Value Creation in Shareholder Activism

Finance Working Paper N° 685/2020
April 2021

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Abstract

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Keywords: Shareholder activism, Value creation, Passive investors, Stock picking, Schedule 13D, Schedule 13G, Structural estimation

JEL Classifications: C34, G14, G34

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Abstract

We measure value creation by activist investors via structural estimation of a model of the choice between passive investment and activism. Our estimates imply that average returns following activist intent announcements consist of 74.8% expected value creation, or treatment, 13.4% stock picking, and 11.8% sample selection effects. Higher treatment values predict improvements in firm performance and lower proxy contest probabilities, whereas abnormal announcements returns do not, suggesting that our estimate identifies more effective activism campaigns. The evidence demonstrates the importance of using the joint distribution of investment strategies and announcement returns to recover the expected returns and costs of activism.

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"Two roads diverged in a yellow wood,
And sorry I could not travel both..."
Robert Frost, *The Road Not Taken*

1. Introduction

Activist shareholders play an important role in modern corporate governance (Gillan and Starks, 2007). A key question is how much value they create. The existing literature searches for answers in the abnormal stock returns observed around the announcements of new activist positions. The consensus is that these returns are significantly larger than those following the announcement of new passive positions (e.g., Holderness and Sheehan, 1985; Brav, Jiang, Partnoy and Thomas, 2008; Klein and Zur, 2009; Edmans, Fang and Zur, 2013). Indeed, in our data, the average return following the public announcement of activist intent via the filing of a Schedule 13D with the Securities and Exchange Commission (SEC) is 6.34%. Following announcements of passive investment, i.e., Schedule 13G filings, the return is only 0.59%.[1]

Which aspects of activism could explain why the stock market rewards activist positions with a higher announcement return than passive positions? First, activist investors may indeed increase value by influencing the firm's corporate policies, i.e., the treatment effect of activism. Second, activist investors could be better at identifying undervalued stocks. That is, if instead of filing a Schedule 13D the activist had filed a Schedule 13G, the announcement return would have been higher than the average return to a Schedule 13G announcement by other investors. To wit, Brav et al. (2008) document that a stated goal of 48.3% of activist campaigns is "General undervaluation/maximize shareholder value," suggesting that part of the Schedule 13D announcement return could be due to stock picking. Finally, because

[1]The SEC mandates investors that become beneficiary owners of at least 5% of any class of equity securities in a publicly traded company to file either a Schedule 13D or a Schedule 13G. The former is required if the investor intends to affect the management of the company, i.e. , become an activist investor. Otherwise, the investor can file the latter, a shorter form associated with passive investing.

the investor strategically chooses to be an activist or to remain passive, the observed average announcement return for either type of filing includes a sample selection component.

There are several challenges to measure these three components of the Schedule 13D announcement return. The investor's decision to be active or passive is endogenous and depends on unobservable quantities such as the expected returns to filing Schedule 13D versus filing Schedule 13G and the private costs of activism. In addition, the distributions of observed announcement returns for either type of filing schedule are each censored by the choice of the other type. It is hard to find good instruments for the unobservable components or get data on the non-censored distribution of announcement returns. In this paper, we propose to overcome these challenges and recover the three components of announcement returns with the structural estimation of an economic model of the investment strategy choice.

The central feature of our model is the investor's decision to become an activist or to remain passive. The assumption that investors have that choice for every filing in the data is grounded on the observation that among all investors that filed at least one Schedule 13D any time in our sample, 78% also filed a Schedule 13G.[2] To choose optimally between the two strategies, in the model the investor trades off the expected announcement return from filing a Schedule 13D, minus a private cost of activism, against the expected announcement return from filing a Schedule 13G. The implicit testable assumption is that the announcement return to a Schedule 13D filing is a noisy indicator of the expected profits of the activist campaign, gross of activism costs.

Our simple model produces the joint distribution of filing choices and announcement returns. The distribution of announcement returns to Schedule 13D filings is censored because announcement returns to Schedule 13D filings are not observed if the investor

[2]Similarly, Boyson et al. (2020) report that the majority of assets in activist hedge fund portfolios are passive stakes. Several papers have looked at the choice between active and passive strategies. For example, Edmans et al. (2013) study activist hedge funds and show that stock liquidity predicts filing Schedule 13D versus Schedule 13G. Giglia (2016) discusses incentives to file Schedule 13G versus Schedule 13D.

chooses to file Schedule 13G, giving rise to a sample selection component in the returns to both Schedule 13D and Schedule 13G filings. Using data on announcement returns and filing choices, we can estimate the unobservable quantities—expected returns and private cost of activism—but also each of the components—treatment, stock picking, and sample selection—in Schedule 13D announcement returns.

We estimate the model's parameters by deriving and maximizing the joint likelihood of filing choices and announcement returns. As a result, our maximum likelihood (ML) estimator of the characteristic loadings on expected returns satisfies a modified orthogonality condition, one that is