regressions of future fund flow (Flow_*t+1*...*Flow_t+15*, monthly fund flows over the next 15-month period) between 2000Q1 and 2021Q4. The dependent variable is the net flow of the fund from month *t+1* (Flow_*t+1) to month* t+15 (*Flow_t+15). DIS_reg* is an indicator variable set to 1 if a regulatory action is initiated against fund. Control variables are identical to those in Table 3. Refer to Appendix B for detailed variable definitions. Standard errors are double clustered by fund and year_month, with *t*-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

	t+1		***t+2***		***t+3***		***t+6***	
DIS_reg	0.173	0.197	-0.314***	-0.289***	-0.228***	-0.210**	-0.217**	-0.202**
	(0.190)	(0.153)	(0.001)	(0.003)	(0.008)	(0.014)	(0.024)	(0.033)
Log AUM	-0.355***	-0.351***	-0.354***	-0.351***	-0.355***	-0.352***	-0.357***	-0.354***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-0.997***	-0.962***	-0.996***	-0.962***	-1.022***	-0.985***	-1.114***	-1.076***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Flow	0.000***	0.000***	0.000***	0.000***	0.000**	0.000**	0.000**	0.000**
	(0.008)	(0.009)	(0.008)	(0.009)	(0.011)	(0.012)	(0.013)	(0.015)
Mgmt. Fee	1.038***	1.015***	1.037***	1.014***	1.039***	1.014***	1.046***	1.017***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Exp. Ratio	-0.598***	-0.579***	-0.598***	-0.578***	-0.595***	-0.574***	-0.598***	-0.573***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Turn. Ratio	-0.006	0.000	-0.006	0.000	-0.008	-0.002	-0.010	-0.003
	(0.753)	(0.986)	(0.754)	(0.985)	(0.657)	(0.925)	(0.585)	(0.863)
Return_5yr		0.413***		0.413***		0.417***		0.430***
		(0.000)		(0.000)		(0.000)		(0.000)
Observations	986,174	985,825	986,174	985,825	978,722	978,373	956,552	956,203
Adj. R2	0.19	0.20	0.19	0.20	0.19	0.19	0.19	0.20
All Controls (inc. 5yr Ret.)	No	Yes	No	Yes	No	Yes	No	Yes
Fund Style x Yr_Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4. Fund Future Monthly Flow Regressions for Firms that have Regulatory Actions (Cont'd)

	t+9		***t+12***		***t+15***	
DIS_reg	-0.189**	-0.178**	-0.180**	-0.164**	-0.201**	-0.181**
	(0.010)	(0.013)	(0.024)	(0.037)	(0.011)	(0.017)
Log AUM	-0.359***	-0.356***	-0.355***	-0.353***	-0.350***	-0.349***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-1.115***	-1.079***	-1.116***	-1.081***	-1.129***	-1.096***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Flow	0.000***	0.000***	0.000**	0.000**	0.000**	0.000**
	(0.009)	(0.010)	(0.012)	(0.013)	(0.021)	(0.025)
Mgmt. Fee	1.058***	1.028***	1.082***	1.049***	1.069***	1.037***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Expense Ratio	-0.596***	-0.569***	-0.605***	-0.575***	-0.598***	-0.568***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Turn. Ratio	-0.011	-0.004	-0.011	-0.004	-0.011	-0.003
	(0.553)	(0.836)	(0.560)	(0.848)	(0.563)	(0.866)
Return_5yr		0.431***		0.429***		0.428***
		(0.000)		(0.000)		(0.000)
Observations	934,713	934,364	913,257	912,908	892,173	891,824
Adj. R2	0.19	0.20	0.19	0.20	0.19	0.20
All Controls (inc. 5yr Ret.)	No	Yes	No	Yes	No	Yes
Fund Style x Yr_Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 5

Fund Future Monthly Flow Regressions for Firms that have Civil Actions

This table reports results of the panel regressions of future fund flow (Flow_*t+1...Flow_t+15,* monthly fund flows over the next 15-month period) between 2000Q1 and 2021Q4. The dependent variable is the net flow of the fund from month *t+1* (Flow_*t+1) to month* t+15 (*Flow_t+15). DIS_civil* is an indicator variable set to 1 if a civil action is initiated against fund. Control variables are identical to those in Table 3. Refer to Appendix B for detailed variable definitions. Standard errors are double clustered by fund and year_month, with *t*-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

	t+1		***t+2***		***t+3***		***t+6***	
DIS_civil	-0.126	-0.119	-0.179	-0.169	-0.347	-0.358	0.279	0.296
	(0.593)	(0.608)	(0.411)	(0.422)	(0.134)	(0.118)	(0.276)	(0.238)
Log AUM	-0.355***	-0.351***	-0.355***	-0.351***	-0.355***	-0.352***	-0.357***	-0.354***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-0.996***	-0.962***	-0.996***	-0.962***	-1.022***	-0.986***	-1.115***	-1.076***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Flow	0.000***	0.000***	0.000***	0.000***	0.000**	0.000**	0.000**	0.000**
	(0.008)	(0.009)	(0.008)	(0.009)	(0.011)	(0.012)	(0.013)	(0.015)
Mgmt. Fee	1.038***	1.015***	1.038***	1.015***	1.039***	1.014***	1.047***	1.018***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Exp. Ratio	-0.598***	-0.579***	-0.598***	-0.579***	-0.595***	-0.574***	-0.599***	-0.574***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Turn. Ratio	-0.006	0.000	-0.006	0.000	-0.008	-0.002	-0.011	-0.003
	(0.755)	(0.984)	(0.756)	(0.984)	(0.660)	(0.929)	(0.580)	(0.858)
Return_5yr		0.413***		0.413***		0.417***		0.431***
		(0.000)		(0.000)		(0.000)		(0.000)
Observations	986,174	985,825	986,174	985,825	978,722	978,373	956,552	956,203
Adj. R2	0.19	0.20	0.19	0.20	0.19	0.19	0.19	0.20
All Controls (inc. 5yr Ret.)	No	Yes	No	Yes	No	Yes	No	Yes
Fund Style x Yr_Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5. Fund Future Monthly Flow Regressions for Firms that have Civil Actions (Cont'd)

	t+9		*t+12*		*t+15*	
DIS_civil	0.134	0.136	0.695	0.707	0.042	0.054
	(0.526)	(0.517)	(0.180)	(0.174)	(0.844)	(0.800)
Log AUM	-0.359***	-0.357***	-0.355***	-0.353***	-0.350***	-0.349***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-1.116***	-1.080***	-1.117***	-1.081***	-1.129***	-1.096***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Flow	0.000***	0.000***	0.000**	0.000**	0.000**	0.000**
	(0.009)	(0.010)	(0.012)	(0.013)	(0.021)	(0.025)
Mgmt. Fee	1.058***	1.028***	1.082***	1.049***	1.069***	1.037***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Expense Ratio	-0.596***	-0.570***	-0.605***	-0.575***	-0.598***	-0.569***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Turn. Ratio	-0.012	-0.004	-0.012	-0.004	-0.011	-0.003
	(0.551)	(0.833)	(0.552)	(0.838)	(0.563)	(0.866)
Return_5yr		0.431***		0.429***		0.428***
		(0.000)		(0.000)		(0.000)
Observations	934,713	934,364	913,257	912,908	892,173	891,824
Adj. R2	0.19	0.20	0.19	0.20	0.19	0.20
All Controls (inc. 5yr Ret.)	No	Yes	No	Yes	No	Yes
Fund Style x Yr_Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 6

Fund Future Monthly Flow Regressions for Matched Firms that have Regulatory Actions

This table reports results of the panel regressions of future fund flow (Flow*_t+1...Flow_t+15*, monthly fund flows over the next 15-month period) of treatment and control groups between 2000Q1 and 2021Q4. The dependent variable is the net flow of the fund from month *t+1* (Flow*_t+1) to month* t+15 (*Flow_t+15). DIS_reg* is an indicator variable set to 1 if a regulatory action is initiated against fund. Control variables are identical to those in Table 3. Refer to Appendix B for detailed variable definitions. Standard errors are double clustered by fund and year_month, with *t*-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

	t+1	***t+2***	***t+3***	***t+6***	***t+9***	***t+12***	***t+15***
DIS_reg	0.195	-0.291***	-0.215**	-0.218**	-0.200***	-0.164**	-0.202***
	(0.154)	(0.002)	(0.010)	(0.021)	(0.005)	(0.039)	(0.009)
Log AUM	-0.323***	-0.322***	-0.323***	-0.324***	-0.329***	-0.328***	-0.326***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-1.254***	-1.255***	-1.294***	-1.353***	-1.368***	-1.346***	-1.372***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Flow	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.130)	(0.132)	(0.136)	(0.140)	(0.155)	(0.143)	(0.134)
Mgmt. Fee	1.030***	1.029***	1.029***	1.039***	1.045***	1.066***	1.043***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Expense Ratio	-0.796***	-0.795***	-0.792***	-0.794***	-0.789***	-0.801***	-0.785***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Turn. Ratio	-0.034	-0.034	-0.036	-0.039*	-0.041*	-0.042*	-0.041*
	(0.136)	(0.137)	(0.111)	(0.082)	(0.074)	(0.063)	(0.072)
Observations	544,758	544,758	542,182	534,455	526,730	519,008	511,286
Adj. R2	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund Style x Yr_Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7

Age Subsample Test: Fund Future Flow Regressions for Regulatory Action Firms

This table reports results of the panel regressions of two subsamples based on median age (11 years) between 2000Q1 and 2021Q$. future fund flow (*Flow_t+1...Flow_t+15*, monthly fund flows over the next 15-month period). The dependent variable is the net flow of the fund from month *t+1* (*Flow_t+1*) to month *t+15* (*Flow_t+15*). DIS_reg is an indicator variable set to 1 if a regulatory action is initiated against fund. Control variables are identical to those in Table 3. Refer to Appendix B for detailed variable definitions. Standard errors are double clustered by fund and year_month, with t-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

	Age <= Median	*Age > Median*	*Age <= Median*	*Age > Median*	*Age <= Median*	*Age > Median*
	t+2	***t+2***	***t+3***	***t+3***	***t+6***	***t+6***
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
DIS_reg	-0.634*	-0.251***	-0.614**	-0.210***	-0.950**	-0.163*
	(0.086)	(0.005)	(0.048)	(0.007)	(0.039)	(5.419)
Log AUM	-0.617***	-0.353***	-0.615***	-0.355***	-0.616***	-0.357***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-0.425***	-0.900***	-0.465***	-0.919***	-0.582***	-0.977***
	(0.714)	(0.000)	(0.621)	(0.000)	(0.428)	(0.000)
Flow	0.000*	0.000**	0.000*	0.000**	0.000*	0.000**
	(0.071)	(0.027)	(0.083)	(0.028)	(0.089)	(0.032)
Mgmt. Fee	0.627***	1.228***	0.635***	1.225***	0.664***	1.226***
	(0.012)	(0.000)	(0.010)	(0.000)	(0.009)	(0.000)
Expense Ratio	0.048	-0.957***	0.041	-0.950***	0.013	-0.950***
	(0.689)	(0.000)	(0.738)	(0.000)	(0.917)	(0.000)
Turnover	0.046	-0.027	0.049	-0.031	0.050	-0.033
	(0.363)	(0.202)	(0.328)	(0.147)	(0.346)	(0.116)
Observations	193,817	792,357	190,135	788,587	179,275	777,277
Adj. R2	0.32	0.19	0.32	0.19	0.32	0.19
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fund Style x Year_Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 7. Age Subsample Test: Fund Future Flow Regressions for Regulatory Action Firms (Cont'd)

	Age <= Median *t+9* (7)	*Age > Median* *t+9* (8)	*Age <= Median* *t+12* (9)	*Age > Median* *t+12* (10)	*Age <= Median* *t+15* (11)	*Age > Median* *t+15* (12)
DIS_reg	-0.635	-0.158**	-0.819***	-0.116	-0.590	-0.156**
	(0.179)	(0.037)	(0.007)	(0.121)	(0.124)	(0.034)
Log AUM	-0.616***	-0.361***	-0.614***	-0.358***	-0.626***	-0.352***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-0.474*	-0.968***	-0.164	-0.978***	0.079	-0.975***
	(5.868)	(0.000)	(59.065)	(0.000)	(82.263)	(0.000)
Flow	0.000*	0.000**	0.000	0.000**	0.000	0.000**
	(0.092)	(0.024)	(0.168)	(0.017)	(0.240)	(0.022)
Mgmt. Fee	0.684***	1.232***	0.694***	1.246***	0.691***	1.223***
	(0.009)	(0.000)	(0.014)	(0.000)	(0.033)	(0.000)
Expense Ratio	0.012	-0.947***	0.034	-0.953***	0.016	-0.931***
	(0.925)	(0.000)	(0.796)	(0.000)	(0.901)	(0.000)
Turnover	0.046	-0.034	0.036	-0.031	0.032	-0.029
	(0.411)	(0.106)	(0.534)	(0.140)	(0.596)	(0.184)
Observations	168,746	765,967	158,600	754,657	148,826	743,347
Adj. R2	0.33	0.19	0.34	0.19	0.34	0.19
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fund Style x Year_Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 8

Size Subsample Test: Fund Future Flow Regressions for Regulatory Action Firms

This table reports results of the panel regressions of two subsamples based on median size ($247.51 million) between 2000Q1 and 2021Q$. future fund flow (*Flow_t+1...Flow_t+15*, monthly fund flows over the next 15-month period). The dependent variable is the net flow of the fund from month *t+1* (*Flow_t+1*) to month *t+15* (*Flow_t+15*). DIS_reg is an indicator variable set to 1 if a regulatory action is initiated against fund. Control variables are identical to those in Table 3. Refer to Appendix B for detailed variable definitions. Standard errors are double clustered by fund and year_month, with t-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

	Size <= Median	*Size > Median*	*Size <= Median*	*Size > Median*	*Size <= Median*	*Size > Median*
	t+2	***t+2***	***t+3***	***t+3***	***t+6***	***t+6***
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
DIS_reg	-0.492**	-0.294***	-0.229	-0.273***	-0.385	-0.229**
	(0.013)	(0.001)	(0.105)	(0.002)	(0.109)	(0.012)
Log AUM	-0.462***	-0.327***	-0.465***	-0.327***	-0.467***	-0.329***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-0.754***	-1.273***	-0.765***	-1.315***	-0.872***	-1.396***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Flow	0.000***	0.000*	0.000***	0.000*	0.000***	0.000*
	(0.003)	(0.081)	(0.006)	(0.082)	(0.008)	(0.082)
Mgmt. Fee	0.754***	1.983***	0.763***	1.981***	0.796***	1.961***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Expense Ratio	-0.142*	-1.443***	-0.148*	-1.433***	-0.178**	-1.417***
	(0.093)	(0.000)	(0.081)	(0.000)	(0.039)	(0.000)
Turnover	0.054**	-0.069***	0.054**	-0.072***	0.060**	-0.077***
	(0.047)	(0.007)	(0.048)	(0.004)	(0.034)	(0.002)
Observations	364,441	621,164	360,750	617,406	349,853	606,169
Adj. R2	0.22	0.24	0.22	0.24	0.22	0.24
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fund Style x Year_Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 8. Size Subsample Test: Fund Future Flow Regressions for Regulatory Action Firms, Conditioning on Fund Manager Skill (Cont'd)

	Size <= Median	*Size > Median*	*Size <= Median*	*Size > Median*	*Size <= Median*	*Size > Median*
	t+9	***t+9***	***t+12***	***t+12***	***t+15***	***t+15***
	(7)	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
DIS_reg	-0.314**	-0.203***	-0.448***	-0.154*	-0.344**	-0.179**
	(0.048)	(0.006)	(0.008)	(0.086)	(0.026)	(0.029)
Log AUM	-0.468***	-0.332***	-0.465***	-0.329***	-0.459***	-0.324***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-0.803***	-1.437***	-0.755***	-1.465***	-0.727***	-1.510***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Flow	0.000***	0.000*	0.000***	0.000	0.000**	0.000
	(0.007)	(0.070)	(0.004)	(0.127)	(0.013)	(0.139)
Mgm_Fee	0.828***	1.930***	0.851***	1.955***	0.848***	1.946***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Expense_Ratio	-0.185**	-1.392***	-0.187**	-1.410***	-0.183**	-1.403***
	(0.033)	(0.000)	(0.033)	(0.000)	(0.036)	(0.000)
Turnover	0.061**	-0.078***	0.062**	-0.079***	0.067**	-0.080***
	(0.035)	(0.002)	(0.036)	(0.002)	(0.028)	(0.001)
Observations	339,219	595,000	328,905	583,894	318,912	572,836
Adj. R2	0.22	0.24	0.23	0.24	0.23	0.24
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fund Style x Year_Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 9

Fund Future Monthly Flow Regressions for Matched Firms that have Regulatory Actions (Falsification Test)

This table reports results of the panel regressions of past fund flow (Flow_t-1...Flow_t-6, monthly fund flows over the previous 6-month period) between 2000Q1 and 2021Q4. The dependent variable is the net flow of the fund from month t+1 (Flow_t+1) to month t+15 (Flow_t+15). DIS_reg is an indicator variable set to 1 if a regulatory action is initiated against fund. Control variables are identical to those in Table 3. Refer to Appendix B for detailed variable definitions. Standard errors are double clustered by fund and year_month, with t-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

	t	*t-1*	*t-2*	*t-3*	*t-6*	*t-9*	*t-12*	*t-15*
DIS_reg	0.150	-0.137	-0.059	0.025	0.028	-0.064	-0.080	-0.063
	(0.127)	(0.144)	(0.574)	(0.792)	(0.722)	(0.689)	(0.420)	(0.725)
Log AUM	-0.003***	-0.003***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-0.007***	-0.007***	-0.009***	-0.007***	-0.009***	-0.009***	-0.009***	-0.009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Flow	0.000*	0.000*	0.000***	0.000*	0.000***	0.000***	0.000***	0.000***
	(0.065)	(0.062)	(0.008)	(0.059)	(0.009)	(0.008)	(0.009)	(0.008)
Mgm_Fee	0.011***	0.011***	0.011***	0.012***	0.011***	0.011***	0.011***	0.011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Expense_Ratio	-0.765***	-0.877***	-0.840***	-1.073***	-1.061***	-1.217***	-1.348***	-1.359***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Turnover	0.000	0.000	0.000	0.000*	0.000	0.000*	0.000**	0.000**
	(0.192)	(0.122)	(0.301)	(0.065)	(0.131)	(0.050)	(0.029)	(0.030)
Observations	986,174	978,717	971,290	963893	949,246	927,519	906,179	885,238
Adj. R2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund Style x Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table IA.1

Table IA.1. Fund Future Monthly Flow Regressions for Matched Firms that have Regulatory Actions including past performance

This table reports results of the panel regressions of future fund flow (Flow_t+1...Flow_t+15, monthly fund flows over the next 15-month period) of treatment and control groups between 2000Q1 and 2021Q4. The dependent variable is the net flow of the fund from month t+1 (Flow_t+1) to month t+15 (Flow_t+15). DIS_reg is an indicator variable set to 1 if a regulatory action is initiated against fund. Control variables are identical to those in Table 3. Refer to Appendix B for detailed variable definitions. Standard errors are double clustered by fund and year_month, with t-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

	t+1	***t+2***	***t+3***	***t+6***	***t+9***	***t+12***	***t+15***
DIS_reg	0.221	-0.264***	-0.198**	-0.203**	-0.188***	-0.144*	-0.181**
	(0.193)	(0.005)	(0.017)	(0.029)	(0.007)	(0.065)	(0.013)
Return_5yr	0.433***	0.433***	0.429***	0.435***	0.428***	0.421***	0.423***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log AUM	-0.315***	-0.315***	-0.315***	-0.317***	-0.322***	-0.322***	-0.320***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-1.170***	-1.170***	-1.205***	-1.262***	-1.286***	-1.274***	-1.309***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Flow	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.143)	(0.145)	(0.149)	(0.154)	(0.170)	(0.157)	(0.146)
Mgmt. Fee	0.998***	0.997***	0.997***	1.006***	1.012***	1.031***	1.009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Exp. Ratio	-0.763***	-0.762***	-0.759***	-0.756***	-0.750***	-0.760***	-0.746***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Turn. Ratio	-0.024	-0.024	-0.026	-0.029	-0.030	-0.032	-0.031
	(0.285)	(0.286)	(0.245)	(0.196)	(0.175)	(0.149)	(0.168)
Observations	544,585	544,585	542,009	534,282	526,557	518,835	511,113
Adj. R2	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund Style x Yr_Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table IA.2

Table IA.2. Fund Future Monthly Flow Regressions for Matched Firms that have Regulatory Actions for Older Firms

This table reports results of the panel regressions of future fund flow (*Flow_t+1...Flow_t+15*, monthly fund flows over the next 15-month period) of treatment and control groups between 2000Q1 and 2021Q4. The subsample is filtered by the age and only older firms (older than median age, 11 years) are selected. The dependent variable is the net flow of the fund from month *t+1* (*Flow_t+1) to month t+15* (*Flow_t+15). DIS_reg* is an indicator variable set to 1 if a regulatory action is initiated against fund. Control variables are identical to those in Table 3. Refer to Appendix B for detailed variable definitions. Standard errors are double clustered by fund and year_month, with *t*-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

	Age > Median Age						
	t+1	***t+2***	***t+3***	***t+6***	***t+9***	***t+12***	***t+15***
DIS_reg	0.236	-0.233***	-0.174**	-0.141*	-0.157**	-0.105	-0.152**
	(0.189)	(0.008)	(0.026)	(0.092)	(0.035)	(0.179)	(0.035)
Log AUM	-0.322***	-0.322***	-0.324***	-0.329***	-0.333***	-0.334***	-0.332***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-1.157***	-1.157***	-1.165***	-1.194***	-1.160***	-1.135***	-1.143***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Flow	0.000	0.000	0.000	0.000	0.000	0.000*	0.000*
	(0.103)	(0.104)	(0.107)	(0.112)	(0.106)	(0.093)	(0.082)
Mgmt. Fee	1.193***	1.192***	1.189***	1.195***	1.198***	1.212***	1.183***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Expense Ratio	-1.017***	-1.016***	-1.010***	-1.011***	-1.012***	-1.018***	-1.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Turnover	-0.043*	-0.043*	-0.045*	-0.048*	-0.048*	-0.048*	-0.044*
	(0.084)	(0.084)	(0.069)	(0.052)	(0.050)	(0.050)	(0.076)
Observations	517,974	517,974	515,700	508,878	502,056	495,234	488,412
Adj. R2	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund Style x Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table IA.3

Fund Future Monthly Flow Regressions for Matched Firms that have Regulatory Actions for Larger Firms

This table reports results of the panel regressions of future fund flow (*Flow_t+1...Flow_t+15*, monthly fund flows over the next 15-month period) of treatment and control groups between 2000Q1 and 2021Q4. The subsample is filtered by the fund size and only big firms (bigger than median size, $247.51 million) are selected. The dependent variable is the net flow of the fund from month *t+1* (*Flow_t+1*) to month *t+15* (*Flow_t+15*). DIS_reg is an indicator variable set to 1 if a regulatory action is initiated against fund. Control variables are identical to those in Table 3. Refer to Appendix B for detailed variable definitions. Standard errors are double clustered by fund and year_month, with t-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

	Size > Median Size						
	t+1	***t+2***	***t+3***	***t+6***	***t+9***	***t+12***	***t+15***
DIS_reg	0.160	-0.301***	-0.272***	-0.254***	-0.211***	-0.146	-0.201**
	(0.110)	(0.001)	(0.002)	(0.004)	(0.005)	(0.105)	(0.011)
Log AUM	-0.281***	-0.280***	-0.280***	-0.284***	-0.288***	-0.287***	-0.284***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-1.608***	-1.608***	-1.681***	-1.791***	-1.896***	-1.885***	-1.887***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Flow	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.324)	(0.326)	(0.327)	(0.331)	(0.215)	(0.216)	(0.214)
Mgmt. Fee	1.708***	1.706***	1.704***	1.719***	1.709***	1.754***	1.766***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Expense Ratio	-1.323***	-1.321***	-1.310***	-1.317***	-1.300***	-1.321***	-1.334***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Turnover	-0.061**	-0.061**	-0.064**	-0.068**	-0.070***	-0.072***	-0.075***
	(0.025)	(0.026)	(0.018)	(0.012)	(0.009)	(0.007)	(0.005)
Observations	401,914	401,914	400,142	394,826	389,510	384,194	378,878
Adj. R2	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund Style x Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Chapter III: Capital Raise in Private Funds and Investor Trust

1. Introduction

Capital formation through private placements has been increasing substantially since the 2008 financial crisis and capital raised through private offerings have outpaced the capital raised through registered securities, totaling more than $3.0 trillion in 2017 (Bauguess, Gullapalli, Ivanov 2018). However, research on private funds has been limited due to these funds' secretive practices and lack of transparency as they do not have to share their performance and financial statements publicly. One interesting topic is the capital raising process of private funds and how investors' trust plays a role for investment decision making. For example, a recent survey from the Alternative Investment Management Association shows that capital raise is consistently among the top two challenges for hedge fund managers regardless of location and fund size (AIMA, 2021). On the other hand, a study conducted by CFA Institute reveals that trust is an important factor in investor's decision making for both individual and institutional investors (CFA Institute, 2022).

In this paper, I investigate the role of investor trust in the private fund's capital raise process such as total amounts raised, number of investors, and share allocation among sophisticated and foreign investors. Investor trust in the capital raise process is affected by various third party service providers and by financial misconduct committed by investment advisors. Certain types of third party providers such as auditors and financial bookkeepers should enhance investor trust while disciplinary actions resulting from financial misconduct should deteriorate it, hence cause less capital raise and ownership. On the other hand, it is unclear whether third party Marketers can help boost invest trust, and the relationship between private fund capital raise and marketers has not been investigated in the literature.

Capital raising for private funds is a long and exhausting process and can take months or even years (Timmons and Sander, 1989). There are regulatory and organizational considerations about how to raise capital and organize private funds during their active years. Fund managers can try to raise capital through their own network and self-marketing or by hiring third party marketers. Depending on the private fund structure, fund managers are also allowed to conduct general solicitation that allows fund managers to use public marketing sources such as media and mass communication systems. Additionally, they can hire external and trusted auditors and bookkeepers to gain investors' trust. Furthermore, fund managers must follow regulatory requirements to collect capital legally from investors. For example, they must register as investment advisers before accepting investors' capital and they need to inform investors about their disciplinary action history via required documents and filings. My goal is to investigate how these providers and actions from fund managers affect the initial and ongoing capital raise and understand how investors' trust plays a role in the process.

I construct a sample of private funds over the period 2013-2021. I gather adviser information from the Securities Exchange Commission's (SEC) Form ADV, a mandatory form that must be filed by all types of investment advisers in the US. Fund managers and their firms must register as an investment adviser with the SEC to accept and manage investors' assets based on two types of adviser registration. Registered Investment Adviser (RIA) registration allows advisory firms and individuals to manage public funds such as mutual funds. Additionally, RIAs can have multiple fund structures to manage other advisory services such as hiring other managers, financial planning services and providing research and other investment related materials. On the other hand, Exempt Reporting Adviser (ERA) authorizes firms and individuals to manage private funds such as hedge funds, private equities, and venture capital funds. ERA registration is a form of exempt registration that is allowed when a fund manager manages only private funds. Compared to public funds, private funds have different characteristics in terms of fund structure, investor types, investment horizons, liquidity, and investment strategies. My sample covers only ERA registered managers because of two main reasons. First, ERA registration is allowed only if a fund manager manages private funds as their sole advisory business. This ensures that disciplinary actions will be directly related to the private fund practices of the fund managers rather than their other advisory services. Second, ERA fund managers must submit their initial ADV forms and state their funds' total assets, and whether they used a marketer in 60 days[7]. This gives me a unique opportunity to observe the effects of third party services on the initial capital raise, since asset amounts disclosed by funds managers in their first registration filings are the initial capital raised (and do not include return on investments) due to private funds' illiquidity and long-term investments.

The third party providers I consider include marketers, auditors and bookkeepers. Marketers help raise capital from investors, auditors inspect funds' financial accounts to ensure they comply with the law, and bookkeepers (books and record holders) are third party firms that keep funds' financial documents. I examine the effects of providers and activities that can potentially improve investors trust such as auditors, bookkeepers, and foreign registration as well as the disciplinary actions that might cause a reduction in investor trust. Additionally, I analyze

[7] General Instructions, Section 13: "*I am an exempt reporting adviser. When must I submit my first report on Form ADV?"* https://www.sec.gov/about/forms/formadv-instructions.pdf *(last accessed May 18,2023)*

how fund raising is affected by general solicitation and marketers whose impact on investor trust has not been studied in the private investment literature.

The misconduct literature documents negative outcomes of adviser misconduct both in public and private markets. Mutual funds' performance and investor flow decrease after the financial misconduct (Celik and Dong 2023; Liang, Sun, and Wu 2020). Hedge funds with misconduct history are less profitable and have high operational risk (Brown set al. 2009). Furthermore, the literature provides the potential outcomes of ownership and third party service providers on financial markets. For example, marketing generates larger day-one returns of IPOs (Gustafson et al., 2021) and increase capital raise of mutual funds (Roussanov et al., 2021). Investors demand better infrastructure and marketing from the private fund managers (Ernst and Young, 2020). I hypothesize that adviser disciplinary actions will negatively affect private funds' manager reputation and investor trust and therefore these actions will cause reductions in number of investors, capital raise and investor ownership as a shareholder. On the other hand, using third party auditors and bookkeepers can be helpful to gain investors' trust and increase capital raise amounts and ownership. Finally, third party marketers can be beneficial for investor value in private funds by increasing the number of investors and capital raise although their effect on trust is hard to determine a priori. To observe these effects, I empirically test whether misconduct and using third party providers lead to a change in capital raise and investor ownership.

I first examine the effects of the third party service providers on capital raise. Specifically, I observe the effects of marketers, auditors and bookkeepers on initial amounts of capital raised, number of investors, percentage of ownership changes of sophisticated (through funds-of-funds investors) and foreign investors by analyzing initial fund documents. Second, I investigate fund ownership by analyzing changes in the number of investors, proportional asset change and total assets over private funds' lifespan. Private funds are typically formed as partnerships and have long lock-up periods that restrict investors from selling their shares. Moreover, these funds heavily invest in private companies, real estate and provide private debt that make private fund investments extremely illiquid and long-term. That is why existing investors have less incentive (and no option in some cases due to redemption penalties) to sell their shares until the liquidation period of the private funds. Consequently, new investors are expected to become shareholders and existing investors are not expected to sell their shares. Hence, changes in the number of investors and assets managed should capture the effects of the third party providers through the years until a fund's liquidation. I define *marketer/auditor/books* that is set to 1 if a private fund has used these services before raising capital in a year. The decision on whether to use a third party provider decision is always made before the actual capital raise as fund managers must report the use of these providers and compensation arrangements in their initial fund registrations before raising capital and update annually.[8]

I find that using marketers increases the number of investors during the initial capital raise period. However, this increase does not reflect the overall capital raise amounts. Fund managers that use third party marketers have raised 37.94% less than the ones that raise by their own efforts. This corresponds to a loss of $27.91 million per capital raise to a fund with an average capital raise amount of $73.57 million in my sample. These effects are robust for controlling fund characteristics and fixed effects such as fund type, date, and location. One concern is that a fund is more likely to bring in an external marketer when they anticipate having a harder time raising funds and having a marketer is not completely exogenous. To address this, I performed propensity

[8] Final Rule: Investment Adviser Marketing https://www.sec.gov/rules/final/2020/ia-5653.pdf *(last accessed May 18,2023)*

score matching and subsample analysis based on fund types, fund size, fund age and investor size. The results are robust and consistent with the main findings. Additionally, general advertising causes less amount raised leading to a decline of 17.39% or $12.79 million per fund. Moreover, sophisticated investors invest less when fund managers use marketers. They tend to have 1.8% less shares as fund shareholders when there is an active third party marketer. This means marketers might be effective to bring small and less-sophisticated investors. However, these results show that marketers do not add value even though they bring more investors in private funds. One potential reason can be investor trust: investors prefer fund managers to present their investment strategies and marketing materials rather than being approached by third party marketers. Further analysis of the use of ongoing marketers during the active years also does not provide any evidence of the marketers' help for capital raise. Marketers bring more investors, however total assets managed and proportional change in assets do not seem to benefit from the presence of these providers. Subsample tests containing size, age, investor and fund types also support these findings. In contrast, auditors have a positive effect on capital raise, number of investors and sophisticated investors ownership. Managers that use auditors raise 95.42% more capital, bring 58.57% more investors, and have 5.50% more sophisticated investors in their funds. Managers that use bookkeepers can raise more capital (48.14%), however, these providers do not affect the number of investors and sophisticated ownership. Overall, private fund managers do not benefit from using third party marketers. On the contrary, providers that help regulate funds help raise more capital from investors. This evidence shows that providers that enhance investor trust impact positively on the capital raise and investors trust, and investors invest more when fund managers are actively involved in marketing activities.

Second, I analyze the disciplinary actions' effects on the number of investors, total capital managed and ownership. These analyses are conducted separately from the service providers. Since undocumented regression analyses (such as interactions between providers and disciplinary actions, and propensity matching) do not provide any relation between the actions and service providers. These analyses also decrease the number of observations as only 1-2% of managers have such action history. There are three types of disciplinary actions. Civil actions are civil lawsuits initiated by private plaintiffs, SEC/State, or district attorneys, and criminal actions are felony and misdemeanor charges initiated by governmental authorities. Regulatory actions are monetary and/or disciplinary penalties initiated by the SEC and state regulatory authorities.[9] I capture the effect of disciplinary action by defining an indicator variable DIS that is set to 1 if there is an action in a year before a capital raise. Then, I observe both short- and long-term effects of these actions on the capital raise, ownership. I find that criminal actions have both short- and long-term effects on the number of investors and total capital managed. Number of investors decreases by 3.8% in the first year, 2.5% in the second and 0.6% in the third year. Moreover, the total capital managed drops by 16.5% in the first year, 7.5% in the second year and 6.7% in the third year. Moreover, criminal actions decrease overall investor share ownership. Among investor groups, sophisticated investors tend to decrease their shares while foreign investors' shares increase. This can be due to foreign investors not having adequate access to the resources to recognize such actions or locational restrictions. On the other hand, regulatory and civil actions do not have any effect on the investor decision making and total capital managed. These results give support to my

[9] In the second chapter, criminal actions are not included due to lack of cases specific to mutual funds. For this chapter, criminal actions are included because fund managers and investors have close relationships due to fund partnership structure. Private funds are small partnerships and managers and investors have closer relationships compared to mutual funds. Thus, any action against fund managers would be expected to affect investors regardless of the action type.

second hypothesis that disciplinary actions affect capital managed and ownership as a result of investors losing trust, although the effect depends on the action type.

Existing literature highlights financial misconduct and its effects on corporate and fund operations of financial firms. Investors who ignore public funds with history avoid potential next frauds and face less losses (Dimmock et al., 2018). Investors who experienced frauds tend to withdraw assets from investment advisers and increase deposits at banks (Gurun et al., 2018). Additionally, mutual fund performance and investor flow decrease after a financial misconduct (Celik and Dong, 2023; Wu et al., 2020). Hedge funds face lower returns and higher operational risk following adviser misconduct (Brown et al., 2009). Finally, consumer sophistication affects household investing behaviors and decisions (e.g., Gennaioli, Shleifer and Vishny 2015; Guiso, Sapienza, and Zingales 2008; Gurun, Stoffman, Yonker 2018; Merkoulova and Veld 2022).

Prior literature also highlights the roles of third party service providers, fund ownership structures and investor sophistication in both public and private funds. For example, Denis, Denis, and Sarin (1997) found that higher insider ownership by General Partners (GP) of funds increases investor interest in those funds. Investor sophistication and location can play a role in processing financial information and monitoring fund managers. For instance, sophisticated investors such as funds-of-funds are better in processing the information, monitoring managers, and accessing inside information from managers (Rajgopal and Venkatachalam 1997; Ramalingegowda and Yu 2012; Gao, Haight, and Yin 2020; Gaver et al. 2020). Foreign investors might have limited control because of their distance from fund managers, and other cultural and political limitations (Ayers, Ramalingegowda, and Yeung 2011; Gao, Wong, Xia, and Yu 2013). On the other hand, fund administrators can be helpful to meet investor demands for transparency (NES Financial 2020) and firms that allocates more resources to their administrative reporting services have high reporting quality (Abramova, Gillette, and Weber 2021; Lee and Yu 2021). Marketing increases IPO underpricing (Gustafson, Henry, Kim, and Pisciotta, 2021) and contributes more investor capital to mutual funds (Roussanov, Ruan, and Wei 2021). Finally, Easton et al. (2022) shows that investors affect reporting quality disclosed by private equity funds and NAV accuracy varies with auditor involvement and the use of third-party service providers.

This paper makes several contributions to the literature. First, I extend the literature on how third party service providers affect capital raise and ownership of private funds. My evidence shows that marketers do not add value in terms of total capital raised amounts even though they are able to bring more investors to private funds. This shows that investors do not trust third party marketers and demand fund managers to be involved in the marketing process. On the other hand, providers that regulate private funds' financials enhance investors' trust resulting in capital raise increase and ownership. Second, I add to the literature by documenting the effects of financial misconduct on private funds. Disciplinary actions resulting from adviser misconduct cause changes in total capital managed and investor ownership. The change depends on the disciplinary action type similar to the prior literature that investigates mutual fund industry investor flow (Celik and Dong, 2023). For example, sophisticated ownership and total capital managed decline after the private funds receive criminal actions, suggesting that investors lose trust and try to distance themselves following such actions. Overall, I document how investor trust plays a crucial role in investment decision making in the private fund industry.

2 Data

The main data source for this chapter is the U.S. Security Exchange Commission's (the SEC) Investment Advisor Public Disclosure (IAPD) website. The website provides investors with search tools for individual registered adviser representatives and registered investment adviser firms. Additionally, this website provides information about Exempt Reporting Advisors (ERA) which is the focus of this chapter. The ERA registration was initiated by the SEC in 2012 with the Dodd-Frank Act[10]. The ERAs are not technically required to register as advisers as defined in the US Investment Advisers Act with the SEC and/or State Regulatory Authorities. However, they still must pay the related fees and report public information by filing a specific form called Form ADV via the IAPD system. There are three exemptions to register as an exempt reporting advisor. Registrants can be eligible for one or multiple of these exemptions. These exemptions are:

- Qualification for the exemption from registration due to being an advisor solely to one or more venture capital funds,
- Qualification for the exemption from registration due to being advisor solely to private funds and having assets under management of less than $150 million in the United States,
- Qualification for the exemption due to acting as an adviser solely to private funds but no longer eligible to qualify the previous exemption, due to having assets under management of $150 million or more in the United States.[11]

According to the SEC, Form ADV is a mandatory form that must be filed annually within 90 days following the end of the firm's fiscal year. Additionally, if there is an important change such as new registration, adding/removing a relying adviser or information change in specific section, advisory firms must amend their updated Form ADVs immediately after the change happens (see

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[10] Implementing the Dodd-Frank Wall Street Reform and Consumer Protection Act, https://www.sec.gov/spotlight/dodd-frank-act (*last accessed January 12, 2023)*

[11] Form ADV, https://www.sec.gov/about/forms/formadv-part1a.pdf *(last accessed December 19, 2022)*

Appendix A for the SEC requirements, specifically for disciplinary actions). The sample period is from January 2013 which is the first available date for ERAs to register (followed by the Dodd-Frank Act) to December 2021.

Disciplinary action information is among the specific sections mentioned in the SEC's general Form ADV instructions.[12] Thus, adviser firms must update their disciplinary action history annually and immediately after a change. I collected disciplinary actions from Part 1 of the Form ADV of each registered ERA firm. The data contains information of filing and action initiation dates, firms' and/or their affiliates' involvement, action initiator, sanction types, resolutions, final decisions, court information, and penalty types.

There are three disciplinary action classifications: Regulatory, Civil and Criminal (See Appendix I for details and additional information of each action type.). Regulatory actions are taken against the adviser firms by the SEC or states' regulatory authorities. These actions can be monetary and/or disciplinary penalties such as censures, bars, and suspensions. These actions are usually resolved without lawsuit initiations. Civil actions are private lawsuits that are filed against the advisory firms. These lawsuits can be filed by the SEC, state regulatory authorities, investors, or any other private plaintiffs. Similar to the Regulatory actions, Civil actions are concluded with monetary and/or disciplinary penalties. Criminal actions are lawsuits filed by the state and can include any kind of offense and consist of two main criminal classifications: misdemeanor and felony. The SEC requires thresholds for investors to be eligible for private fund investments and classify investors as sophisticated (or Accredited) based on these thresholds. For individuals, there are two criteria to be eligible as an accredited investor and thus invest in private investments.

[12] General Instructions, Section 4: "*When am I required to update my Form ADV?*" https://www.sec.gov/about/forms/formadv-instructions.pdf *(last accessed November 11,2022)*

Firstly, an investor can be accredited if their net worth is over $1 million, excluding their primary residence (individually or with spouse or partner). Moreover, the investors can have an income more than $200,000 individually or $300,000 with spouse or partner in each of the prior two years, and reasonable expects the same for the current year.[13] The second criterion is professional credentials. Investors can be eligible to invest in alternatives if they have professional licenses such as Series 7, Series 65 or Series 82, if they are directors, executive officers or general partners of the company selling the securities, if they are family client or family offices and lastly if they are "knowledgeable" employees of the private investment funds. I hypothesize that these sophisticated investors have direct access to the private fund managers and can react accordingly to any type of action including criminal charges once they are initiated.

I derived key variables from the Form ADVs for exempt reporting advisers to perform the analysis. The first set of variables are defined as third party marketers, auditors, and bookkeepers involved in the capital raise process. Specifically, these variables identify whether a firm uses other companies for marketing, financial auditing, and bookkeeping (*marketing, audit, books)*. My focus is to observe the marketers' effects; however, auditors and bookkeepers will also give an opportunity to observe whether investors value these providers as a sign of trust. Furthermore, I add another set of variables to analyze whether some other trust-related activities such as general solicitation and foreign registration affect the capital raise process. General solicitation shows whether a fund solicits its clients publicly while foreign registration is defined as whether a fund is registered with a foreign authority other than the SEC (*solicitation*, *foreign)*. For each of these

[13] https://www.sec.gov/education/capitalraising/building-blocks/accredited-investor#:~:text=Financial%20Criteria,same%20for%20the%20current%20year (*last accessed December 19, 2022)*

variables, I defined indicators that show whether a third party, solicitation or foreign registration is involved in a year as 1, 0 otherwise.

The second set of key variables defines the number of disciplinary actions for civil, criminal and regulatory actions. For each action type, I defined indicators that show whether an action is initiated in a year as 1 (*DIS_reg* = 1, *DIS_civil* = 1, *Dis_criminal* = 1), 0 otherwise.

The third set of variables, the dependent variables, are defined as the initial capital raised amount (*CR),* number of investors invested (*owners),* the annual proportional asset change (*NAC),* sophisticated investor ownership percentage (*funds_ownr)* and foreign investor ownership percentage (*foreign_ownr)* for each fund. *CR* is defined only for the initial raise period, while *NAC* is used for ongoing fund analysis during funds' lifespan. *Owners, fund_ownr* and *foreign_ownr* are calculated separately for both the initial capital raise and through the active years of funds (See Appendix II for detailed variable definition).

3 Results

3.1 Summary Statistics

Table 1 shows the summary statistics of exempt reporting advisers over the sample period from January 2013 to December 2021. There are 8,446 firms with an average age of 3.56 years. 99.48% of the firms have already established adviser relationship with their private funds with 2.50% of these firms manage more than $1 billion assets. As mentioned in the Data section, ERAs need to qualify for one of the three exemptions to be eligible for ERA registration. 25.79% of the firms use venture capital exemption which the adviser firms solely manage these types of private funds. On the other hand, 88.48% qualify for exemption by managing solely private funds with less than

$150 million assets under management while 8.95% manage more than $150 million assets and qualify for the last exemption. Panel B includes the initial capital raise period. There are 37,230 funds formed by ERAs with an average of $73.57 million raised in the initial period. The average number of investors invested is 28.02 while the minimum investment amount required is $1.25 million and the average invested amount per investor is $7.96 million. Funds-of-funds investor percentage ownership is 9.33% and funds that successfully raised capital are 94.99% in the sample. Among private funds, 13.54% are hedge funds while private equity, venture capital and other private funds are 28.02%, 47.97% and 10.47% respectively. Finally, funds that use third party marketers are 26.24% in the sample. For funds' lifespan, the average fund age is 2.92 years, and the average number of investors is 34.42. Total assets managed is 89.32$ million with 10% percent average change in assets (NAC).

Table 2 reports the types and details of the disciplinary actions against the adviser firms (See Appendix I for more information of the action classifications). *Adviser Lifespan* column shows the percentage of firms that face any disciplinary action throughout the firms' lifespan, while *Latest Filing* includes percentages based on adviser firms' latest filing. The difference between these two columns is that firms must include any finalized or pending disciplinary action for ten-year period after the initiation or finalization date (in their *Latest Filings)* while *Adviser Lifespan* shows all disciplinary action history throughout a firm's existence. Firms have higher criminal felony cases than misdemeanor with 0.47% conviction and 1.20% pending felony charges. For Civil Judicial actions, violations of investment related regulations are the highest type that firms face and 0.93% of Civil Judicial cases are pending. There are four main organizational types of regulatory actions against the adviser firms. For actions initiated by Commodity Futures Trading Commission (CFTC), violation of regulations and orders against the advisory firms are the highest with 1.96%

and 1.88% respectively. For actions initiated by the federal, state or foreign authorities and self-regulatory organizations or commodities exchanges, same actions (violation of regulations and orders against) share the highest percentages against the firms. In summary, the percentage of total number of criminal, civil judicial and regulatory actions against the adviser firms are 0.09%, 0.61% and 4.98% respectively.

3.2 Initial Capital Raise

Private fund managers can either use their own resources to raise capital through their networks and their own advertising efforts or hire a third party marketer to help raise capital from investors. Fund managers and marketers can have different compensation agreements such as fixed fees, success-based percentage fees and carried interest which depends on the fund performance. Alternatively, managers can set their funds in compliance with regulations that allow them to advertise their funds publicly. They can also hire other third party providers such as external financial auditors, books and records holders and register with foreign authorities to gain investor trust.

The core variables, marketing, audit, books, are indicators that are set to 1 if a private fund used one of these services before the capital raise process. Additionally, I included three more variables to control other effects on the capital raise. These variables are foreign (whether a fund is also registered with a foreign authority in addition to the US registration), solicit (whether investors were solicited publicly) and minimum investment amount (minimum dollar amount required to participate).

Figure 1 shows the differences of initial capital raise, number of investors initially invested, percentage of sophisticated investors and percentage of foreign investors between the private funds when they use third party marketers and those without the marketers. Figure 1 shows some interesting results for the initial capital raise. For example, funds that do not use marketers raised more capital on average than the ones that use these providers. On the other hand, funds with marketers seem to have more investors. However, sophisticated investors tend to have less ownership when there is an active third-party marketer. Finally, foreign ownership does not appear to change regardless of the presence of the marketers.

While Figure 1 provides a first test of the differences for funds that use and those do not use third party providers, there needs to be additional controls for observable and unobservable differences in the funds. That is why I introduced a combination of fund type, year, and state fixed effects to help control these observable and unobservable variables. I also control fund characteristics such as size for additional analysis. I also add other third party providers such as auditors and bookkeepers to ensure other omitted variables do not cause false analysis. The first set of regressions are:

$$R\_var_i = \alpha + \beta_1 marketer_i + \beta_2 auditor_i + \beta_3 books_i + \beta_4 solicit_i + \beta_5 foreign_i + \beta_6 \log(\text{min \_investment})_i + \delta_{i,fund\_type} + \varphi_{i,year} + \gamma_{i,state} + \varepsilon_{i,t}, \quad (1)$$

where R_var_i is one of the *log(CR), log(owners), funds_ownr* and *foreign_ownr*. *Log(CR)* is the log of total capital raised amount, *log(owners)* is the total number of investors invested, *funds_ownr* is the percentage of shares held by sophisticated investors and *foreign_ownr* is the percentage of shares held by foreign investors for fund *i*. $marketers_i$ $auditor_i$, $books_i$ are indicator variables equal to one whether fund manager used those providers for the capital raise of fund i. $foreign_i$ is an indicator variable equal to one when fund *i* is registered with a foreign authority. $solicit_i$ is an indicator that shows whether fund manager uses general solicitation to market the private fund i. $\delta_{i,fund\_type} + \varphi_{i,year} + \gamma_{i,state}$ indicates fund type, year, and state fixed effects. Additional control variables are added to ensure that the results are not due to other causes such as fund size (*log(min_investment))*.

Table 3 shows that third party marketers have significant effects on the initial capital raising of private funds. Using third party marketers increases the number of investors by 40%. However, this increase is not observed in the total capital raised. Surprisingly, managers that raise capital with marketers help raise less money compared to the ones that do not use such services. The decline is 37.94%. In terms of economic magnitude, funds with marketers raise $27.91 million less with an average size of $73.57 million in the sample. I also observe that sophisticated ownership declines by 1.8% when the marketers are involved in the capital raise process. On the other hand, auditors seem to help raise more capital. Managers that use auditors are able to raise more capital (95.42%), have a greater number of investors (58.57%) and more sophisticated ownership (5.5%) compared to funds that do not have auditors. Interestingly, having auditors does not have any effect on foreign ownership. One potential reason could be that managers are subject to less regulations for foreign investors and in some cases do not need to provide adequate information to foreign investors. That might be a reason that auditors do not have a significant effect on foreign investors. Bookkeepers also help raise more capital by 48.14%, however, the number of investors is not affected. Finally, general solicitation has a negative effect on the capital raised amounts, causing a decline of 17.39%.

These results show that using third party marketers and public advertising have negative effects on the total capital raise for private funds. On the other hand, using auditors and bookkeepers increases the value of the raise. This indicates that investor trust plays an important role in investment decision making as investors prefer funds regulated by third parties but marketed by funds' managers.

3.3 Fund Lifespan

This section consists of two parts to observe potential effects of third party service provider involvements and disciplinary actions on capital raise process of the private funds. I examine total capital managed, proportional change in the managed amounts, number of investors and investor ownership when fund managers use third party marketers through the funds' active years along with auditors and bookkeepers. On the other hand, disciplinary actions might have negative effects on capital raise once initiated by the SEC, State Regulatory Authorities, and/or private plaintiffs. I observe the overall managed amounts and investor reaction after a disciplinary action is initiated.

3.3.1 Capital Raise and Third Party Providers

In the previous section, I showed that marketers negatively affect the overall capital raise amounts although they are able to bring more investors. Sophisticated investors also involve less when there is an active marketer. On the other hand, funds that use auditors and bookkeepers increased the total capital raised. In this section, I analyze these providers' role through the years when funds are actively managed. One caveat is that the total managed amounts include investor inflows, outflows and return on investment. Due to data limitation, I am not able to observe these effects. However, total assets managed should reflect the majority effect of the marketers and their ability to bring more investors and contribution to the total capital managed for various reasons. First, private funds are extremely illiquid and long-term investments. For example, a typical private equity or venture capital fund stays active for at least 5 years, because these funds invest in startups and private companies. These investments typically take years to capitalize investment returns at the end of funds' lifespan (liquidation period). Furthermore, private funds have long lock-up periods that prevent investors from withdrawing capital once the investors commit without a penalty. Finally, funds charge annual management fees and report their assets' fair market values. It is unlikely to report unrealistically higher or lower returns on investments because of annual management fees and the obligation of returning capital back to the investors. Building upon this, this section is complementary to the initial capital raise analysis.

Similar to the previous section I use marketers, auditors, bookkeepers, general solicitation and foreign registration as the core variables. These variables are set to 1 if a fund managers used one of the services during their funds' active years, 0 otherwise. Additionally, I included three more variables to control other effects on the capital raise. These variables are foreign (whether a fund is also registered with a foreign authority in addition to the US registration), solicit (whether investors were solicited publicly) and minimum investment amount (minimum dollar amount required to participate).

Figure 2 provides proportional asset change between funds that have marketers and ones without marketers. Additionally, Figure 2 shows proportional asset differences between funds with general solicitation and ones that do not use. Similar to the previous analysis, additional controls are added for observable and unobservable differences in the funds by adding a combination of fund type, year and state fixed effects and fund characteristics such as size and age. The panel regression is:

$$\begin{aligned} R\_var_{i,t+1} = \alpha &+ \beta_1 marketer_{i,t} + \beta_2 auditor_{i,t} + \beta_3 books_{i,t} \\ &+ \beta_4 solicit_{i,t} + \beta_5 foreign_{i,t} + \beta_6 \log(\text{min \_investment})_{i,t} \\ &+ \beta_6 \log(\text{AUM})_{i,t} + \beta_6 \log(\text{age})_{i,t} + \beta_6 Annual\ Audit_{i,t}\ \delta_{i,fund\_type} \\ &+ \varphi_{i,year} + \gamma_{i,state} + \varepsilon_{i,t}, \end{aligned} \tag{2}$$

where $R\_var_{i,t+1}$ is one of the future *log(CR), log(owners), funds_ownr* and *foreign_ownr*. *Log(CR)* is the log of total capital raised amount, *log(owners)* is the total number of investors invested, *funds_ownr* is the percentage of shares held by sophisticated investors and *foreign_ownr* is the percentage of shares held by foreign investors for fund *i* at year *t+1*. $marketers_i$ $auditor_i$, $books_i$ are indicator variables equal to one whether fund manager used those providers for the capital raise of fund *i*. $foreign_i$ is an indicator variable equal to one when fund *i* is registered with a foreign authority. $solicit_i$ is an indicator that shows whether fund manager uses general solicitation to market the private fund *i*. $\delta_{i,fund\_type} + \varphi_{i,year} + \gamma_{i,state}$ indicates fund type, year, and state fixed effects. Additional control variables are added to ensure that the results are not due to other causes such as fund size and age and annual audits (*Ln_AUM*, *Ln_Age*, *Annual Audit)*.

Table 4 provides similar results of marketers' effect on number of investors. Marketers are able to increase number of investors by 60%, however, there is no evidence that this contributes to the overall capital managed by the fund managers either positively or negatively. Again, this might be due to return on investments, yet these results support my initial analysis that marketers do not add value in terms of capital managed amounts. On the other hand, funds that use auditors are able to have more assets managed and experience number of investors in their funds. Funds with auditors grow their assets managed by 22.63% and have 5.02% more investors than ones do not have external auditors.

In summary, these results are in line with the initial capital raise that marketers seem not to bring value to private funds in terms of capital amounts. Moreover, funds that use auditors are better off in terms of increased assets managed and number of investors over the sample period.

3.3.2 Capital Raise and Disciplinary Actions

In this section, I observe the effects of disciplinary actions on private funds' total assets managed, number of investors and investor ownership. Figure 3 provides a first glance of the differences between funds that have faced disciplinary actions and those that have not. For each disciplinary action type (civil, criminal, regulatory), funds that do not have any action history appear to have a steady increase in capital raise over the years. On the other hand, funds that have an action history tend to have extremely volatile annual capital raise process. In this section, I analyze whether the disciplinary actions cause lower assets managed ratios or investor ownership.

To test whether an action affect the capital raise percentages, I modified the regression equation (2) by setting independent variable as disciplinary action by type:

$$R\_var_{i,t+1} = \alpha + \beta_1 DIS_t + \delta_{i,fund\_type} \times \theta_t + \varphi_{i,fund\_id} + \gamma_{i,state} + \varepsilon_{i,t}, \quad (3)$$

where $R\_var_{i,t+1}$ is one of the future *log(CR)*, *log(owners)*, *funds_ownr* and *foreign_ownr*. *Log(CR)* is the log of total capital raised amount, *log(owners)* is the total number of investors invested, *funds_ownr* is the percentage of shares held by sophisticated investors and *foreign_ownr* is the percentage of shares held by foreign investors for fund *i* at year *t+1*. DIS_t is an indicator variable equal to one when a civil, criminal or regulatory action is initiated against a private fund in a given year. $\delta_{i,fund\_type} \times \theta_t + \varphi_{i,year} + \gamma_{i,state}$ are controls for fund type, year, and state fixed effects. Similar to the equation (2), additional control variables are added to ensure that the results are not due to other causes such as fund size, age and annual audits (*Ln_AUM*, *Ln_Age*, *Annual Audit)*.

Table 5 shows the disciplinary effects on the number of investors (Panel A), proportional capital managed (NAC) (Panel B), overall investor ownership percentage (Panel C), sophisticated ownership percentage (Panel D) and foreign ownership percentage (Panel E). Having a criminal action has negative effects on the number of investors, total assets managed and ownership of sophisticated investors. After a criminal action initiation, the number of investors decreased by 3.83% in the first year, 2.47% in the second and 0.6% in the third year. Similarly, fund managers with criminal action experienced 16.5%, 7.5% and 6.7% reduction in their total assets managed within the first three years respectively. Sophisticated investors also own a lower percentage after the criminal action initiation. The decline is 1.3% in the first year, 1.9% in the second year and 2.1% in the third year. They also react negatively to regulatory actions as they decrease their holdings by 0.6% and 0.5% in the first and second years respectively. Interestingly, foreign investors' ownership increases 8.8% and 8.3% in the following two-year period. Private funds are formed as partnerships and every investor base has a total percentage share ownership of 100%. That means when an investor sells their shares, another investor's percent share ownership automatically increases. Thus, since foreign investors either buy more shares or do not sell their shares while sophisticated investors sell their shares, their percentage ownership will increase. Either way, foreign investors do not recognize these actions to act accordingly compared to the sophisticated investors. These results are consistent with the literature that sophisticated investors can monitor funds better than unsophisticated investors and foreign investors do not have adequate resources to monitor their investments due to distance from fund managers. On the other hand, regulatory and civil actions do not cause a change in the capital managed, number of investors and overall investor ownership regardless of time periods.

In summary, criminal actions decrease capital managed, number of investors, and sophisticated investors while foreign ownership increases. This evidence shows that investors are willing to exit and distance themselves from managers that have criminal cases even though there might be an early exit penalty. On the other hand, civil and regulatory actions do not have any effect on investors and assets managed.

4 Robustness

Table 3 shows that fund managers that use marketers raised less capital compared to ones that used their own resources. One can claim some unobserved fund and investor characteristics might drive the results. To address this issue, I performed both subsample and propensity score matching regression analysis. Specifically, I use both generalized linear and generalized booted models separately and use the nearest matching method. All matches are conducted without replacement. All treated units have mostly matched with control units and there is a satisfactory overlap in the propensity score distribution. Additionally, I conduct subsample analysis to confirm that the results are not driven by fund or investor size. Table 6 shows the propensity match analysis for each fund type (hedge fund, private equity fund, venture capital fund and other private funds). The results are consistent and robust. Marketers are able to bring more investors into hedge funds, private equities and other private funds, however, there is no significant effect on the total capital raise. For venture capital funds, marketers are not able to bring investors and funds raise less capital when funds managers use these providers. Table 7 provides subsample analysis for small and big funds in terms of their total capital raise during the initial raise period. For both small and big size funds, marketers have a negative effect on the total amount raised while they are able to bring more investors for only small sized funds. On the other hand, Table 8 shows subsample analysis for small and big investors in terms of the SEC classification. 3(c)1 funds are structured for small size investors (accredited investors, see Data Section for more information) and only have 100 investor seats in a fund while 3(c)7 funds are designed for qualified purchasers (investors that have at least $5 million investable assets[14]) and can allow up to 2000 investor seats in a fund. The results are consistent with Table 3 that regardless of fund and investor size, showing that marketers do not add value to private funds in terms of the total capital invested.

Table 4 shows that funds that use third party marketers have subsequently brought more investors than the ones that do not use these services, however, this does not affect the total capital managed. One can claim that funds that use third party marketers need to raise more capital through bringing more investors, and more capital raise causes the third party use and therefore creates reverse causality issue. On the other hand, funds that have faced disciplinary actions can have different fund characteristics in terms of size and age and the effect of a disciplinary action can be a cause of a selection bias. To address this, I perform propensity score matching regression analysis to confirm the results are not driven by any reverse causality or selection bias. Table 9 shows the third party effects on capital raise for treated and control units. Additionally, I add company type to make sure that specific fund types do not influence the regression outcomes. The results confirm that reverse causality is not the cause of the 3r party providers' effects on capital managed. Table 11 provides the disciplinary action effects on the capital raise. Consistent with the main results, funds that have criminal actions experience declines in both total capital managed and number of investors. I also perform subsample tests to confirm that the results are not driven by the fund size and age. Table 11 shows the subsample tests for fund age and size respectively when funds use third party marketers. Marketers consistently bring more investors for funds of different ages and sizes; however, this does not result in more capital managed.

[14] Defining the Term "Qualified Purchaser" under the Securities Act of 1933 https://www.sec.gov/rules/proposed/33-8041.htm *(last accessed May 18,2023)*

5 Conclusion

This paper examines the role of investor trust in private funds' capital raising. I document the role of investor trust on investment decisions by analyzing the effects of third-party service providers and financial misconduct. I contribute the literature by using a unique sample of private funds to shed light on investor behavior under different fund-raising circumstances.

I show that using third party marketers is not beneficial for private fund managers as these providers are not able to help raise more capital from investors. Managers that do not use marketers can raise $27.91 million more on average even though marketers can help bring more investors in a private fund. Sophisticated investors have 1.8% less ownership in funds that are marketed by the providers. These results suggest that investors do not have high trust in the marketers. On the other hand, other providers such as auditors and bookkeepers help enhance investor trust, resulting in positive effect on the initial capital raise. I also show that there is no evidence that marketers can add value during funds' active years while auditors increase investor value in capital raise.

Second, I show that disciplinary actions have both short and long-term effects on the capital managed and investor redemption, owing to the reduced investor trust as a result of such actions. Specifically, funds that have criminal actions experience less capital managed and investor ownership. US and sophisticated investors tend to distance themselves following a criminal action. Interestingly, foreign ownership increases in the first two years after a criminal action meaning that foreign investors might have limited access to information to monitor funds due to distance from fund managers.

The effect of the service providers shows that investors prefer fund managers to market their funds and other providers such as auditors and bookkeepers to regulate private funds before making an investment decision. Additionally, they distance themselves after a serious disciplinary action. Therefore, my evidence suggests that investor trust plays an important role in the decision making of private fund investment.

6 Figures and Tables

Figure 1

This figure shows the differences of initial capital raise, number of investors, percentage ownership of sophisticated and percentage ownership of foreign investors between firms that use marketers and the ones that do not use.

Figure 1: Initial Capital Raise and Marketers

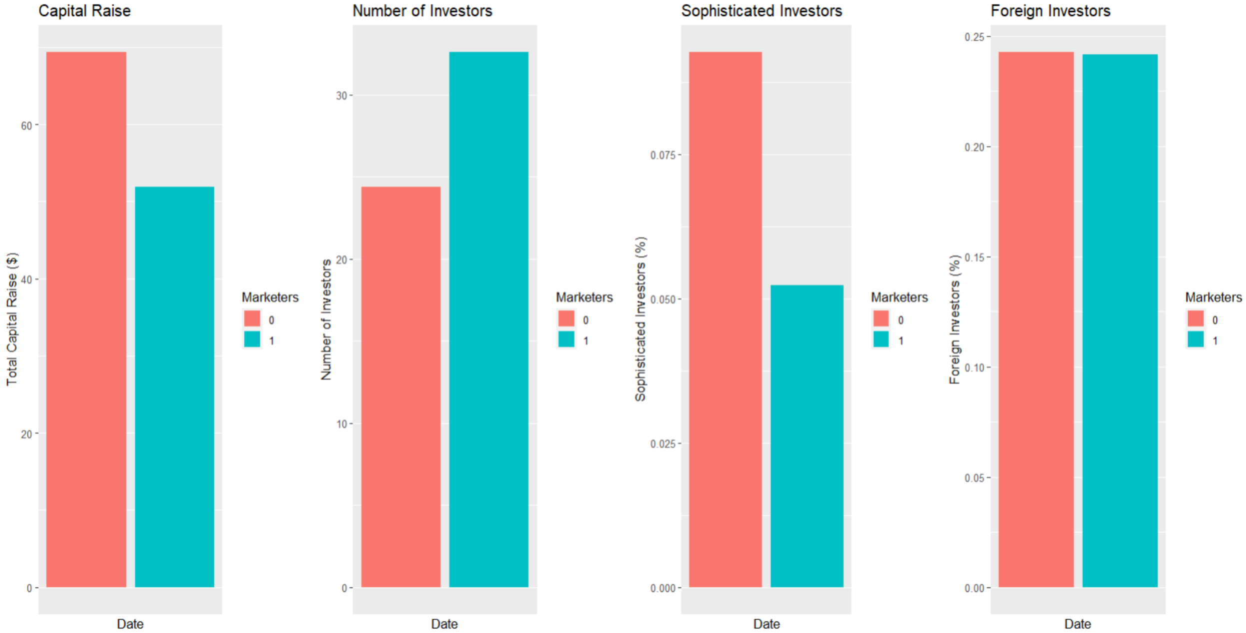


Figure 2

This figure shows annual proportional assets managed and number of share holders (owners) by private funds when a third-party marketer is used before the capital raise.

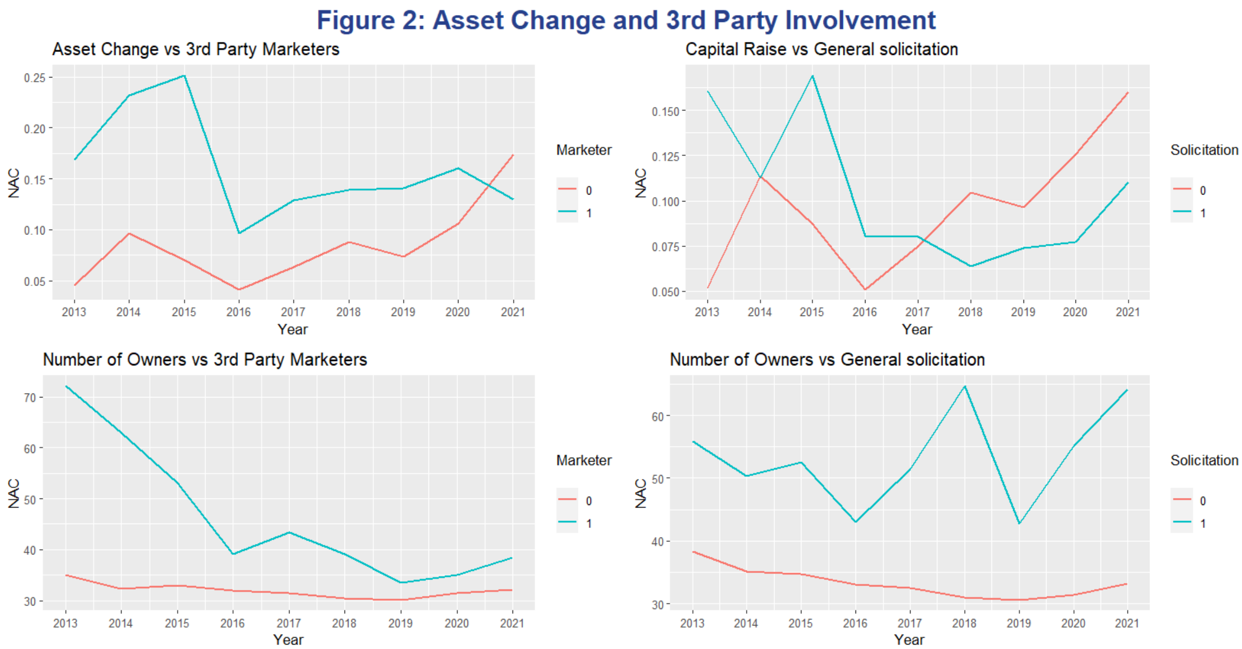


Figure 3

This figure displays fund level proportional assets managed when an action is initiated (for civil, criminal and regulatory actions, respectively).

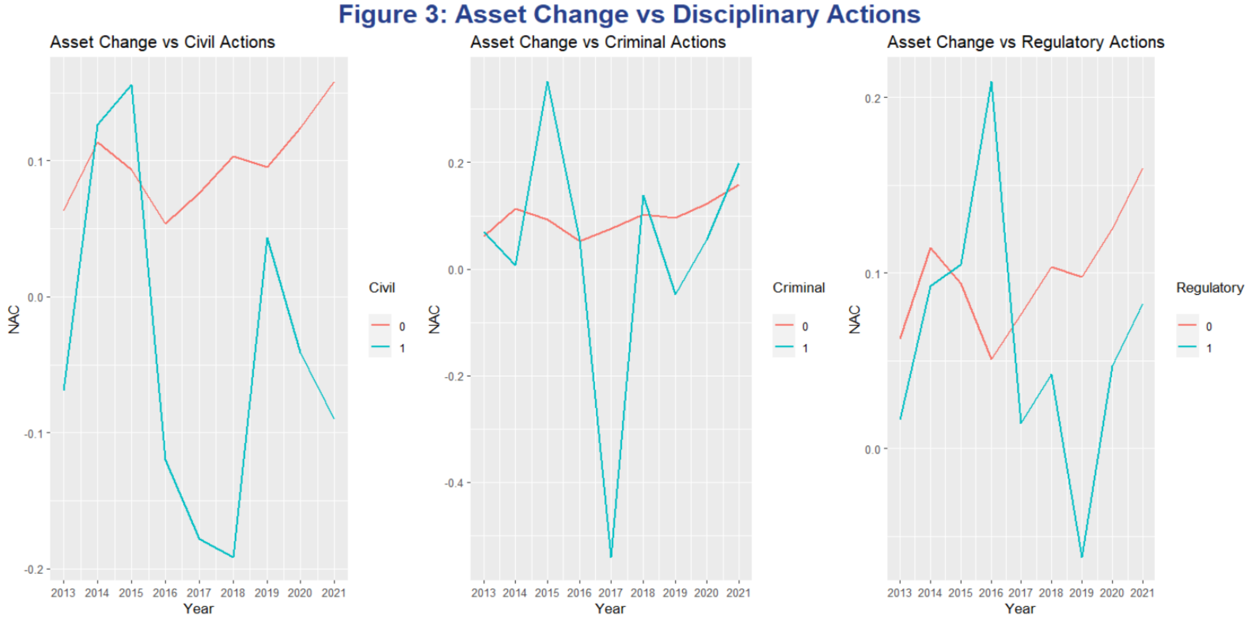


Figure 4

This figure shows annual distribution of civil, criminal and regulatory actions over the sample period.

Figure 4: Distribution of Total Number of Disciplinary Actions

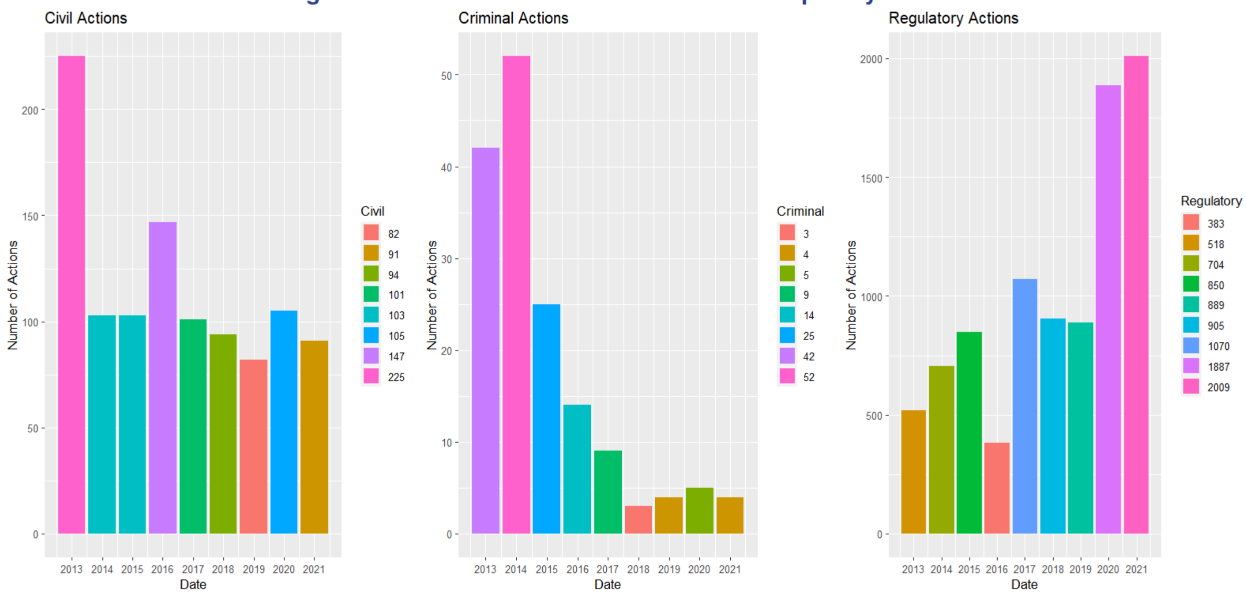


Table 1

Summary Statistics of Advisory Firms (2013Q1 to 2021Q4)

This table reports the summary statistics for the key characteristics of advisory firms and their fund that they manage over the full sample period (2013Q1-2021Q4). Panel A includes the key characteristics of advisory firms and types of exemption qualifications to register as an exempt reporting adviser. Panel B includes fund characteristics at the initial capital raise period and over the sample period.

Panel A: Firm Characteristics and Exemptions to Qualify for Exempt Reporting Adviser						
	N	Mean	Std. Dev	P25	Median	P75
Age (years)	48,104	3.56	3.77	0.86	2.57	5.79
Number of firms	8,446					
Number of firms with more than $1B assets	211	2.50%				
Firms advising to a private fund (%)	8,402	99.48%				
Exemption qualifications						
Venture Capital Funds	2,178	25.79%				
US AUM < $150M	7,473	88.48%				
US AUM > $150M	756	8.95%				

Panel B: Fund Characteristics						
	N	Mean	Std. Dev	P25	Median	P75
Initial Capital Raise Period						
Initial Capital Raised ($millions)	37,230	73.57	200.52	0.50	7.00	45.39
Number of Investors (Owners)	37,230	28.05	34.78	5.00	16.00	38.00
Minimum Inv. Threshold ($millions)	37,230	1.25	3.42	0.00	0.05	0.50
Avg. Invested per investor ($millions)	37,230	7.96	43.34	0.04	0.54	3.74
Funds-of-Funds Ownership (%)	37,230	9.33	21.94	0.00	0.00	3.00
Foreign Onwership (%)	37,230	25.01	36.66	0.00	5.00	47.00
Number of funds	37,230					
Firms Successful Raise	35,365	94.99%				
US Based Funds	25,581	68.71%				
3(c)7 Exclusion	15,566	41.81%				
Hedge Funds	5,041	13.54%				
Private Equity Funds	10,432	28.02%				
Venture Capital Funds	17,859	47.97%				
Other Private Funds	3,898	10.47%				
Marketers	9,769	26.24%				
Auditors	20,860	56.03%				
General Solicitation	1,888	5.07%				
Foreign Registration	9,628	25.86%				
Fund Lifespan						
Age (years)	195,140	2.92	3.09	0.60	2.00	4.61
Number of Investors (Owners)	195,140	34.42	46.98	7	20	45
AUM ($Million)	195,140	89.32	235.26	8.20	9.81	59.88
NAC	153,674	0.10	0.73	-0.02	0	0.03

Table 2

Disciplinary Action Types Against Adviser Firms

This table reports disciplinary action types and percentages of adviser firms that face each action type. Panel A includes the types of each action and percentages of the adviser firms that face the related action. *Advisor Lifespan* shows the firms that face a disciplinary action if a firm has experienced the action during its lifespan. *Latest Filing* shows if a firm was faced an action in the last 10 years and the action is included in the firm's latest filing. Panel B includes all action types as Regulatory, Civil and Criminal.

Panel A: Details of Disciplinary Actions

	N	Adviser Lifespan	Latest Filing
Criminal			
Felony - Conviction	48,104	0.47%	0.41%
Felony - Pending	48,104	1.20%	0.60%
Misdemeanor - Conviction	48,104	0.13%	0.12%
Misdemeanor - Pending	48,104	0.07%	0.04%
Civil Judicial			
Court Enjoinment	48,104	0.55%	0.32%
Violations - Investment Related Regulations	48,104	0.77%	0.31%
Dissmissed, Settlement	48,104	0.18%	0.11%
Civil Judicial Actions - Pending	48,104	0.93%	0.53%
Regulatory			
Commodity Futures Trading Commission (CFTC)			
False statement or omission	48,104	0.60%	0.32%
Violation of regulations	48,104	1.96%	1.21%
Denied, Suspended, Revoked, Restricted	48,104	0.05%	0.11%
Order against	48,104	1.88%	1.16%
Civil Money Penalty - Cease, Desist	48,104	1.97%	1.22%
Federal, State, Foreing Regulatory Authority			
False statement or omission	48,104	0.75%	0.34%
Violation of regulations	48,104	3.25%	2.05%
Denied, Suspended, Revoked, Restricted - Inv. Activities	48,104	0.14%	0.11%
Order against	48,104	2.21%	1.24%
Denied, Suspended, Revoked - License	48,104	0.63%	0.43%
Self-regulatory organization or commodities exhange			
False statement or omission	48,104	0.13%	0.02%
Violation of regulations	48,104	1.43%	0.95%
Denied, Suspended, Revoked, Restricted - Inv. Activities	48,104	0.03%	0.04%
Denied, Suspended, Revoked - Association	48,104	0.47%	0.40%
Revoked, Suspended - Attorney, Accountant, Federal Contractor	48,104	0.13%	0.13%
Regulatory Actions - Pending	48,104	0.40%	0.30%

Panel B: Total Number of Actions Against Adviser Firms

All Actions

Number of total criminal actions	48,104	0.09%
Number of total civil actions	48,104	0.61%
Number of total regulatory actions	48,104	4.98%
Max. Actions - Criminal	3	
Max. Actions - Civil	3	
Max. Actions - Regulatory	9	

Table 3

Fund Initial Capital Raise Regression for Firms that Use Marketers

This table reports results of the regressions of log of initial capital amount raised *(log(CR)* (Col 1-2), log of number of shareholders *(log(No. Owners))* (Col 3-4), share percentage of funds-of-funds owners *(funds_ownr)* (Col 5-6), and share percentage of foreign owners *(foreign_ownr)* (Col 7-8) between 2013Q1 and 2021Q4, conditioning on fund's third party service provider, general solicitation and foreign registration of the private fund. The dependent variables are *log(CR), log(No. Owners), funds_ownr and foreign_ownr. Marketer/Auditor/books&records holder* is an indicator variable set to 1 if the fund decides to use a third-party service provider and 0 otherwise. *solicitation* is an indicator variable set to 1 if a fund allows investors to be advertised publicly in compliance with the regulations. Minimum investment amount indicates the total number of minimum dollar amount to be invested in a fund. *foreign registration* is an indicator that is 1 if a fund is registered with foreign regulatory authorities. Control variable is the minimum investment amount Refer to Appendix II for detailed variable definitions. Standard errors are triple clustered by fund type, year and state, with *t*-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

	log(CR)		***log(No. Owners)***		***funds_ownr (%)***		***foreign_ownr (%)***	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Marketer	-0.651*	-0.477**	0.436***	0.340***	-0.032***	-0.018**	0.035**	0.003
	(0.059)	(0.038)	(0.000)	(0.000)	(0.000)	(0.035)	(0.040)	(0.808)
Auditor (external)		0.670***		0.461***		0.055***		0.019
		(0.000)		(0.001)		(0.000)		(0.356)
Books & Records holder		0.393***		-0.027		0.010		0.011**
		(0.006)		(0.574)		(0.410)		(0.030)
Solicitation		-0.191**		-0.013		0.037*		0.012
		(0.027)		(0.866)		(0.054)		(0.696)
Foreign Registration		-0.281		-0.066		0.023***		0.081***
		(0.535)		(0.583)		(0.004)		(0.001)
Min Inv. Amount (log)		0.124		-0.102**		0.005***		0.004
		(0.101)		(0.021)		(0.007)		(0.499)
Observations	37,230	30,635	36,220	29,817	37,230	30,635	37,230	30,635
Adj. R2	0.10	0.16	0.07	0.10	0.06	0.09	0.23	0.27
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4

Fund Future Assets and Owners Regressions for Third Party Service Provider Firms

This table reports results of the panel regressions of future log of initial capital amount raised *(log(CR)* (Col 1-2), log of number of shareholders *(log(No. Owners))* (Col 3-4), share percentage of funds-of-funds owners *(funds_ownr)* (Col 5-6), and share percentage of foreign owners *(foreign_ownr)* (Col 7-8) between 2013Q1 and 2021Q4, conditioning on fund's third party service provider, general solicitation and foreign registration of the private fund. The dependent variables are *log(CR), log(No. Owners), funds_ownr and foreign_ownr. Marketer/Auditor/books&records holder* is an indicator variable set to 1 if the fund decides to use a third-party service provider and 0 otherwise. The dependent variable is the log of number of owners on year *t+1* (log(Owners)_*t+1). marketer/prime_broker/ administrator/custodian/books&records.* Control variables are fund size and age and annual audit (*Log_AUM, Log_Age, Annual Audit*). Refer to Appendix II for detailed variable definitions. Standard errors are triple clustered by fund and year and state, with *t*-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

	log(CR)		***NAC***		***log(No. Owners)***	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Marketer	-0.386	-0.037	0.198	-0.003	0.339***	0.483***
	(0.194)	(0.188)	(0.230)	(0.980)	(0.008)	(0.000)
Auditor (external)		0.204**		0.580***		0.049**
		(0.012)		(0.001)		(0.040)
Books & Records holder		0.026		0.034***		-0.048
		(0.108)		(0.000)		(0.364)
Solicitation		0.031***		0.075		0.086
		(0.001)		(0.414)		(0.553)
Foreign Registration		-0.063**		-0.063		-0.073
		(0.033)		(0.551)		(0.474)
Min Inv. Amount (log)		0.009**		0.052***		-0.128**
		(0.022)		(0.000)		(0.026)
Log AUM		0.953***		-0.194***		0.211***
		(0.000)		(0.010)		(0.000)
Log Age		-0.130***		-0.233***		0.164**
		(0.000)		(0.003)		(0.026)
Annual Audit		0.002		0.128		-0.007
		(0.911)		(0.470)		(0.972)
Observations	188,233	118,244	153,674	119,015	192,464	160,453
Adj. R2	0.03	0.06	0.02	0.03	0.04	0.08
Controls	No	Yes	No	Yes	No	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	Yes	Yes	Yes	Yes	Yes	Yes

Table 5

Fund Future Assets and Owners Regressions for Disciplinary Action Firms

This table reports results of the panel regressions of future log of number of shareholders (*log(Owners_t+1,2,3*, Panel A), proportional capital change (*NAC_t+1,2,3,* Panel B), percentage of total investors *(investor_ownr_t+1,2,3*, Panel C), sophisticated investors (*funds_ownr_t+1,2,3*, Panel D), and foreign investors (*foreign_ownr_t+1,2,3*, Panel E), yearly values over the next 3 years, between 2013Q1 and 2021Q4, conditioning on fund's disciplinary action type (col 1-2). DIS is an indicator variable set to 1 if a Civil/Criminal/Regulatory action is initiated against fund and 0 otherwise. Control variables are identical to those in Table 4. Refer to Appendix II for detailed variable definitions. Standard errors are triple clustered by fund and year and state, with t-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Panel A: Number of Investors

Disciplinary Action (DIS)		***Civil***			***Criminal***			***Regulatory***	
	t+1	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***
DIS	-0.020	-0.024	-0.046	-0.039**	-0.025**	-0.007***	0.045	0.053	0.046
	(0.452)	(0.414)	(0.116)	(0.027)	(0.043)	(0.004)	(0.742)	(0.398)	(0.253)
Log AUM	0.050***	0.048***	0.047***	0.050***	0.048***	0.047***	0.050***	0.048***	-0.274***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Log Age	0.043***	0.035**	0.029**	0.043***	0.034**	0.029**	0.042***	0.034**	-0.171***
	(0.000)	(0.028)	(0.043)	(0.000)	(0.029)	(0.044)	(0.000)	(0.032)	(0.002)
Annual Audit	0.030***	0.025***	0.022*	0.030***	0.025***	0.022*	0.030***	0.025***	-0.003
	(0.000)	(0.000)	(0.053)	(0.000)	(0.001)	(0.052)	(0.000)	(0.001)	(0.792)
Observations	143,908	109,150	84,118	143,908	109,150	84,118	143,908	109,150	84,039
Adj. R2	0.11	0.13	0.14	0.11	0.13	0.14	0.11	0.13	0.14
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: ***Fund Future Assets and Owners Regressions for Disciplinary Action Firms*** **(Cont'd)**

Panel B: NAC

Disciplinary Action (DIS)		***Civil***			***Criminal***			***Regulatory***	
	t+1	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***
DIS	-0.021	0.034	0.027	-0.165***	-0.075**	-0.067*	0.016	0.052	0.046
	(0.586)	(0.239)	(0.490)	(0.000)	(0.010)	(0.055)	(0.482)	(0.388)	(0.253)
Log AUM	-0.299***	-0.286***	-0.274***	-0.299***	-0.286***	-0.274***	-0.299***	-0.286***	-0.274***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Age	-0.123**	-0.158***	-0.171***	-0.123**	-0.158***	-0.171***	-0.124**	-0.158***	-0.171***
	(0.016)	(0.007)	(0.002)	(0.016)	(0.008)	(0.002)	(0.016)	(0.007)	(0.002)
Annual Audit	0.203***	0.210***	0.221***	0.203***	0.210***	0.221***	0.203***	0.210***	0.221***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	143,745	109,025	84,039	143,745	109,025	84,039	143,745	109,025	84,039
Adj. R2	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: ***Fund Future Assets and Owners Regressions for Disciplinary Action Firms*** **(Cont'd)**

Panel C: Total Investor Ownership

Disciplinary Action (DIS)		***Civil***			***Criminal***			***Regulatory***	
	t+1	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***
DIS	-0.010	-0.008	0.003	-0.013***	-0.015***	-0.017***	0.004	0.001	-0.002
	(0.413)	(0.424)	(0.027)	(0.000)	(0.000)	(0.000)	(0.112)	(0.825)	(0.637)
Log AUM	0.006**	0.006**	0.006*	0.006***	0.006***	0.006***	0.006**	0.006**	0.006**
	(0.039)	(0.036)	(0.089)	(0.000)	(0.000)	(0.000)	(0.039)	(0.036)	(0.041)
Log Age	-0.007	-0.006	-0.002	-0.007	-0.006	-0.002	-0.007	-0.006	-0.002
	(0.360)	(0.627)	(0.908)	(0.173)	(0.446)	(0.868)	(0.347)	(0.622)	(0.902)
Annual Audit	-0.001	-0.002	0.007	-0.001	-0.002	0.007*	-0.001	-0.002	0.007
	(0.895)	(0.856)	(0.527)	(0.772)	(0.717)	(0.070)	(0.895)	(0.856)	(0.398)
Observations	143,908	109,150	84,118	143,908	109,150	84,118	143,908	109,150	84,118
Adj. R2	0.06	0.07	0.07	0.06	0.07	0.07	0.06	0.07	0.07
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: ***Fund Future Assets and Owners Regressions for Disciplinary Action Firms*** **(Cont'd)**

Panel D: Sophisticated (Funds-of-Funds) Investor Ownership

Disciplinary Action (DIS)		***Civil***			***Criminal***			***Regulatory***	
	t+1	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***
DIS	-0.016	-0.018	-0.017	-0.013***	-0.019***	-0.021***	-0.006**	-0.005*	-0.004
	(0.372)	(0.288)	(0.183)	(0.000)	(0.000)	(0.000)	(0.028)	(0.100)	(0.234)
Log AUM	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(0.124)	(0.189)	(0.214)	(0.124)	(0.190)	(0.213)	(0.219)	(0.260)	(0.257)
Log Age	-0.008	-0.008	-0.005	-0.008	-0.008	-0.005	-0.008	-0.008	-0.005
	(0.288)	(0.528)	(0.787)	(0.277)	(0.521)	(0.786)	(0.281)	(0.522)	(0.786)
Annual Audit	-0.001	0.001	0.009	-0.001	0.001	0.009	-0.001	0.001	0.009
	(0.777)	(0.674)	(0.131)	(0.773)	(0.678)	(0.132)	(0.774)	(0.698)	(0.134)
Observations	139,927	106,147	81,829	139,927	106,147	81,829	139,927	106,147	81,829
Adj. R2	0.11	0.11	0.10	0.11	0.11	0.10	0.11	0.11	0.10
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: ***Fund Future Assets and Owners Regressions for Disciplinary Action Firms*** **(Cont'd)**

Panel E: Foreign Investor Ownership

Disciplinary Action (DIS)		***Civil***			***Criminal***			***Regulatory***	
	t+1	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***
DIS	-0.035	-0.035	-0.030	0.088***	0.083**	0.023	0.001	-0.006	-0.012
	(0.144)	(0.152)	(0.156)	(0.007)	(0.041)	(0.186)	(0.691)	(0.102)	(0.185)
Log AUM	0.004	0.003	0.004	0.004*	0.003	0.004	0.004*	0.003	0.004
	(0.155)	(0.281)	(0.219)	(0.086)	(0.173)	(0.161)	(0.092)	(0.131)	(0.277)
Log Age	0.001	0.001	0.007	0.001	0.000	0.007	0.001	0.000	0.007
	(0.415)	(0.875)	(0.514)	(0.566)	(0.939)	(0.491)	(0.524)	(0.916)	(0.527)
Annual Audit	0.002	0.002	0.004	0.002	0.002	0.004	0.002	0.002	0.004
	(0.734)	(0.834)	(0.721)	(0.763)	(0.847)	(0.729)	(0.746)	(0.843)	(0.729)
Observations	143,908	109,150	84,118	143,908	109,150	84,118	143,908	109,150	84,118
Adj. R2	0.28	0.28	0.29	0.28	0.28	0.29	0.28	0.28	0.29
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 6

Fund Future Capital Raise and Owner Regressions for Matched Funds that Use Third Party Service Providers

This table reports results of the regressions of total capital managed amounts (*log(CR)*, Col 1-4) and log number of investors (*log(Owners),* Col 5-8) between 2013Q1 and 2021Q4, conditioning on fund's use of third party service provider and firm type. The dependent variables are total capital managed amounts (*log(CR)*) and log number of investors (*log(Owners). Marketer, auditor, books, solicit, foreign* are indicator variables set to 1 if a fund uses related service provider and 0 otherwise. Control variables are identical to those in Table 3. Refer to Appendix II for detailed variable definitions. Standard errors are triple clustered by fund and year and state, with t-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

	log(CR)				***log(Owners)***			
Fund Type	***Hedge Fund***	***Private Equity***	***Venture Capital***	***Other Private***	***Hedge Fund***	***Private Equity***	***Venture Capital***	***Other Private***
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Marketer	0.072	0.063	-0.689*	-0.774	0.450***	0.342***	0.226	0.530***
	(0.280)	(0.707)	(0.091)	(0.265)	(0.000)	(0.000)	(0.104)	(0.000)
Auditor (external)	0.864	0.966***	0.696***	0.076**	0.381***	0.353***	0.519**	-0.058
	(0.349)	(0.003)	(0.000)	(0.033)	(0.005)	(0.000)	(0.034)	(0.478)
Books & Records holder	-0.014	0.433***	0.251**	0.738	0.079	-0.089*	-0.067***	0.025
	(0.926)	(0.000)	(0.044)	(0.139)	(0.121)	(0.055)	(0.001)	(0.840)
Solicitation	-0.686*	-0.014	-0.182	-0.110	-0.129	0.069	-0.218*	0.262*
	(0.052)	(0.944)	(0.752)	(0.611)	(0.107)	(0.353)	(0.063)	(0.073)
Foreign Registration	0.617	-0.695**	-0.680	0.579	0.150	0.094*	-0.139	0.149
	(0.304)	(0.018)	(0.159)	(0.362)	(0.644)	(0.067)	(0.387)	(0.511)
Min Inv. Amount (log)	0.086	0.068	0.203***	-0.060	-0.120**	-0.125*	-0.135***	-0.143***
	(0.272)	(0.375)	(0.000)	(0.279)	(0.033)	(0.062)	(0.000)	(0.000)
Observations	1,806	31,22	10,890	758	1717	2982	10797	721
Adj. R2	0.08	0.05	0.27	0.14	0.085	0.094	0.094	0.230
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects, Clusters	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Match Ratio (%)	100.00	100.00	87.74	100.00	100.00	100.00	87.74	100.00

Table 7

Fund Initial Capital Raise Regression for Firms that Use Marketers (Size Subsample)

This table reports results of the regressions of log of initial capital amount raised *(log(CR)* (Col 1-2), log of number of shareholders *(log(No. Owners))* (Col 3-4), share percentage of funds-of-funds owners *(funds_ownr)* (Col 5-6), and share percentage of foreign owners *(foreign_ownr)* (Col 7-8) based on median size ($7 million) between 2013Q1 and 2021Q4, conditioning on fund's third party service provider, general solicitation and foreign registration of the private fund. The dependent variables are *log(CR), log(No. Owners), funds_ownr and foreign_ownr. Marketer/Auditor/books&records holder* is an indicator variable set to 1 if the fund decides to use a third-party service provider and 0 otherwise. *solicitation* is an indicator variable set to 1 if a fund allows investors to be advertised publicly in compliance with the regulations. Minimum investment amount indicates the total number of minimum dollar amount to be invested in a fund. *foreign registration* is an indicator that is 1 if a fund is registered with foreign regulatory authorities. Control variable is the minimum investment amount Refer to Appendix II for detailed variable definitions. Standard errors are triple clustered by fund type, year and state, with *t*-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Age	***<= Med. Size***	***> Med. Size***	***<= Med. Size***	***> Med. Size***	***<= Med. Size***	***> Med. Size***	***<= Med. Size***	***> Med. Size***
Dependent Variable	***log(CR)***		***log(Owners)***		***funds_ownr (%)***		***foreign_ownr (%)***	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Marketer	-0.540***	-0.006*	0.284***	0.062	-0.015**	-0.022**	0.008	0.042***
	(0.002)	(0.082)	(0.000)	(0.409)	(0.042)	(0.014)	(0.608)	(0.004)
Auditor (external)	0.250***	0.060	0.313***	0.786	0.043***	-0.101	0.002	0.111**
	(0.000)	(0.211)	(0.007)	(0.299)	(0.000)	(0.209)	(0.778)	(0.015)
Books & Records holder	0.146**	0.007	-0.082	-0.042	0.017	-0.014	0.012**	0.003
	(0.022)	(0.611)	(0.147)	(0.767)	(0.148)	(0.520)	(0.022)	(0.873)
Solicitation	0.110	-0.036*	0.011	0.095	0.043	0.034	-0.017	0.092***
	(0.285)	(0.093)	(0.903)	(0.202)	(0.111)	(0.208)	(0.565)	(0.001)
Foreign Registration	-0.603***	0.048	-0.183**	0.157	0.039***	0.000	0.060**	-0.002
	(0.010)	(0.177)	(0.039)	(0.278)	(0.000)	(0.997)	(0.026)	(0.827)
Min Inv. Amount (log)	0.206**	0.014***	-0.138***	-0.053***	0.006***	0.006*	0.010**	0.000
	(0.012)	(0.004)	(0.002)	(0.003)	(0.000)	(0.060)	(0.013)	(0.920)
Observations	21,686	7,467	21,618	7,432	21,686	7,467	21,686	7,467
Adj. R2	0.53	0.16	0.15	0.10	0.08	0.05	0.21	0.30
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 8

Fund Initial Capital Raise Regression for Firms that Use Marketers (Investor Size Subsample)

This table reports results of the regressions of log of initial capital amount raised *(log(CR)* (Col 1-2), log of number of shareholders *(log(No. Owners))* (Col 3-4), share percentage of funds-of-funds owners *(funds_ownr)* (Col 5-6), and share percentage of foreign owners *(foreign_ownr)* (Col 7-8) based on fund structure (*3(c)1, 3(c)7)* between 2013Q1 and 2021Q4, conditioning on fund's third party service provider, general solicitation and foreign registration of the private fund. The dependent variables are *log(CR), log(No. Owners), funds_ownr and foreign_ownr. Marketer/Auditor/books&records holder* is an indicator variable set to 1 if the fund decides to use a third-party service provider and 0 otherwise. *solicitation* is an indicator variable set to 1 if a fund allows investors to be advertised publicly in compliance with the regulations. Minimum investment amount indicates the total number of minimum dollar amount to be invested in a fund. *foreign registration* is an indicator that is 1 if a fund is registered with foreign regulatory authorities. Control variable is the minimum investment amount Refer to Appendix II for detailed variable definitions. Standard errors are triple clustered by fund type, year and state, with *t*-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Age	***3(c)1***	***3(c)7***	***3(c)1***	***3(c)7***	***3(c)1***	***3(c)7***	***3(c)1***	***3(c)7***
Dependent Variable	***log(CR)***		***log(Owners)***		***funds_ownr (%)***		***foreign_ownr (%)***	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Marketer	-0.393***	0.233	0.304***	0.309***	-0.007**	-0.032***	-0.004	0.016
	(0.003)	(0.109)	(0.000)	(0.000)	(0.032)	(0.001)	(0.748)	(0.378)
Auditor (external)	0.747***	0.592*	0.459***	0.648**	0.036***	0.080***	0.010	0.004
	(0.000)	(0.073)	(0.000)	(0.011)	(0.001)	(0.000)	(0.653)	(0.862)
Books & Records holder	0.183***	0.049	-0.002	0.017	0.005	0.003	-0.014*	-0.014
	(0.003)	(0.525)	(0.965)	(0.678)	(0.102)	(0.890)	(0.085)	(0.164)
Solicitation	0.038	0.006	-0.059	0.088***	0.059*	0.032	-0.029*	0.037
	(0.454)	(0.965)	(0.510)	(0.006)	(0.098)	(0.115)	(0.081)	(0.254)
Foreign Registration	-0.317	0.340	-0.072	-0.051	0.033***	-0.007	0.091***	0.107***
	(0.331)	(0.182)	(0.619)	(0.265)	(0.000)	(0.420)	(0.001)	(0.001)
Min Inv. Amount (log)	0.284***	0.113*	-0.133***	-0.069*	0.007***	0.001	0.005	0.001
	(0.002)	(0.088)	(0.002)	(0.091)	(0.000)	(0.302)	(0.301)	(0.793)
Observations	20,644	11,222	21,020	11,643	21,432	12,118	21,432	12,118
Adj. R2	0.58	0.21	0.12	0.09	0.09	0.05	0.31	0.20
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 9

Fund Future Ongoing Capital Managed and Owners Regressions for Matched Funds by Fund Type that Use Third Party Service Providers

This table reports results of the panel regressions of total capital managed amounts (*log(CR)*, Col 1-4) and log number of investors (*log(Owners),* Col 5-8) between 2013Q1 and 2021Q4, conditioning on fund's use of third party service provider and firm type. The dependent variables are total capital managed amounts (*log(CR)*) and log number of investors (*log(Owners). Marketer, auditor, books, solicit, foreign* are indicator variables set to 1 if a fund uses related service provider and 0 otherwise. Control variables are identical to those in Table 3. Refer to Appendix II for detailed variable definitions. Standard errors are triple clustered by fund and year and state, with t-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

	log(CR)				***log(Owners)***			
Fund Type	***Hedge Fund***	***Private Equity***	***Venture Capital***	***Other Private***	***Hedge Fund***	***Private Equity***	***Venture Capital***	***Other Private***
	(1)	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
Marketer	0.047	0.921	0.063	0.789	0.389***	0.282***	0.231*	0.455***
	(0.577)	(0.252)	(0.620)	(0.742)	(0.000)	(0.000)	(0.089)	(0.000)
Auditor (external)	0.032	0.106	-0.023	-0.104	0.666***	0.462***	0.653***	0.835***
	(0.841)	(0.156)	(0.651)	(0.598)	(0.000)	(0.000)	(0.001)	(0.000)
Books & Records holder	-0.143***	-0.008	-0.024	-0.169	0.144***	-0.088***	0.020	-0.030
	(0.000)	(0.904)	(0.216)	(0.219)	(0.001)	(0.000)	(0.776)	(0.495)
Solicitation	-0.145**	-0.381***	0.332*	-0.201	-0.057	0.231***	-0.330***	0.479***
	(0.031)	(0.003)	(0.076)	(0.113)	(0.564)	(0.001)	(0.000)	(0.000)
Foreign Registration	0.223	0.186***	0.000	0.679*	0.052	-0.086**	-0.219*	0.032
	(0.150)	(0.000)	(0.995)	(0.099)	(0.885)	(0.026)	(0.098)	(0.919)
Min Inv. Amount (log)	0.093***	0.014	0.019	0.107***	-0.062	-0.046	-0.109***	-0.194***
	(0.001)	(0.163)	(0.236)	(0.000)	(0.294)	(0.267)	(0.002)	(0.000)
Observations	16,231	29,041	57,154	5,475	19,300	33,988	70,105	6,555
Adj. R2	0.007	0.009	0.007	0.018	0.049	0.053	0.078	0.297
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects, Clusters	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Match Ratio (%)	99.97	100.00	90.01	100.00	99.97	100.00	90.01	100.00

Table 10

Fund Ongoing Capital Raise Regressions for Firms that Use Marketers (Size/Age Subsample)

This table reports results of the panel regressions of log of initial capital amount raised *(log(CR)* (Col 1-2), log of number of shareholders *(log(No. Owners))* (Col 3-4), share percentage of funds-of-funds owners *(funds_ownr)* (Col 5-6), and share percentage of foreign owners *(foreign_ownr)* (Col 7-8) based on median age (2.01 years) and median size ($9.81 million) between 2013Q1 and 2021Q4, conditioning on fund's third party service provider, general solictitation and foreign registration of the private fund. Dependent and independent variables identical to those in Table 7. Control variables are identical to those in Table 4. Refer to Appendix II for detailed variable definitions. Standard errors are triple clustered by fund type, year and state, with *t*-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Age	***<= Med. Size***	***> Med. Size***	***<= Med. Age***	***> Med. Age***	***<= Med. Size***	***> Med. Size***	***<= Med. Age***	***> Med. Age***
Dependent Variable	***log(CR)***		***log(CR)***		***log(Owners)***		***log(Owners)***	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Marketer	-0.176*	0.486	0.102	-0.032	0.420***	0.287**	0.534***	0.474***
	(0.079)	(0.110)	(0.167)	(0.774)	(0.001)	(0.019)	(0.000)	(0.000)
Auditor (external)	0.365***	0.620**	0.582***	0.599***	-0.053	-0.194	0.085	0.121
	(0.000)	(0.036)	(0.000)	(0.001)	(0.113)	(0.425)	(0.624)	(0.109)
Books & Records holder	0.004	-0.176	0.090	0.013	-0.085	0.130**	-0.086	-0.044
	(0.844)	(0.496)	(0.117)	(0.588)	(0.136)	(0.048)	(0.296)	(0.380)
Solicitation	0.216***	-0.404	0.062	0.075	0.041	0.214**	-0.122	0.103
	(0.006)	(0.164)	(0.422)	(0.439)	(0.857)	(0.021)	(0.328)	(0.485)
Foreign Registration	-0.142	0.224	-0.319**	-0.009	-0.203*	0.057	-0.143*	-0.087
	(0.110)	(0.308)	(0.046)	(0.927)	(0.054)	(0.401)	(0.068)	(0.413)
Min Inv. Amount (log)	0.034**	0.034	0.087***	0.048***	-0.176**	-0.017	-0.170***	-0.122**
	(0.024)	(0.323)	(0.006)	(0.001)	(0.012)	(0.328)	(0.001)	(0.037)
Log AUM	-0.180***	-0.715**	-0.267***	-0.191**	0.154**	0.264***	0.245***	0.205***
	(0.006)	(0.017)	(0.007)	(0.015)	(0.010)	(0.001)	(0.000)	(0.000)
Log Age	-0.147***	-0.306*	-0.216***	-0.239**	0.121***	0.146**	0.132*	0.155**
	(0.007)	(0.051)	(0.001)	(0.017)	(0.008)	(0.040)	(0.098)	(0.025)
Annual Audit	0.011	0.078	0.271	0.083	0.109	0.561***	0.029	-0.060
	(0.865)	(0.892)	(0.266)	(0.491)	(0.389)	(0.002)	(0.918)	(0.678)
Observations	50,374	68,641	29,923	101,717	50,296	68,507	29,891	101,513
Adj. R2	0.03	0.08	0.05	0.04	0.21	0.20	0.23	0.20
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 11

Fund Future Proportional Capital Managed and Owners Regressions for Matched Funds that faced Disciplinary Actions

This table reports results of the panel regressions of future proportional capital manager amounts *(NAC_t+1,2,3,* yearly percentages over the next 3 years) and log number of investors *(log(Owners)_t+1,2,3,* over the next 3 years) between 2013Q1 and 2021Q4, conditioning on fund's disciplinary action type. The dependent variable is the percentage change in capital raise amount on year t+1,2,3 *(NAC_t+1,2,3)* or log number of investors (*log(Owners_t+1,2,3)*. DIS is an indicator variable set to 1 if a Civil/Criminal/Regulatory action is initiated against fund and 0 otherwise. Control variables are identical to those in Table 4. Refer to Appendix II for detailed variable definitions. Standard errors are triple clustered by fund and year and state, with t-statistics reported in parenthesis. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Panel A: Number of Investors

Disciplinary Action		***Civil***			***Criminal***			***Regulatory***	
	t+1	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
DIS	-0.017	-0.029	-0.064	-0.036**	-0.004*	-0.038**	0.052	0.057	0.046
	(0.598)	(0.396)	(0.107)	(0.019)	(0.068)	(0.049)	(0.352)	(0.198)	(0.457)
Log AUM	0.076**	0.076**	0.079**	0.098***	0.081**	0.054**	0.082***	0.090***	0.093***
	(0.015)	(0.016)	(0.012)	(0.006)	(0.013)	(0.023)	(0.000)	(0.000)	(0.000)
Log Age	-0.015	-0.040	-0.027	-0.039	-0.120	-0.139	0.006	-0.015	0.017
	(0.647)	(0.206)	(0.476)	(0.508)	(0.310)	(0.139)	(0.860)	(0.761)	(0.621)
Annual Audit	0.057	0.069	0.087	0.036	-0.021	0.016	0.111***	0.108***	0.116***
	(0.295)	(0.253)	(0.118)	(0.171)	(0.396)	(0.414)	(0.009)	(0.000)	(0.005)
Observations	7,512	6,401	5,409	1,329	1,171	1,019	27,861	24,224	20,867
Adj. R2	0.20	0.20	0.20	0.45	0.45	0.45	0.22	0.23	0.23
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Match Ratio (%)	99.43	100	100	100	100	100	100	100	100

Table 11: ***Fund Future Proportional Capital Managed and Owners Regressions for Matched Funds that faced Disciplinary Actions (Cont'd)***

Panel B: NAC

Disciplinary Action		***Civil***			***Criminal***			***Regulatory***	
	t+1	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***	***t+1***	***t+2***	***t+3***
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
DIS	-0.059	0.002	0.023	-0.184***	-0.073*	-0.015*	0.014	0.049	0.042
	(0.147)	(0.928)	(0.505)	(0.000)	(0.078)	(0.050)	(0.608)	(0.200)	(0.320)
Log AUM	-0.192***	-0.202***	-0.214***	-0.366**	-0.398***	-0.445***	-0.274***	-0.270***	-0.257***
	(0.000)	(0.000)	(0.000)	(0.011)	(0.009)	(0.010)	(0.000)	(0.000)	(0.000)
Log Age	-0.117	-0.167*	-0.128	0.013	0.053*	0.103	-0.141**	-0.186**	-0.154***
	(0.104)	(0.058)	(0.179)	(0.711)	(0.099)	(0.495)	(0.040)	(0.020)	(0.010)
Annual Audit	0.192	0.178	0.140	-0.035	-0.144	-0.164	0.125*	0.158***	0.205***
	(0.125)	(0.202)	(0.206)	(0.862)	(0.546)	(0.579)	(0.071)	(0.001)	(0.000)
Observations	7,553	6,437	5,442	1,330	1,172	1,021	27,973	24,329	20,970
Adj. R2	0.02	0.03	0.03	0.18	0.19	0.23	0.04	0.03	0.03
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Match Ratio (%)	99.43	100	100	100	100	100	100	100	100

7 Appendix I – Disclosure Information

This information is excerpted from U.S. Securities Exchange Commission's website available at **https://www.sec.gov/about/forms/formadv-part1a.pdf**

1. **Criminal Actions**

   a. In the past ten years, have you or any advisory affiliate:

   i. been convicted of or pled guilty or nolo contendere ("no contest") in a domestic, foreign, or military court to any felony?

   ii. been charged with any felony?

   b. In the past ten years, have you or any advisory affiliate:

   i. been convicted of or pled guilty or nolo contendere ("no contest") in a domestic, foreign, or military court to a misdemeanor involving:

   1. investments or an investment-related business, or any fraud, false statements, or omissions, wrongful taking of property, bribery, perjury, forgery, counterfeiting, extortion, or a conspiracy to commit any of these offenses?

   ii. been charged with a misdemeanor listed in Item 11.B.(1)?

2. **Regulatory Actions**

   a. Has the SEC or the Commodity Futures Trading Commission (CFTC) ever:

   i. found you or any advisory affiliate to have made a false statement or omission?

   ii. found you or any advisory affiliate to have been involved in a violation of SEC or CFTC regulations or statutes?

iii. found you or any advisory affiliate to have been a cause of an investment-related business having its authorization to do business denied, suspended, revoked, or restricted?

iv. entered an order against you or any advisory affiliate in connection with investment-related activity?

v. imposed a civil money penalty on you or any advisory affiliate, or ordered you or any advisory affiliate to cease and desist from any activity?

b. Has any other federal regulatory agency, any state regulatory agency, or any foreign financial regulatory authority:

i. ever found you or any advisory affiliate to have made a false statement or omission, or been dishonest, unfair, or unethical?

ii. ever found you or any advisory affiliate to have been involved in a violation of investment-related regulations or statutes?

iii. ever found you or any advisory affiliate to have been a cause of an investment-related business having its authorization to do business denied, suspended, revoked, or restricted?

iv. in the past ten years, entered an order against you or any advisory affiliate in connection with an investment-related activity?

v. ever denied, suspended, or revoked your or any advisory affiliate's registration or license, or otherwise prevented you or any advisory affiliate, by order, from associating with an investment-related business or restricted your or any advisory affiliate's activity?

c. Has any self-regulatory organization or commodities exchange ever:

i. found you or any advisory affiliate to have made a false statement or omission?

ii. found you or any advisory affiliate to have been involved in a violation of its rules (other than a violation designated as a "minor rule violation" under a plan approved by the SEC)?

iii. found you or any advisory affiliate to have been the cause of an investment-related business having its authorization to do business denied, suspended, revoked, or restricted?

iv. disciplined you or any advisory affiliate by expelling or suspending you or the advisory affiliate from membership, barring or suspending you or the advisory affiliate from association with other members, or otherwise restricting your or the advisory affiliate's activities?

d. Has an authorization to act as an attorney, accountant, or federal contractor granted to you or any advisory affiliate ever been revoked or suspended?

e. Are you or any advisory affiliate now the subject of any regulatory proceeding that could result in a "yes" answer to any part of Item 11.C., 11.D., or 11.E.?

3. Civil Judicial Actions

a. (1) Has any domestic or foreign court:

i. in the past ten years, enjoined you or any advisory affiliate in connection with any investment-related activity?

ii. ever found that you or any advisory affiliate were involved in a violation of investment-related statutes or regulations?

iii. ever dismissed, pursuant to a settlement agreement, an investment-related civil action brought against you or any advisory affiliate by a state or foreign financial regulatory authority?

b. Are you or any advisory affiliate now the subject of any civil proceeding that could result in a "yes" answer to any part of Item 11.H.(1)?

8 Appendix II – Variable Definitions

Variable	Definition
auditor	Indicator variable set to 1 if a fund used a third-party auditor before the capital raise; 0 otherwise.
AUM	Total equity assets managed of a private fund, calculated using the equity assets based on the Form ADVs.
books	Indicator variable set to 1 if a fund used a third-party books and records holder before the capital raise; 0 otherwise.
DIS_reg	Indicator variable set to 1 if regulatory disciplinary action happens within a year; 0 otherwise.
DIS_civil	Indicator variable set to 1 if regulatory disciplinary action happens within a year; 0 otherwise.
DIS_criminal	Indicator variable set to 1 if regulatory disciplinary action happens within a year; 0 otherwise.
foreign	Indicator variable set to 1 if a fund is registered with a foreign authority before the capital raise; 0 otherwise.
foreign_ownr	Annual percentage of fund holdings of foreign investors.
funds_ownr	Annual percentage of fund holdings of funds-of-funds.
Log_Age	The natural logarithms of 1 + the Fund's age in years.
marketing	Indicator variable set to 1 if a fund used a third-party marketer before the capital raise; 0 otherwise.
Minimum Investment Amount	Minimum required dollar amount from investors to be accepted in a private fund.
NAC	Ratio of total capital managed in a given year divided by the amount of the previous year.
owners	Number of total investors that invested in a fund during a capital raise process in a year.
solicitation	Indicator variable set to 1 if a fund performed general solicitation to the outside investors before the capital raise; 0 otherwise.

Chapter IV: Valuation of Bitcoin Options

1 Introduction

Since the introduction of the bitcoin in 2009, over 6,000 cryptocurrencies have been created worldwide and are being traded on more than 25,000 online venues. At the time of writing (March 31, 2021), the total market capitalization is over $1.92 trillion, with bitcoin being the dominant leader with a market cap of $1.09 trillion. Eithereum is the distant second with a market cap of $210 billion (see https://coinmarketcap.com). The fast development of cryptocurrencies and the investors' avid interest have promoted the listing of futures contracts on bitcoins, the market leader of cryptocurrencies, by Cboe Global Markets Inc and CME Group on December 10 and December 17, 2017, respectively. In fact, before these formal listings of futures contracts, derivatives on cryptocurrencies have been traded on various online venues.

Despite the prevalence of cryptocurrency derivatives on both the formal exchanges and online venues, there exists no rigorous valuation framework that models the behavior of cryptocurrency prices and the values of derivatives on cryptocurrencies in a consistent and uniform fashion. To the best of our knowledge, there are only a few trade articles explaining how the bitcoin or crypto derivatives work. For example, Lielacher (2019) and Shome (2020) describe the basic terms of crypto futures and option contracts and provide some tips on how and where to trade crypto derivatives. Söylemez (2019) uses bitcoin derivatives as an example to illustrate the application of the blockchain technology from the perspective of the financial market innovation.

The current paper fills this gap by focusing on bitcoins. In a small open economy setting, we build a valuation framework by taking into account two important features of the bitcoin: the total supply of bitcoins is capped at 21 million units, and the prices experience frequent, large size jumps (Chaim, 2018; and Yalaman, 2020). For the sake of both modeling convenience and intuitive interpretations, we treat the bitcoin as a foreign currency and thus its price is just an exchange rate against the U.S. dollar. We summarize the key model features below, followed by the main insights from numerical analyses.

The fixed supply of 21 million bitcoins necessarily means that the bitcoin price depends on the home country's money supply. Therefore, money supply must be an important element in the valuation framework. Meanwhile, insofar as bitcoin prices are found to be correlated with the U.S. stock market index (e.g., Chavez-Dreyfuss, 2020), the framework must feature a correlation between the bitcoin returns and the market portfolio returns. Finally, bitcoin prices exhibit large jumps, some of which might not be diversifiable, rendering the standard risk-neutral valuation technique inapplicable. An equilibrium valuation framework is called for.

The framework in Cao (2001) offers all of the above features and is therefore adopted by treating bitcoin as the foreign currency and by generalizing the log-utility to a power utility so as to study the effect of risk-aversion. In the small open economy, money has a non-trivial role in the representative agent's utility function. The home government controls money supply which follows an exogenously specified mixed jump-diffusion process. The domestic market portfolio is modelled as a single risky asset which represents the ownership of the productive technology for the single consumption good traded worldwide. The aggregate dividend from the market portfolio is exogenous and follows a mixed-jump diffusion process. Aside from the market portfolio, the representative agent in the small open economy also has access to a foreign discount bond which is denominated in bitcoins and whose real return is exogenous to the agent. Given the processes of the money supply, aggregate dividends, and bond prices in bitcoins, prices of all other assets including the bitcoin price and prices of bitcoin options are derived by solving the domestic agent's maximization problem. As such, the bitcoin price is a function of both the domestic money supply and aggregate dividend (which makes up part of the total consumption), and the jump risks in bitcoin prices are inherited from those in the domestic money supply and aggregate dividend.

Once obtaining the process for the equilibrium bitcoin price, we use the equilibrium valuation equation to derive valuation formulas in analytical form for European options written on the bitcoin. The valuation formulas encompass both the diffusive and jump risks inherent in the money supply process and the exogenous aggregate dividend process. Our valuation framework nests Merton's (1976) model as a special case where there is no jump risk in the market portfolio and the agent is risk neutral in consumption. As such, the only jumps underlying the bitcoin price stem from the money supply and are not priced.

We establish, via static analyses, that bitcoin option prices increase with aggregate consumption volatility and its jump risks, as well as the volatility and jump risks of money supply. However, the effects of the jump intensity of money supply and aggregate consumption are ambiguous. Moreover, call (put) option prices increase (decrease) with the growth rate of money supply.

We also gauge the relative importance of various risks in option valuation using parameters estimated from the time series of bitcoin prices and the S&P 500 index returns. First, a large portion of the bitcoin return volatility comes from the diffusive and jump risks of money supply. Second, the price premiums due to the various risks relative to the base-case Black-Scholes model are all positive and significant regardless of the maturity and moneyness. Third, the magnitude of the aforementioned risk premiums is large in the presence of jump risk, be it systematic or non-systematic. Forth, generally, the risk premiums decrease with maturity and moneyness. Fifth, the

Black-Scholes model undervalues options across all maturities and moneyness and the undervaluation is more pronounced for deep-in-the-money options. Last but not the least, risk premiums increase with the risk aversion parameter.

The rest of the paper is organized as follows. Section 2 introduces the bitcoin and the bitcoin futures markets. Section 3 proposes an equilibrium model to value options. Comparative statics are discussed. Section 4 describes the empirical methodology and presents estimated model parameter values. Section 5 conducts numerical analyses of risk premiums for the bitcoin derivatives. Section 6 concludes the paper. Proofs and tables are relegated to the Appendix.

2 Background of the Bitcoin and Bitcoin Futures

Bitcoin, a cryptocurrency, was invented in 2008 by an unknown person or group of people using the name Satoshi Nakamoto and went into existence in 2009 when its source code was released as open-source software. Bitcoins are created as rewards for a process known as mining. They can be exchanged for other currencies, products, and services. Bitcoin is a decentralized digital currency that can be transacted among users on the peer-to-peer bitcoin network without intermediaries. Transactions are verified by network nodes through cryptography and recorded in a public distributed ledger called a blockchain.[15] Other cryptocurrencies share the same fundamental feature of public ledger and decentralization but differ in various other ways.

Bitcoins can be bought on digital currency exchanges and are often used as an investment vehicle. The price of bitcoins has seen dramatic fluctuations since the inception. The bitcoin price quoted in U.S. dollars rose from a few dimes to more than $30 and then went back down to a few

[15] For more information on bitcoin, please consult the following website: https://en.wikipedia.org/wiki/Bitcoin#cite_note-174 recent financial downturn.

dollars in 2011. In the latter part of 2012 and during the 2012-2013 Cypriot financial crisis, the bitcoin price reached a high of $266 on April 10, 2013, and then crashed to around $50. On November 29, 2013, the bitcoin price reached a new high of $1,242, only to return to $600 in August 2014. Subsequently, the bitcoin price has seen tremendous volatilities although the general trend is impressively upward. At the time of writing (March 2021), the bitcoin price is around $55,000, back from a historical high of $61,283.80 It is evident that the bitcoin price exhibits extremely high volatility compared with gold price or the U.S. stock market indices.

The bitcoin's novelty, its meteoric price rise and the high volatility in the general price appreciation created a perfect impetus for exchanges to list bitcoin derivatives. Such listings can ease investors' concerns about the less known online venues shrouded in mystery and high risk and, at the same time, provide a legitimate venue for investors (e.g., some hedge funds) that would otherwise shun bitcoin investments. To respond to such a market need, Cboe Global Markets Inc and CME Group Inc launched futures contracts on bitcoins on December 10 and 17, 2017 respectively. Perhaps not coincidentally, the launching time corresponded to the peak of the bitcoin price at that time. The bitcoin futures offered by these two exchanges are similar in nature and only differ on minor contract details. For brevity, we only summarize the CME's contract specification here.[16]

Each of the CME Bitcoin Futures contract is on five bitcoins and is settled in U.S. dollars. The underlying contract variable is the so-called CME Bitcoin Reference Rate, an index that references pricing data from designated cryptocurrency exchanges, currently made up of Bitstamp, GDAX, itBit and Kraken. Trading takes place on CME Globex and CME ClearPort from Sunday

[16] To see the differences between the Cboe and the CME bitcoin futures contracts, please consult the following website: https://www.reuters.com/article/us-bitcoin -futures-contracts-idUSKBN1E10KC

to Friday during 6 p.m. to 5 p.m. Eastern time with a one-hour break each day beginning at 5 p.m. All contracts are cleared through CME ClearPort and have an initial margin rate of about 35% (the margin rate varies at the discretion of the exchange). The CME bitcoin futures are monthly contracts for the nearest two months in the March quarterly cycle plus the nearest two serial months not in the March quarterly cycle. CME will apply price limits, also known as circuit breakers, to its bitcoin futures of 7 percent, 13 percent, and 20 percent to the futures fixing price. Trading will not be allowed outside of the 20 percent price limit.

The bitcoin futures market has grown steadily since its inception. At the time of writing (March 2021), almost 10,000 accounts have been opened which entail an average daily trading volume of 8,500 contracts or 42,500 bitcoins, a non-trivial amount given the level of bitcoin prices. Market participants come from all over the world, with 53% of the trading volume originating from the U.S. and the remining 47 percent from the rest of the world.

As investors acquire trading experiences via bitcoin futures, they naturally start to look for vehicles that allow them to speculate on and hedge against bitcoin price volatilities. Responding to such a demand, the CME Group Inc. launched options on its bitcoin futures on January 13, 2020. According to Mr. Tim McCourt, the CME Group Global Head of Equity Index and Alternative Investment Products, the introduction of options on bitcoin futures will offer their customers with greater precision and flexibility to manage their risk exposure to bitcoin.[17] Since its inception, the dollar trading volume for the bitcoin options has increased steadily. [18]

Steady and smooth growth of the bitcoin derivatives market notwithstanding, the total trading volume relative to the total market cap is still small. The lack of a widely accepted valuation

[17] For precise option contracts on bitcoin futures, please consult the following website: http://www.cmegroup.com/bitcoinoptions.

[18] For details, please consult https://decrypt.co/30510/cme-bitcoin-options-set-new-record-in-trading-volume.

model might be partially responsible. An analogy could be drawn to the CME weather derivatives in their early years. After its inception in 1997, the CME weather derivatives market saw only sporadic trades in the early years and the total trading volume ranged from 2,000 to 5,000 contracts per year. It is reasonable to speculate that the lackluster trading was partly due to the challenge in properly valuing the weather derivatives written on non-tradable temperature indices. As reliable valuation models were slow in coming, potential market participants stayed on the sidelines for not knowing exactly how the weather derivatives should be valued. Subsequently, as various valuation models became available (e.g., Cao and Wei, 2004), more investors were drawn to the market (e.g., hedge fund managers used weather derivatives as alternative investment vehicles). In fact, the trading volume of the CME weather derivatives was 15,775 in 2019, and 13,725 for the first five months in 2020.

To the best of our knowledge, despite a few trade articles explaining how crypto derivatives work (Lielacher 2019, Shome 2020 and Söylemez 2019), a widely accepted valuation model doesn't exist. The objective of the paper is to propose a sensible valuation model for bitcoin derivatives. It is our hope that the proposed valuation framework will help stimulate more trading of the bitcoin derivatives down the road.

3 A Small Open Monetary Economy

We adopt the framework of a small open economy in Cao (2001) with a monetary component and take the bitcoin as the foreign currency. This small open economy consists of a single risk-averse representative agent with an infinite lifetime horizon. In Cao (2001), the representative agent has a log utility which prevents us from studying the impact of risk-aversion on asset prices. To remedy this while maintaining analytical tractability, we extend the log utility preference in Cao (2001) to the following:

$$U(c_t, m_t, t) = e^{-\rho t}\left[\alpha \frac{c_t^{\gamma+1}}{\gamma+1} + (1-\alpha) ln m_t\right],$$

(3.1)

where γ measures the risk-aversion attitude of the representative agent.

In addition, this small open economy has perfect capital mobility between itself and the rest of the world, viz. the foreign country. That is, the agent has perfect access to the international goods and assets markets. Since the small economy has little influence on the foreign country, it takes the price of any foreign asset as given. Also, the domestic currency and domestic assets held by the foreign country are assumed to be negligible, implying that the supplies of these assets and the domestic currency are cleared by domestic demands. Furthermore, the domestic aggregate consumption is financed through both the aggregate output (dividend) and the return from foreign asset holdings paid in consumption goods.

In the following subsections, we describe the primitives of the economy and then derive bitcoin forward and option prices.

3.1 Structure of a Small Open Economy

In the small open economy in Cao (2001), there is a single good traded worldwide with no barriers and this good can be used for consumption and investment. The nominal price of the good at home at time t is denoted p_t. Let P^* be the price level measured in the foreign currency. According to the law of one price in the good market, p_t equals the spot exchange rate times P^*. Since the home country is small, it takes P^* as given and so we can simplify the discussions by normalizing $P^{*}=1$. Then, p_t becomes the spot exchange rate and, in our setting, it is the dollar price per unit of bitcoin.

The home government controls domestic money supply, which is taken as given by each domestic agent. The balance of real money held by the domestic agent at time t is defined as $m_t = M_t / p_t$, where M_t is the domestic money demanded by home agents. Following Cao (2001), we assume that the agent's period utility function, $U(c_t, m_t, t)$, depends on the agent's consumption c_t, and the real money balance, m_t. The rationale is that a larger real money balance reduces the transaction time in the goods market and hence allows the agent to enjoy more leisure. Since we work with a representative agent in the economy, in equilibrium, the government's money supply will equal the agent's total demand for money.

We assume the government's purchase of goods and services to be constant, implying that any change in the money supply will directly translate into a corresponding change in the representative agent's money holding. Therefore, it is the changes in the total money supply that will affect the agent's utility optimization. In the current setup, we first solve for the agent's optimization problem and then determine the equilibrium asset prices and the exchange rate (namely, the bitcoin price). Therefore, the bitcoin price will depend on the model primitives, including the agent's utility function, the domestic money supply, and aggregate dividends.

As we know, the bitcoin price exhibits frequent and large jumps as shown by Chaim (2018) and Yalaman (2020). This empirical feature is not unique to bitcoin prices. Other major exchange rates also exhibit jump risks, as shown in Akgiray and Booth (1988), and Bates (1996). To reflect these jumps in bitcoin prices, it is necessary to introduce jumps in the domestic money supply. The mixed jump-diffusion model has been used in the existing literature to study monetary policies. For example, Ball (1993) uses a mixed jump-diffusion process to study the European monetary system. We adopt Ball (1993)'s approach by proposing the following process for the domestic money supply:

$$\frac{dM^S}{M^S} = (\mu_m - \lambda_m k_m)dt + \sigma_m dz_m + (Y_m - 1)dQ_m, \qquad \forall \qquad t \in (0, \infty), \qquad (3.2)$$

where μ_m is the instantaneous expected growth rate of the money supply, σ^2_m is the instantaneous variance of the growth rate, conditional on no arrivals of new important shock and dz_m is the increment of a one-dimensional Gauss-Weiner process. The element dQ_m is the increment of a jump process with a jump intensity parameter λ_m, and $(Y_m - 1)$ is the random percentage change in the money supply if the Poisson event occurs. The logarithm of Y_m is assumed to be normally distributed with mean θ_m and variance ϕ^2_m, which means the expected jump amplitude is $k_m = E(Y_m - 1) = \exp\left(\theta_m - \frac{1}{2}\phi_m^2\right) - 1$, and $\bar{k}_m = E\left(\frac{1}{Y_m} - 1\right) = \exp\left(-\theta_m + \frac{1}{2}\phi_m^2\right) - 1$. The random variables $\{z_{mt}, t >= 0\}$, $\{Q_{mt}, t >= 0\}$, and $\{Y_{mj}, j >= 1\}$ are assumed to be mutually independent. Also, Y_{mj} is independent of $Y_{mj'}$ for $j \neq j'$. The parameters (μ_m, σ_m, λ_m, θ_m, and ϕ_m) are constant.

In the above money supply process, the diffusion term dz_m captures the frequent fluctuations in the money supply while the jump term dQ_m captures the infrequent large shocks, both of which mimic actual changes in government monetary policies. For instance, large increases in money supply due to quantitative easing can be considered as infrequent jumps.

There is only one domestic risky asset, which represents the ownership of the home productive technology for the single good and whose total supply is normalized to one. Denote its real price at time t as S_t and the dividend as δ_t. The dividend stream $\{\delta_t\}$ is exogenous and can be understood as aggregate dividends in this small open economy.

There is a single foreign pure discount bond denominated in bitcoins available for trading to the home agent at any time. That is, the net trading in assets between this small economy and the foreign country is positive and time-varying. The agent diversifies his portfolio internationally by holding the bitcoin and the domestic financial assets. Since the country is small, the real price of the foreign bond at time t, F_t, is taken as exogenous by the home agent. The dynamics of F_t are assumed as $dF = r_f F dt$, where r_f is the foreign interest rate, or interest rate on bitcoin.

Finally, there is a single domestic nominal discount bond in zero net supply characterized by $dB = r_d B dt$ where r_d is the nominal rate of return to be endogenously determined in equilibrium. The real price of the domestic bond at time t, b_t is given as $b_t = B_t / p_t$. In addition, there are many other contingent claims on the risky domestic asset or stock and the spot exchange rate available for trading at any time in the economy. These contingent claims are all in zero net supply and their real prices at time t are dented by a vector x_t with the corresponding vector of real dividends δ_t^x.

3.2 Equilibrium Exchange Rate and Asset Prices

Within the aforementioned set-up, the representative agent in the small open economy maximizes his expected lifetime utility by optimally choosing his consumption and portfolio holdings. The optimization problem is stated below:

$$\max_{c,m,N} \int_0^\infty U(c_t, m_t, t)dt$$

subject to the following budget constraint

$$\int_0^t c_\tau \; d\tau = \frac{M_0}{p_0} + \int_0^t M_\tau \; (\frac{1}{p_\tau}) - \frac{M_t}{p_t} + N_0 X_0 + \int_0^t N_\tau \; (dD_\tau + dX_\tau) - N_t X_t.$$

In the above budget constraint, X is a vector standing for prices of any assets in the small open economy including derivative securities. The subscript denotes the time index. N is a vector standing for shareholdings of the corresponding assets. The budget constraint intuitively states that the sum of the wealth increase and consumption flow is bounded by the dividend and capital gain from the portfolio holdings.

By solving the representative agent's optimization problem, we can determine the equilibrium exchange rate and asset prices as follows:

$$\frac{1}{p_t} = \frac{1}{U_c(c_t, m_t, t)} E\left[\int_0^\infty U_m\,(c_\tau, m_\tau, \tau)\frac{1}{p_\tau}\,d\tau\right]. \tag{3.3}$$

$$X_t = \frac{1}{U_c(c_t, m_t, t)} E\left[\int_0^\infty U_c\,(c_\tau, m_\tau, \tau) dD_\tau\right]. \tag{3.4}$$

The notations U_c and U_m stand for the first order derivative of the utility function with respect to consumption *c* and real money holding *m*. The interpretations of the equilibrium exchange rate and asset prices are as follows. The reciprocal of the real exchange rate in (3.3) equals the expected discounted sum of future real wealth of one dollar, with the state price deflator being the marginal rate of substitution between consumption and the real money balance. The price of any other asset in (3.4) equals the expected discounted sum of dividends, with the stochastic state price deflator being the marginal rate of substitution between consumption at different dates.

The usual goods market clearing condition in Lucas (1982), the equality between consumption and dividend, doesn't hold in the small open economy. The investment in the foreign bond provides additional source of consumption and the holding of the foreign bond acts as a final adjustment account. Specifically, let *f* be the value of the foreign bond holding. Then the total cash inflow is $(\delta dt + r_f f\, dt)$ and the residual after consumption is $(\delta dt + r_f f\, dt) - cdt = (\delta + r_f f - c)dt$, which is balanced out by the change in the foreign bond holding, i.e., $df = (\delta + r_f f - c)dt$.

By taking derivatives of the utility function in Equation (3.1) with respective to the consumption argument and integrating the expectation in Equation (3.4), we can obtain the following result. To save space, we have collected the derivations and the main equilibrium results in the Appendix. For further derivation details, interested readers may consult Cao (2001).

Result 1. *The domestic market portfolio price is* $X = \frac{\delta}{\rho - \gamma(\mu_x - \lambda_x k_x) - \frac{\gamma(\gamma-1)\sigma_x^2}{2} - \lambda_x\left[\exp\left(\gamma\theta_x + \frac{1}{2}\gamma^2\phi_x^2\right) - 1\right]}$,

hence its process is determined as follows:

$$\frac{dX}{X} = (\mu_x - \lambda_x k_x)dt + \sigma_x dz_x + (Y_x - 1)dQ_x, \qquad \forall \qquad t \in (0, \infty). \qquad (3.5)$$

Here, μ_x is the instantaneous expected return; σ_x is the instantaneous volatility, conditional on no arrivals of new important shock and dz_x is the increment of a one-dimensional Gauss-Weiner process. The element dQ_x is increment of a jump process with a jump intensity parameter λ_x and E(Y_x -1) is the random percentage change if the Poisson event occurs. The logarithm of Y_x is normally distributed with mean θ_x and variance ϕ^2_x. The expected jump amplitude, $k_x = E(Y_x - 1) = \exp\left(\theta_x - \frac{1}{2}\phi_x^2\right) - 1$, which is also understood as the expectation of the random percentage change. In addition, we also compute $\bar{k}_x(\gamma) = E\left(\frac{1}{Y_x^\gamma} - 1\right) = \exp\left(-\gamma\theta_x + \frac{1}{2}\gamma^2\phi_x^2\right) - 1$. The random variables $\{z_{xt}, t >= 0\}$, $\{Q_{xt}, t >= 0\}$, and $\{Y_{xj}, j >= 1\}$ are assumed to be mutually independent. Also, Y_{xj} is independent of $Y_{xj'}$ for $j \neq j'$. The parameters (μ_x, σ_x, λ_x, θ_x, and ϕ_x) are constant. dQ_m and dQ_x are independent. dz_{mt} and dz_{xt} are correlated with a correlation coefficient η. It should be noted that all the parameters are functions of the parameters governing the processes of the money supply and the aggregate dividend. Moreover, dz_x and dQ_x will be directly inherited from the dividend process once it is specified.

It is worth noting that the exogenous aggregate dividend is assumed to follow a mixed jump-diffusion process which entails the price process for the domestic market portfolio stated in Equation (3.5). The assumed mixed jump-diffusion process for aggregate dividend is supported by empirical evidence documented by Marsh and Merton (1987) for aggregate divided behavior. Such an assumption has been used by other researchers such as Naik and Lee (1990).

Result 2. *The equilibrium bitcoin price is the exchange rate, determined as* $p_t = \alpha\, r_d M_t\, d_t^{\,\gamma}/(1\text{-}\alpha)$*. It is a function of the domestic money supply and the market portfolio through its dependence on aggregate dividend as stated in* ***Result 1****. Its process is*

$$\frac{dp}{p} = (\mu_m - \lambda_m k_m)dt + \gamma(\mu_x - \lambda_x k_x)dt + \frac{1}{2}\gamma(\gamma-1)\sigma_x^2 dt$$

$$\sigma_m dz_m + \gamma\sigma_x dz_x + (Y_m - 1)dQ_m + \left(Y_x^{\gamma} - 1\right)dQ_x, \quad \forall \quad t \in (0,\infty). \tag{3.6}$$

It is evident that the market portfolio and the bitcoin price processes in (3.5) and (3.6) are intertwined since they are both endogenously derived from the more fundamental variables, viz., the aggregate dividend and the money supply. This internal link provides cross-equation restrictions for estimation to be made explicitly in the empirical section.

The forward price of a bitcoin obeys the cost-of-carry condition. Since the bitcoin price is the exchange rate, the forward price satisfies the interest rate parity and is simply $p_t e^{(r_d - r_f)T}$ where T is the maturity of the forward contract. The dynamic of the forward price is a direct mapping of the spot price dynamic and, as a result, the forward price per se does not depend on all the risks. However, prices of bitcoin options would directly depend on the diffusive and jump risks due to the nonlinear payoff. We present the option prices below, followed by detailed risk discussions.

Result 3. *The European call and put option prices written on bitcoin with a strike price of K and a maturity of T are stated below (see Appendix for a proof):*

$$C_{CB}(p_t, T-t, K) = \sum_{i=0}^{\infty}\sum_{j=0}^{\infty} \frac{e^{-\lambda_x\tau}[\lambda_x\tau]^i}{i!}\frac{e^{-\lambda_m\tau}[\lambda_m\tau]^j}{j!} C_{BS}\left(p_t, \tau, K, r_f^i, r_d^j, \sigma_{i,j}\right), \tag{3.7}$$

$$P_{CB}(p_t, T-t, K) = \sum_{i=0}^{\infty}\sum_{j=0}^{\infty} \frac{e^{-\lambda_x\tau}[\lambda_x\tau]^i}{i!}\frac{e^{-\lambda_m\tau}[\lambda_m\tau]^j}{j!} P_{BS}\left(p_t, \tau, K, r_f^i, r_d^j, \sigma_{i,j}\right), \tag{3.8}$$

where

$$r_f^i = r_f + \lambda_x \bar{k}_x(\gamma) - i\left[\frac{-\gamma\theta_x + \frac{1}{2}\gamma^2\,\phi_x^2}{\tau}\right], \qquad r_d^j = r_d + \lambda_m \bar{k}_m - j\left[\frac{-\theta_m + \frac{1}{2}\phi_m^2}{\tau}\right],$$

$$\bar{k}_x(\gamma) = \exp\left(-\gamma\theta_x + \frac{1}{2}\gamma^2\phi_x^2\right) - 1,\ \bar{k}_m = \exp\left(-\theta_m + \frac{1}{2}\phi_m^2\right) - 1. \text{ The}$$

$$\sigma_{i,j}^2 = \sigma_m^2 + j\frac{\phi_m^2}{\tau} + 2\gamma\eta\left[(\sigma_m^2 + j\frac{\phi_m^2}{\tau})(\sigma_x^2 + i\frac{\phi_x^2}{\tau})\right]^{\frac{1}{2}} + \gamma^2\left[\sigma_x^2 + i\frac{\phi_x^2}{\tau}\right], \qquad \tau = T - t.$$

Also, C_{BS} and P_{BS} stand for the Black-Scholes European call and put valuations with the following notation:

$$C_{BS}(p_t, \tau, K, r_1, r_2, \sigma) = p_t e^{-r_1\tau} N(d_1) - K e^{-r_2\tau} N(d_2),$$

$$P_{BS}(p_t, \tau, K, r_1, r_2, \sigma) = K e^{-r_2\tau} N(-d_2) - p_t e^{-r_1\tau} N(-d_1),$$

$$d_1 = \frac{\ln\left(\frac{p_t}{K}\right) + (r_2 - r_1 + \frac{1}{2}\sigma^2)\tau)}{\sigma\sqrt{\tau}}, \qquad d_2 = d_1 - \sigma\sqrt{\tau}.$$

Insofar as the call and put option values in (3.7) and (3.8) are infinite sums of Black-Scholes option values, we can easily see that the bitcoin option value increases with the aggregate consumption volatility and its jump risks, as well as the volatility and jump risks of the money supply. The call (put) value should increase (decrease) with the money supply growth rate. Unfortunately, the effects of the jump intensity in the money supply and aggregate consumption processes are ambiguous.

Our model encompasses the Black-Scholes model and the Merton's model as special cases. Additionally, it allows various other simplifications depending on the parameter combinations we choose. Below, we describe four versions in addition to the Black-Scholes model and the Merton model.

I. Black-Scholes Model: $\lambda_y = \phi_y = \lambda_x = \phi_x = \sigma_x = 0$. The only model input is the bitcoin return volatility σ_y. This set-up corresponds to an economy where no jump risks are present in the domestic money supply and market portfolio which are not correlated (h = 0).

II. Merton's Model: $\lambda_x = \phi_x = \gamma = 0$. The total variance is $\sigma_y^2 + \lambda_y \phi_y^2$ in this case. This specification depicts an economy where there are jump risks in the money supply and the agent is risk neutral in consumption (i.e. $\gamma = 0$). The bitcoin price here only has non-systematic jump risks which is inherited from the domestic money supply.

III. Version 1 without jump risks: $\lambda_y = \phi_y = \lambda_x = \phi_x = 0$. This specification corresponds to an economy where there are no jump risks in the money supply and market portfolio. In this case, the bitcoin price does not exhibit jump risks. The total variance is $\sqrt{\sigma_y^2 + 2\eta\gamma\sigma_y \sigma_x + \gamma^2\sigma_x^2}$, measuring the co-variability between the bitcoin and the market portfolio. Version 1 reduces to the Black-Scholes model when h = 0 (bitcoin return is not correlated with the market return) or g = 0 (agents are risk neutral).

IV. Version 2 with only non-systematic jump risks: $\lambda_x = \phi_x = 0$. The economy described in this specification exhibits jump risks in domestic money supply. The total variance is $\sigma_y^2 + \lambda_y \phi_y^2 + 2\eta\gamma\sigma_x \sqrt{\sigma_y^2 + \lambda_y \phi_y^2} + \gamma^2\sigma_x^2$. The bitcoin price has non-systematic jump risks only, inherited from the home country's money supply. The Merton's model is a special case of Version 2 with g = 0 (agents are risk-neutral).

V. Version 3 with systematic jump risks: $\lambda_y = \phi_y = 0$. This specification contains jump risks in the market portfolio. The total variance is $\sigma_y^2 + 2\eta\gamma\sigma_y \sqrt{\sigma_x^2 + \lambda_x \phi_x^2} + \gamma^2(\sigma_x^2 + \lambda_x \phi_x^2)$. The bitcoin price has systematic jump risks only, inherited from the stock.

VI. Version 4 with systematic and non-systematic jump risks: this is the full version of the current model where the total variance equals $\sigma_y^2 + \lambda_y \phi_y^2 + 2\eta\gamma\sqrt{(\sigma_y^2 + \lambda_y \phi_y^2)(\sigma_x^2 + \lambda_x \phi_x^2)} + \gamma^2(\sigma_x^2 + \lambda_x \phi_x^2)$. The bitcoin price has jump risks inherited from both the domestic stock market and the money supply.

In the next section, we empirically estimate model parameters for the above six specifications and numerically compute corresponding option prices. We then quantify the effects of various risks.

4 Empirical Estimations

4.1 Methodology of Empirical Estimation

This section presents the maximum-likelihood estimation procedure adopted by Jorion (1988) and Bates (1996) for mixed jump-diffusion processes. Define the logarithmic difference of the stock market portfolio as $x_t = ln(Xt / X_{t-1})$. For notational purpose, we rewrite the process for the market portfolio in (3.5) as

$$dlnX = \alpha_x dt + \sigma_x dz_x + (Y_x - 1)dQ_x,$$

where $\alpha_x = \mu_x - \lambda_x k_x + \frac{1}{2}\sigma_x^2$. Thus,

$$x_t = \ln(X_t/X_{t-1}) = \alpha_x + \sigma_x z_x + \sum_{i=1}^{n_t} lnY_x^i, \quad (4.1)$$

where n_t is the actual number of jumps in the stock market during the interval. The diffusive risk dz_x and the jump uncertainty dQ_x are inherited from aggregate consumption.

Similarly, define the logarithmic difference of bitcoin price as $y_t = ln(p_t / p_{t-1})$. We rewrite the process in (3.6) as

$$dlnp = (\alpha_y + \gamma\alpha_x)dt + \sigma_y dz_y + \gamma\sigma_x dz_x + (Y_y - 1)dQ_y + (Y_x^\gamma - 1)dQ_x,$$

where $\alpha_y = \mu_m - \lambda_m k_m + \frac{1}{2}\sigma_m^2$ *and* $\sigma_y = \sigma_m$. Thus,

$$y_t = \ln\,(p_t/p_{t-1}) = \alpha_y + \gamma\alpha_x + \sigma_y z_y \quad + \gamma\sigma_x z_x \alpha_x + \sum_{j=1}^{w_t} lnY_y^j + \gamma\sum_{i=1}^{n_t} lnY_x^i, \qquad (4.2)$$

where w_t is the actual number of jumps in the money supply during the interval. The diffusive risk dz_y and the jump uncertainty dQ_y are inherited from domestic money supply. The correlation between dz_y and dz_x is η.

Denote the parameters by a vector $\beta = (\alpha_x, \sigma_x, \lambda_x, \theta_x, \phi_x, \alpha_y, \sigma_y, \lambda_y, \theta_y, \phi_y, \eta, \gamma)'$. It is easy to show that the joint density function for x_t and y_t is

$$f(x_t, y_t; \beta) = \sum_{i=0}^{\infty}\sum_{j=0}^{\infty} \frac{e^{-\lambda_x}\lambda_x^i}{i!}\frac{e^{-\lambda_y}\lambda_y^j}{j!}\frac{1}{2\pi\sqrt{\Sigma_x^i\Sigma_y^j(1-\eta^2)}} g(x_t, y_t - \lambda x_t; \psi_x^i, \psi_y^j, \Sigma_x^i, \Sigma_y^j, \eta),$$

where

$$g\big(x_t, y_t - \lambda x_t; \psi_x^i, \psi_y^j, \Sigma_x^i, \Sigma_y^j, \eta\big) = exp\left[\frac{-1}{2(1-\eta^2)}\left\{\frac{(x_t-\psi_x^i)^2}{\Sigma_x^i} - 2\eta\frac{(x_t-\psi_x^i)\big(y_t-\gamma x_t-\psi_y^j\big)}{\sqrt{\Sigma_x^i\Sigma_y^j}} + \frac{\big(y_t-\gamma x_t-\psi_y^j\big)^2}{\Sigma_y^j}\right\}\right],$$

with

$$\psi_x^i = \alpha_x + i\theta_x, \qquad \Sigma_x^i = \sigma_x^2 + i\phi_x^2,$$

$$\psi_y^j = \alpha_y + j\theta_y, \qquad \Sigma_y^j = \sigma_y^2 + j\phi_y^2.$$

The marginal densities for x_t and y_t are

$$f(x_t,;\beta) = \sum_{i=0}^{\infty} \frac{e^{-\lambda_x}\lambda_x^i}{i!}\frac{1}{\sqrt{2\pi\Sigma_x^i}} exp\left[-\frac{(x_t-\psi_x^i)^2}{2\Sigma_x^i}\right],$$

$$f(y_t;\beta) = \sum_{j=0}^{\infty} \frac{e^{-\lambda_y}\lambda_y^j}{j!}\frac{1}{\sqrt{2\pi\Sigma_{xy}^{ij}}} exp\left[-\frac{\big(y_t-\gamma x_t-\psi_y^j\big)^2}{2\Sigma_{xy}^{ij}}\right],$$

where

$$\Sigma_{xy}^{ij} = \gamma^2\Sigma_x^i + 2\eta\gamma\sqrt{\Sigma_x^i\Sigma_y^j} + \Sigma_y^j.$$

The first and second moments for the stock market and bitcoin returns are as follows:

$$E(x) = \alpha_x + \lambda_x\theta_x, \qquad Var(x) = \sigma_x^2 + \lambda_x(\theta_x^2 + \phi_x^2), E(y) = \alpha_y + \lambda_y\theta_y + \gamma E(x),$$

$$Var(y) = \sigma_y^2 + \lambda_y(\theta_y^2 + \phi_y^2) + 2\eta\gamma\sqrt{(\sigma_y^2 + \lambda_y(\theta_y^2 + \phi_y^2))Var(x)} + \gamma^2 Var(x).$$

(4.3)

The parameters of interest are estimated by numerical maximization of the likelihood function of the parameter vector $\beta = (\alpha_x, \sigma_x, \lambda_x, \theta_x, \phi_x, \alpha_y, \sigma_y, \lambda_y, \theta_y, \phi_y, \eta, \gamma)'$ given the observation $X = (x,y)$, *and* $L(\beta; X) = \Pi_{t=1}^{T} f(x_t, y_t; \beta)$. The *log-likelihood function* is

$$l(\beta; X) = lnL(\beta; X) = -Tln(2\pi) - T\lambda_x - T\lambda_y - \frac{T}{2}\ln(1-\eta^2)$$

$$+\sum_{t=1}^{T} ln\left[\sum_{i=0}^{\infty}\sum_{j=0}^{\infty}\frac{\lambda_x^i}{i!}\frac{\lambda_y^j}{j!}\frac{1}{\sqrt{\Sigma_x^i\Sigma_y^j}} g(x_t, y_t - \lambda x_t; \psi_x^i, \psi_y^j, \Sigma_x^i, \Sigma_y^j, \eta)\right]. \qquad (4.4)$$

The estimates are consistent, with normal asymptotic distributions of known parameters.[19] In addition, the maximum-likelihood estimation permits formal tests of the relative fit of various distributions. Nested hypotheses can be tested using the generalized likelihood ratio of the maximized likelihood functions under the null and under the enlarged parameter space, which also includes the alternative hypothesis.

$$\Lambda = sup_{\beta\epsilon\Omega 0} L(\beta; X) / sup_{\beta\epsilon\Omega 1} L(\beta; X).$$

Under the null Ω_0, the statistic -2ln Λ has a chi-square distribution with the degree of freedom equal to the difference between the numbers of parameters in the two models. Thus, the improvement in the maximized likelihood indicates the extent to which an enlarged specification

[19] See Judge et. al (page 202) for more detailed discussions regarding the properties of maximum-likelihood estimators and the corresponding regularity conditions.

helps in fitting the data. For example, if the null hypothesis is the Black-Scholes specification, then we test $\lambda_y = \phi_y = \lambda_x = \phi_x = \sigma_x = 0$ against the full specification of the model. Necessary conditions for the existence of maximum likelihood estimators $\underline{\beta}$ are provided by the solution to

$$\frac{\partial l(\beta; X)}{\partial \beta} = 0.$$

Corresponding sufficient conditions require the matrix -*H*($\underline{\beta}$; *X*) to be positive definite, where the Hessian matrix *H(β; X)* is defined by

$$H(\beta; X) = \frac{\partial^2 l(\beta; X)}{\partial \beta \partial \beta'}.$$

Unfortunately, the infinite summation in (4.4) cannot be perfectly computed numerically. Truncation on the sum is commonly used for approximation, where the precision of the approximation is provided by a bound on the truncated error. To illustrate this, let us consider the numerical calculation of the infinite sum in (4.4) for a single density *f(β; X)*. Clearly, adequate approximation of *f(β; X)* will imply adequate approximation of the likelihood function given by (4.4). The infinite sum in *f(β; X)* shall be truncated at *I* and *J*, the resultant approximation error denoted by *B(I, J)*. Since all terms are positive and

$$sup_{X \epsilon R^2, i \epsilon I, j \epsilon J}\, g\left(x_t, y_t - \lambda x_t; \psi_x^i, \psi_y^j, \Sigma_x^i, \Sigma_y^j, \eta\right) \leq 1.$$

We can use the Taylor series expansion for the exponential function and apply integration by parts I times sequentially, we can show that

$$0 \leq B(I, J) \leq \frac{1}{2\pi\sigma_x\sigma_y\sqrt{1-\eta^2}} \frac{\lambda_x^{I+1}}{(I+1)!} \frac{\lambda_y^{J+1}}{(J+1)!}$$

With this error bound as a criterion, a series of experiments are performed to select the optimal truncation point. Although the truncation error is a function of parameters, for plausible values of parameters, truncation at $I = 7$ and $J = 7$ provides satisfactory accuracy.[20] For example, the upper bound of the truncation error on the log-likelihood is less than 10^{-8} for reasonable empirical parameter values.

On the basis of the above presentation and the experimental evidence, we can provide the approximate maximum likelihood estimates by maximizing the truncated log-likelihood function

$$l_{(I,J)}(\beta; X) = lnL(\beta; X) = -Tln(2\pi) - T\lambda_x - T\lambda_y - \frac{T}{2}\ln(1-\eta^2)$$

$$+\sum_{t=1}^{T} ln\left[\sum_{i=0}^{I}\sum_{j=0}^{J}\frac{\lambda_x^i}{i!}\frac{\lambda_y^j}{j!}\frac{1}{\sqrt{\Sigma_x^i\Sigma_y^j}}g(x_t, y_t - \lambda x_t; \psi_x^i, \psi_y^j, \Sigma_x^i, \Sigma_y^j, \eta)\right]. \qquad (4.5)$$

Necessary conditions for a maximum become

$$\frac{\partial l_{(I,J)}(\beta; X)}{\partial \beta} = 0$$

with analogous sufficient conditions for the truncated likelihood function. This nonlinear maximization problem is solved using the quasi-Newton method with a mixed quadratic and cubic line search procedure.

4.2 Estimation Results

To facilitate the analysis of the risk impacts on bitcoin derivatives, we need to empirically estimate the underlying processes. To this effect, we collect from Yahoo Finance the historical bitcoin prices quoted in U.S. dollars and the returns on the S&P 500 index which is taken as the domestic country's market portfolio. The sample period starts on September 17, 2014, which is the first available date when Bitcoin price quote became publicly available. The sample period

[20] A similar approach to establish the upper bound on the truncation error for the approximation of the likelihood function has been used by Ball and Torous (1985) in a study of a single jump risk on common stock indices.

ends on April 29, 2020. We use the adjusted closing prices to compute continuously compounded returns. Daily and weekly sample frequency are used in the analysis. Bitcoin is traded daily, entailing 365 observations in a year. However, S&P 500 index observations are only available for workdays. As a result, the sample contains 2,050 daily bitcoin returns and 1,412 daily S&P500 returns. The weekly sample, on the other hand, contains the same number of observations (293) for bitcoin and the S&P500.

Table 1 presents the summary statistics for the bitcoin and S&P500 return series. Panel A shows that the annualized average return for bitcoins in the past 5.5 years is more than 50%, in contrast to the S&P 500 annual return of slightly higher than 6%. The annualized return volatility for bitcoins is more than 74%, much higher than that of the S&P 500. For all sample frequency, the normality test is rejected for S&P500 returns. But for bitcoin returns, the normality test is rejected at the weekly frequency. The autocorrelation test for one lag is only rejected for S&P500 daily returns. Panel B presents the correlation between the bitcoin and S&P500 returns. The correlation is 0.1099 and 0.1198 for weekly and daily frequency respectively. The positive correlation confirms the observation made by Chavez-Dreyfuss (2020).

Figure 1 indicates that bitcoin daily returns are much more volatile than S&P500 returns. Moreover, controlling for its own standard deviation, each return series also exhibits occasional, large movements. During the entire sample period, 118 of the 2,050 bitcoin returns (about 6%) are outside the two standard deviation range and the counterparts for the S&P 500 returns are 57 out of 1,412 (about 4%). It indicates that the bitcoin returns exhibit volatility clustering. This empirical feature supports the use of a mixed jump-diffusion process to model returns.

The overall estimation strategy follows Jorion (1988) by setting jump sizes to zero (i.e., $q_y = q_x = 0$) for mixed jump-diffusion processes. The jump size is less essential in valuations and the reduction in the number of parameters will greatly improve the estimation accuracy.

For the purpose of numerical analysis, we could estimate the encompassing model, Version 4, and set certain parameters to zero to evaluate the reduced versions. While this strategy reduces the estimation efforts, it doesn't allow the data to "optimally" fit the model in other versions. In other words, by estimating the reduced versions separately, we hope to improve the estimation accuracy by virtue of the smaller set of parameters. This is the strategy we take.

Since Merton's model shares the same parameters as Version 2 (by setting g = 0), we have five sets of parameters to estimate altogether: the Black-Scholes model and Versions 1 to 4 models. Table 2 reports the estimation results. Given the similar properties of the estimated parameters in different sample frequencies, for brevity, we only focus on the weekly estimation results. It is seen that all parameters are estimated with high accuracy as evidenced by the small standard errors. Moreover, the Chi-square tests indicate that the full version of the model (Version 4) is indeed the best model describing the bitcoin return distribution.

Since the Black-Scholes model only depends on the overall risk of the bitcoin, we estimate the parameters with only the bitcoin returns. The estimated weekly return volatility is 10.71%, which annualizes to 77.21% (i.e., $10.71\% \times \sqrt{52}$), consistent with the annualized sample standard deviation. For Version 1, the estimation is performed for the joint distribution of bitcoin and S&P500 returns. The weekly bitcoin volatility is still 10.71%. Additionally, the estimated correlation between bitcoin and S&P500 returns is 0.1099, consistent with the sample correlation.

When jumps are part of the estimation, the diffusive variation is necessarily smaller. For instance, under Version 2, the weekly volatility is now 2.87%, annualizing to only 20.679%, much lower than 77.21% in Version 1. The remaining variation is captured by the jump component. The weekly jump intensity for bitcoin returns is 1.2544, indicating that there are more than one jumps per week on average. The volatility of the jump size is 0.093, leading to an annualized variance of 0.6071 (i.e. $52(\sigma_y^2 + \lambda_y \phi_y^2)$), or an annual volatility of 77.92%, close to the overall sample volatility of 77.21%. Similar properties are observed with other versions too.

5 Numerical Analysis

5.1 Option Price Premiums due to Systematic Diffusive and Jump Risks

Insofar as the Black-Scholes model is the most parsimonious and naïve version in capturing the risk dynamics, we ascertain in this section whether the bitcoin option prices contain a premium relative to the Black-Scholes prices when we have nuanced risk characterizations in the other versions of the model. To this end, we calculate the percentage increase of the option price from the Black-Scholes model to a particular version of the model, and call this quantity the "risk premium." Since the volatility will affect call and put options to the same extent via the put-call parity, we will only examine call options for brevity. Additionally, for ease of analysis, we normalize the option strike price K to be 1 and examine three moneyness cases: out-of-money ($p_t/K = 0.95$), at-the-money ($p_t/K = 1$) and in-the-money ($p_t/K = 1.05$). To facilitate calculations, we set the U.S. interest rate at 0.25% p.a.. The bitcoin interest rate is set to 0% because it is impossible to deposit bitcoin with an organization and there is no interest paid.[21] In addition, we set option maturity to be 3 months, 6 months and 12 months. We examine three levels of risk

[21] Insofar as bitcoins are not fiat money and do not serve the traditional value storage function with a centralized authority, it is impossible to deposit a bitcoin and earn interest rate. If anything, there might a storage cost in the form of fees paid to the online hosting venues that administer the account. Regardless, the level of "interest rate" on bitcoin won't have a material impact on the bitcoin option prices. Our focus is on the various types of risks,

aversion: -1 (log utility), -2 (commonly used risk-aversion), -4 (a more risk-averse preference). Table 3 presents the results, with Panel A reporting the call option prices corresponding to the annualized volatility of σ_y =77.21%.

Panel B presents risk premiums generated by option prices from the Merton model. As discussed earlier, the total volatility is $\sqrt{\sigma_y^2 + \lambda_y \phi_y^2}$ =77.92%, higher than the Black-Scholes volatility of σ_y =77.21%. The excess volatility comes from the non-systematic jump risks $\lambda_y \phi_y^2$. Not surprisingly, option prices under the Merton model are higher than the corresponding Black-Scholes prices. The risk premiums are positive and decrease with time-to-maturity and moneyness, which is intuitive in that over longer horizons and/or when the option is in the money, the effect of jumps diminishes. All risk premiums are less than 1%, largely negligible.

Panel C presents risk premiums for Version 1 where the total volatility measures the co-movements between bitcoin and S&P500 returns and is $\sqrt{\sigma_y^2 + 2\eta\gamma\sigma_y\ \sigma_x\ + \gamma^2\sigma_x^2}$. In particular, when g = -1, -2, -4, the volatility is 77.23%, 80.99%, and 97.57%, respectively, all higher than the Black-Scholes volatility of 77.21%. The excess volatility $2\eta\gamma\sigma_y\sigma_x + \gamma^2\sigma_x^2$ is contributed by the co-movements as well as the risk aversion parameter. Risk premiums of Version 1 increase with the risk aversion parameter. Precisely, they are less than 0.035% when g = -1, between 4% to 5% when g = -2, higher than 22% when g = -4. In addition, risk premiums decrease with time-to-maturity and moneyness, as in the Merton's model.

Panel D exhibits risk premiums under Version 2 where bitcoin returns exhibit non-systematic jump risks. The total volatility is $\sqrt{\sigma_y^2 + \lambda_y\phi_y^2 + 2\eta\gamma\sigma_x\sqrt{\sigma_y^2 + \lambda_y\phi_y^2} + \gamma^2\sigma_x^2}$ which takes the values of 77.92%, 81.63%, and 98.08% when g = -1, -2, and -4, respectively, all higher than the Black-Scholes volatility. The excess volatility comes from two components: 1) the non-systematic jump risks $\lambda_y \phi_y^2$, and 2) the co-movements with the stock market returns $2\eta\gamma\sigma_x \sqrt{\sigma_y^2 + \lambda_y \phi_y^2} + \gamma^2 \sigma_x^2$. The range of risk premiums is comparable to that in Panel C.

Panel E presents the results for Version 3 which embeds systematic jump risks in bitcoin returns. The total volatility is $\sqrt{\sigma_y^2 + 2\eta\gamma\sigma_y \sqrt{(\sigma_x^2 + \lambda_x \phi_x^2)} + \gamma^2(\sigma_x^2 + \lambda_x \phi_x^2)}$. The excess volatility contains two parts: systematic diffusion risk $2\eta\gamma\sigma_y \sqrt{\sigma_x^2 + \lambda_x \phi_x^2} + \gamma^2 \sigma_x^2$ and systematic jump risks $\gamma^2 \lambda_x \phi_x^2$. The range of risk premiums is also comparable to that in Panel C which presents Version 1.

Finally, Panel F presents risk premiums for Version 4, the full version of the model, where the total volatility is $\sqrt{\sigma_y^2 + \lambda_y \phi_y^2 + 2\eta\gamma\sqrt{(\sigma_y^2 + \lambda_y \phi_y^2)(\sigma_x^2 + \lambda_x \phi_x^2)} + \gamma^2(\sigma_x^2 + \lambda_x \phi_x^2)}$ containing both systematic and non-systematic jump risks. The excess volatility has three components: 1) non-systematic jump risk inherited from the money supply $\lambda_y \phi_y^2$, 2) the co-movement with the stock market diffusive risk $2\eta\gamma\sqrt{(\sigma_y^2 + \lambda_y \phi_y^2)(\sigma_x^2 + \lambda_x \phi_x^2)} + \gamma^2 \sigma_x^2$, and 3) the systematic jump risk from the stock market, $\gamma^2 \lambda_x \phi_x^2$. More risk sources notwithstanding, the range of risk premiums is once again comparable to that for Version 1 in Panel C.

In sum, all four versions of our model lead to sizable risk premiums which increase with the risk aversion parameter and decrease with moneyness. The risk premiums mostly increase with option maturities with a few exceptions such as in Panel E under *g = -1*. However, the dollar values of these options increase with option maturities.

5.2 Relative Importance of Systematic Diffusion Risks and Jump Risks

While the previous subsection establishes the overall impact of the diffusive and jump risks, we now examine their relative importance in determining the option prices. For each version of the model, we simply calculate the proportion of each risk as a percentage of the total variance. Table 4 contains the results. For brevity, we only examine the representative case where the risk aversion parameter g = -2. Once again, the Black-Scholes volatility is taken as the benchmark that captures the total bitcoin return volatility, 77.21%.

As stated earlier, the risk in Merton's model comes from two sources: diffusive risk and non-systematic jump risk. Table 4 shows that the diffusive risk accounts for only 7.04% of the total variance and the non-systematic jump risk accounts for 92.96%. Judging by the small risk premiums in Table 3, the relative size of each risk doesn't seem to affect the overall option prices.

Version 1 corresponds to an economy where jump risks are absent in both the money supply and the stock returns. As a result, the total variance only depends on the diffusive risks in the money supply and stock market returns, and it has two components: diffusive risks and the co-variation between money supply and the stock market. Table 4 shows that the diffusive risk inherited from the money supply accounts for 90.88% of the total variance and the co-variation accounts for 9.12%. The domestic money supply volatility is the major source of the volatility for bitcoin and hence plays a major role in determining option prices. This impact is non-trivial as revealed in Table 3.

Version 2 depicts an economy where the jump risk is only present in the money supply. In this case, the bitcoin's total variance has three parts: 1) diffusive risk from money supply, 2) co-variation between money supply and the stock market, and 3) non-systematic jump risk inherited from the money supply. Table 4 indicates that the diffusive risk inherited from the money supply accounts for only 6.42% of the total variance, the co-variation risk accounts for 8.9%, and the non-systematic jump risk accounts for 84.69%. Again, the non-systematic jump risk is the major source for the bitcoin return fluctuations.

Version 3 describes an economy where the jump risk is only present in the stock market. The bitcoin's total variance has three parts: 1) diffusive risk from money supply, 2) co-variation as in Version 2, and 3) systematic jump risk inherited from the stock market. Table 4 shows that the diffusive risk inherited from the money supply accounts for 91.01% of the total variance, the co-variation accounts for -2.31%, and the systematic jump risk accounts for 11.31%. In this economy, the bitcoin volatility mostly stems from the diffusive risk of the money supply.

Version 4 describes an economy with all risks present. The bitcoin's total variance now has four parts: 1) diffusive risk from the money supply, 2) co-variation risk, 3) non-systematic jump risk from the money supply, 4) systematic jump risk from the stock market. Table 4 indicates that the diffusive risk inherited from the money supply accounts for only 6.27% of the total variance, the co-variation risk accounts for -2.45%, the non-systematic jump risk accounts for 84.91%, and the systematic jump risk account for 11.27%. In contrast to Version 3, the bitcoin volatility mostly stems from the non-systematic jump risk, but still originating from money supply.,

It is interesting to note that, under Version 4, the co-variation risk accounts for -2.45% of the total variance. Recall that co-variation risk is measured as $2\eta\gamma\sqrt{(\sigma_y^2 + \lambda_y\phi_y^2)(\sigma_x^2 + \lambda_x\phi_x^2)} + \gamma^2\sigma_x^2$. Under Versions 1, 2 and 3, the first term is zero, hence the co-variation is always positive. Under Version 4, the first term is negative because the risk-aversion parameter g is negative. If the first term is greater than the second term, then the co-variation measure will be negative.

To summarize, the return fluctuations in bitcoin are largely influenced by the domestic money supply. More than 80% of the total variance comes from either the diffusive risk or the jump risk of the money supply. The stock market variance accounts for only about 10% of the total bitcoin variance.

5.3 Implied Volatility from Model Prices

While the previous analyses shed light on how much premium each source of risk generates in the option prices relative to the Black-Scholes model with a constant volatility, it is also of interest to see how the option prices under each version of the model map back to the Black-Scholes prices via implied volatility. To this end, we calculate the implied volatilities from the full version of our model, Version 4 for the risk-aversion case of g = -2. Figure 2 depicts the results. It is seen that the patterns are largely consistent with those in the equity option literature. The implied volatility curve for the 3-month maturity is convex and resembles a smile. The implied volatility reaches the minimum when the call option is about 10% out-of-the-money. This indicates that the Black-Scholes model undervalues deep out-of-the-money or in-the-money calls. The intuition is that when the option is deeply-out-of-the money, the negative jump will not affect option price much, but the positive jumps will lift the option into the money, hence increase the value of the option. The opposite argument can be made for deep-in-the money option: negative jumps may not reduce the option value significantly, but the positive jumps will enhance the value of deep-in-the-money options.

As for options with longer maturities (6 months or 12 months), the implied volatility increases with moneyness. This suggests that the Black-Scholes model undervalues options for all moneyness but undervalues more for the deep-in-the-money options. The intuition is the following: when the maturity is long, bitcoin prices have more room to move dramatically, hence make all options valuable. As for the deep-in-the-money options, they benefit more positively with volatile movements in bitcoin prices during a long duration.

6 Conclusion

We model the bitcoin price as a function of the domestic money supply and stock market returns in an equilibrium setting and study option prices therewithin. To this end, we extend Cao (2001) of a small open monetary economy where money has a non-trivial role in the representative agent's utility function and we take bitcoin as a foreign currency. The money supply and the aggregate dividend (from which the market price is derived) follow exogenously specified, correlated mixed jump-diffusion processes. The foreign investment opportunity set is represented by a pure discount bond denominated in bitcoin whose real return is taken as given by the domestic agent. The bitcoin price (viz. the exchange rate), the domestic nominal interest rate and the prices of all other domestic assets including bitcoin options are determined endogenously. The bitcoin price inherits the diffusive and jump risks in both the money supply and the aggregate dividend processes.

The equilibrium option pricing admits analytical form solutions. The pricing model nests the Merton (1976) model as a special case where there is no jump risk in aggregate stock prices and the agent is risk neutral in consumption. In this case, only the jump risk of the money supply drives the bitcoin price and is not priced. Static analysis shows that the value of bitcoin options increases with the diffusive and jump risks of the money supply and the aggregate dividend or consumption. The call (put) price increases (decreases) with the money supply growth rate. The effect of the jump intensity for the money supply and aggregate dividend is ambiguous.

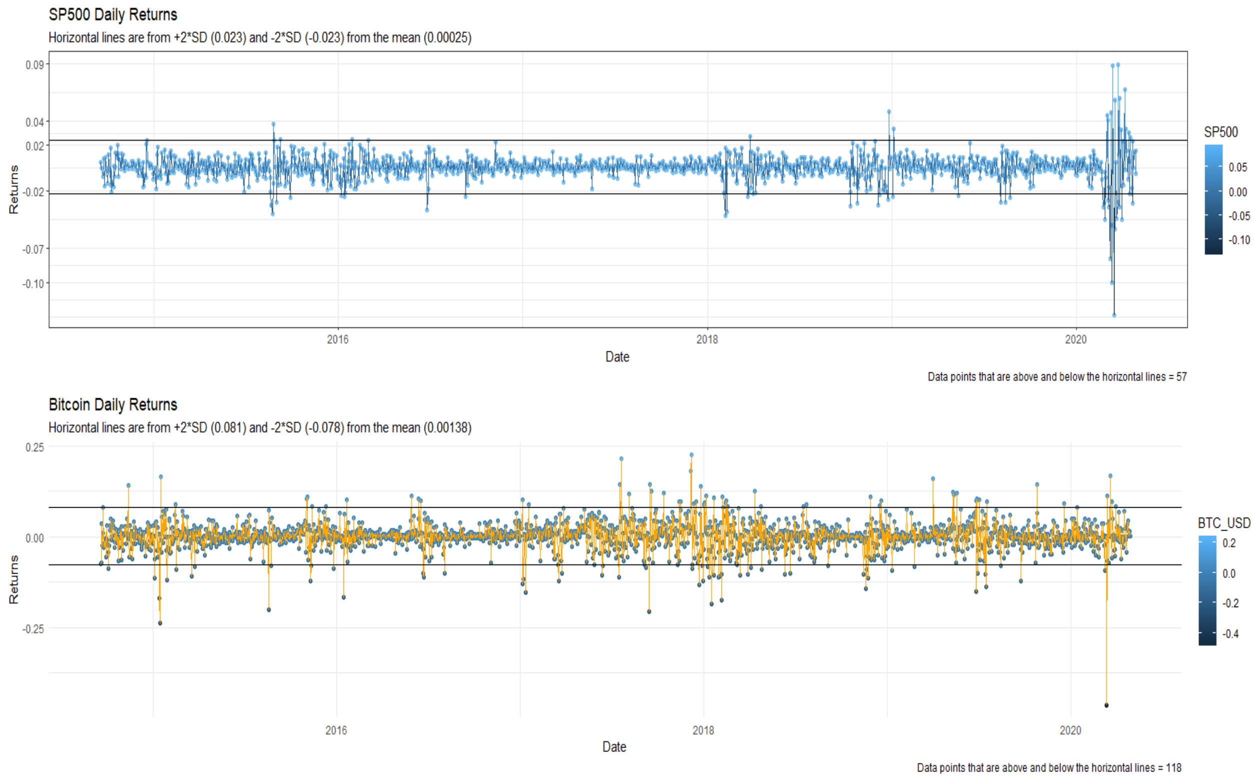
To assess the pricing premiums arising from the various risks, we empirically estimate the model parameters and compare option prices of different versions of our model against the benchmark Black-Scholes pricing model. The analysis leads to six findings. First, a large portion of the bitcoin return volatility stems from the diffusive and/or the jump risks of money supply.

Second, risk premiums are positive and significant for all maturities and moneyness. Third, the magnitude of risk premiums is large in the presence of systematic and non-systematic jump risks. Forth, risk premiums decrease with maturity and moneyness. Fifth, the Black-Scholes model undervalues options with all maturity and all moneyness and the undervaluation is more pronounced for deep-in-the-money options. Last but not the least, risk premiums increase with the risk aversion parameter.

7 Figures and Tables

Figure 1

Daily Returns

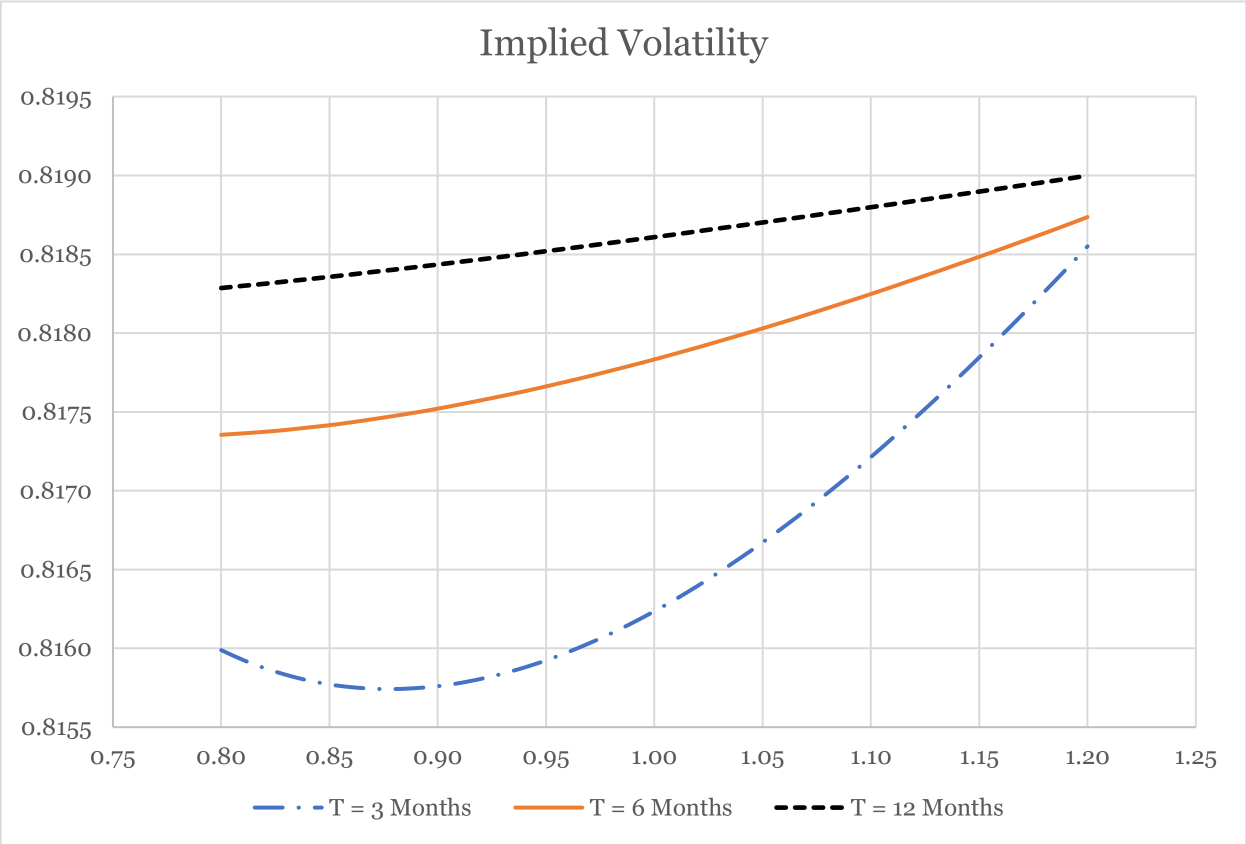


Notes:

1. The sample period is from September 17, 2014 to April 29, 2020.
2. There are 118 out of 2050 (about 6%) bitcoin returns that are outside the two standard deviation interval around the mean (viz. two standard deviations on each side of the mean). The corresponding number is 57 out of 1412 (about 4%) for S&P500 returns.

Figure 2

Implied Volatility



Notes:

1. Call option prices are calculated from the model with both systematic and non-systematic jump risks.
2. Model parameters are taken from Table 2 with weekly estimation. Risk aversion parameter γ = -2 and the U.S. risk-free rate = 0.25%.

Table 1

Summary Statistics

	Panel A: Statistics			
	Bitcoin ($/unit)		S&P 500	
	Weekly	Daily	Weekly	Daily
Mean	1.0560%	0.1384%	0.1207%	0.0254%
Annuliazed Mean	54.9126%	50.5190%	6.2768%	6.3906%
Std Dev	10.7252%	3.9834%	2.3877%	1.1605%
Annuliazed Std Dev	77.34%	76.10%	17.22%	18.42%
Skewness	-0.3821	-0.9668	-1.4956	-1.0179
Kurtosis	1.5230	13.2683	12.0170	23.4593
Normality Test	0.9722	0.8854	0.8349	0.7933
P-value	0.0000 ***	0.0000 ***	0.0000 ***	0.0000 ***
Autocorrelation Lags				
1	0.0140	-0.0160	-0.0680	-0.2140
2	0.0630	0.0020	0.0620	0.1430
3	0.0790	0.0160	-0.0030	0.0100
4	-0.1050	0.0030	-0.1130	-0.0840
5	0.0040	0.0030	-0.0550	0.0860
6	0.0390	0.0570	-0.1000	-0.1610
7	-0.0300	-0.0330	-0.0390	0.2370
8	-0.0210	-0.0160	0.0320	-0.2120
9	0.0590	-0.0320	-0.0240	0.1690
10	0.0190	0.0550	-0.0420	-0.0570
Standard Error	0.0063	0.0009	0.0014	0.0003
Box-Pierce Test	0.0577	0.5427	1.3721	64.6720
for 1 lag	0.8102	0.4613	0.2415	0.0000 *
Sample Size	293	2050	293	1412

Panel B: Correlation		
Bitcoin Return	S&P 500 Return	
	Weekly	Daily
Weekly	0.1099	
Daily		0.1198

Notes:

1. Time series for S&P500 and bitcoin are downloaded from Yahoo Finance.
2. The sample period is from September 17, 2014 to April 29, 2020.

Table 2

Maximum Likelihood Estimated Model Parameters

	σ_y	λ_y	ϕ_y	σ_x	λ_x	ϕ_x	η	*Log likelihood Value*	Chi-Square Test
Panel A: Weekly Data									
BS Model	0.1071 (0.004)							238.8961	
Version 1: Our Model without Jumps	0.1071 (0.004)			0.0238 (0.001)			0.1099 (0.058)	919.7403	
Version 2: Our Model with non sys Jumps	0.0282 (0.005)	1.2836 (0.243)	0.0921 (0.010)	0.0239 (0.001)				939.5140	39.5474 ***
Version 3: Our Model with sys Jumps	0.1072 (0.004)			0.0144 (0.001)	0.1151 (0.054)	0.0557 (0.013)		983.9555	88.8830 ***
Version 4: Our Model with both Jumps	0.0284 (0.005)	1.2711 (0.240)	0.0927 (0.010)	0.0143 (0.001)	0.1181 (0.056)	0.0554 (0.013)		1002.2920	36.6730 ***
Panel B: Daily Data									
BS Model	0.0398 (0.001)							3698.8869	
Version 1: Our Model without Jumps	0.0398 (0.001)			0.0089 (0.000)			0.1198 (0.022)	10490.3647	
Version 2: Our Model with non sys Jumps	0.0113 (0.001)	0.8007 (0.092)	0.0406 (0.002)	0.0089 (0.000)				10874.5333	768.3372 ***
Version 3: Our Model with sys Jumps	0.0355 (0.000)			0.0000 (0.000)	2.2998 (0.091)	0.0055 (0.000)		12602.4000	3455.7334 ***
Version 4: Our Model with both Jumps	0.0097 (0.001)	0.9734 (0.102)	0.0372 (0.002)	0.0000 (0.000)	1.7752 (0.057)	0.0055 (0.000)		13753.3700	2301.9400 ***

Notes:

1. All parameters are estimated with the Maximum Likelihood Method. The optimization procedure is the non-linear minimization (NLM) method. Numbers in parenthesis are estimated errors.
2. The sample period is from September 17, 2014 to April 29, 2020.

Table 3

Model Comparisons for Bitcoin Call Option Prices

	γ = −1			γ = −2			γ = −4		
	T = 3	T = 6	T = 12	T = 3	T = 6	T = 12	T = 3	T = 6	T = 12
Panel A: BS Model									
p_t/K = 0.95	0.1258	0.1861	0.2694	0.1258	0.1861	0.2694	0.1258	0.1861	0.2694
p_t/K = 1.00	0.1533	0.2156	0.3014	0.1533	0.2156	0.3014	0.1533	0.2156	0.3014
p_t/K = 1.05	0.1834	0.2469	0.3346	0.1834	0.2469	0.3346	0.1834	0.2469	0.3346
Panel B: Merton's Model									
p_t/K = 0.95	0.415%	0.798%	0.942%	0.415%	0.798%	0.942%	0.415%	0.798%	0.942%
p_t/K = 1.00	0.412%	0.741%	0.881%	0.412%	0.741%	0.881%	0.412%	0.741%	0.881%
p_t/K = 1.05	0.418%	0.692%	0.827%	0.418%	0.692%	0.827%	0.418%	0.692%	0.827%
Panel C: Version 1 of Our Model without Jumps									
p_t/K = 0.95	0.036%	0.033%	0.032%	5.683%	5.347%	5.030%	30.521%	28.570%	26.630%
p_t/K = 1.00	0.030%	0.030%	0.029%	4.822%	4.754%	4.622%	25.861%	25.383%	24.463%
p_t/K = 1.05	0.026%	0.027%	0.027%	4.099%	4.237%	4.258%	22.009%	22.639%	22.544%
Panel D: Version 2 of our Model with only non-systematic Jumps									
p_t/K = 0.95	0.485%	0.833%	0.962%	6.211%	6.141%	5.915%	31.155%	29.290%	27.354%
p_t/K = 1.00	0.470%	0.771%	0.899%	5.319%	5.485%	5.448%	26.424%	26.036%	25.135%
p_t/K = 1.05	0.464%	0.718%	0.843%	4.574%	4.915%	5.031%	22.516%	23.235%	23.169%
Panel E: Version 3 of our Model with only Systematic Jumps									
p_t/K = 0.95	0.264%	0.205%	0.173%	5.908%	5.503%	5.149%	30.393%	28.658%	26.814%
p_t/K = 1.00	0.224%	0.182%	0.158%	5.004%	4.888%	4.730%	25.660%	25.417%	24.611%
p_t/K = 1.05	0.190%	0.162%	0.146%	4.247%	4.354%	4.355%	21.774%	22.635%	22.662%
Panel F: Version 4 of our Model with both Systematic and non-Systematic Jumps									
p_t/K = 0.95	0.844%	1.126%	1.215%	6.590%	6.444%	6.173%	31.271%	29.624%	27.767%
p_t/K = 1.00	0.774%	1.031%	1.132%	5.631%	5.750%	5.683%	26.431%	26.289%	25.493%
p_t/K = 1.05	0.722%	0.949%	1.057%	4.833%	5.147%	5.246%	22.460%	23.427%	23.482%

Notes:

1. Call option prices are calculated with the following inputs: the risk-free rate for the U.S. dollar is 0.25% p.s. while the risk-free rate for the bitcoin is 0%.
2. Model parameters are taken from Table 2 with weekly estimates.

Table 4

Importance of Systematic Risks and Jump Risks

	Total Variance	Diff. Risks	Diff. Risks /Total Var	Sys. Risks	Sys. Risks /Total Var	Non sys. Jumps	Non sys. Risks /Total Var	Systematic Jumps	Systematic Jumps /Total Var	Total %
BS Model	0.5961	0.5961	100.00%							100.00%
Merton's Model	0.6071	0.0428	7.04%			0.5644	92.96%			100.00%
Version 1: Our Model without Jumps	0.6559	0.5961	90.88%	0.0598	9.12%					100.00%
Version 2: Our Model with non-sys jumps	0.6664	0.0428	6.42%	0.0593	8.90%	0.5644	84.69%			100.00%
Version 3: Our Model with sys jumps	0.6567	0.5976	91.01%	-0.0152	-2.31%			0.0743	11.31%	100.00%
Version 4: Our Model with both jumps	0.6689	0.0419	6.27%	-0.0164	-2.45%	0.5680	84.91%	0.0754	11.27%	100.00%

Notes:

1. Total variance is computed as $\sigma_y^2 + \lambda_y \phi_y^2 + 2\eta\gamma\sqrt{(\sigma_y^2 + \lambda_y \phi_y^2)(\sigma_x^2 + \lambda_x \phi_x^2)} + \gamma^2(\sigma_x^2 + \lambda_x \phi_x^2)$.
2. Diffusion risks = σ_y^2.
3. Systematic risks $= 2\eta\gamma\sqrt{(\sigma_y^2 + \lambda_y \phi_y^2)(\sigma_x^2 + \lambda_x \phi_x^2)} + \gamma^2 \sigma_x^2$.
4. Non-systematic jump risks $= \lambda_y \phi_y^2$.
5. Systematic jump risks = $\gamma^2 \lambda_x \phi_x^2$.
6. Risk-aversion is set γ = -2.

8 Appendix

This appendix provides equilibrium results with a more generalized utility stated in Equation (3.1). The utility function in Cao (2001) is a special case by setting *g = - 1*. Given the assumed process for the money supply in (3.2) and the equilibrium asset pricing equations in (3.3) and (3.4), tedious algebra will yield the main results below.

(1) The domestic interest rate is $r_d = \rho + u_m - \sigma_m^2 - \lambda_m k_m - \lambda_m \bar{k}_m$.

(2) The equilibrium Bitcoin price (i.e. the exchange rate) is $p_t = \frac{\alpha r_d}{1-\alpha} M_t c_t^{\gamma}$. Note that if *g = 0*, the representative agent is risk-neutral over the consumption. In this case, there is no systematic jump risk in the Bitcoin price.

(3) The (foreign) interest rate on Bitcoin is $r_f = \rho - A(\gamma)$, where $A(\gamma) = \gamma(u_x - \lambda_x k_x) + \lambda_x \bar{k}_x(\gamma) + \frac{\gamma(\gamma-1)}{2}\sigma_x^2$.

(4) The European call option with a strike price K and a time-to-maturity T-t on Bitcoin price is priced according to equation (3.4) as

$$C_{CB}(p_t, T-t, K) = \frac{E[U_m(c_T, m_T, T)\max(p_T - K, 0)]}{U_c(c_t, m_t, t)} = e^{-\rho(T-t)} c_t p_t E\left[\frac{\max(p_T - K, 0)}{c_T, p_T}\right].$$

Similarly, the European put option with a strike price K and a time-to-maturity T-t on Bitcoin price is as

$$P_{CB}(p_t, T-t, K) = \frac{E[U_m(c_T, m_T, T)\max(K - p_T, 0)]}{U_c(c_t, m_t, t)} = e^{-\rho(T-t)} c_t p_t E\left[\frac{\max(K - p_T, 0)}{c_T, p_T}\right].$$

The joint density function for (c_T, M_T) conditional on (c_t, M_t), f$(c_T, M_T, T | c_t, M_t, t)$, is known. Since Bitcoin price in equilibrium is a function of c and M, I can explicitly derive the European call and put prices. The detailed derivation process is similar to that in Cao (2001) from pages

214-215. The precise expressions for the European call and put on Bitcoin are stated in equations (3.7) and (3.8).

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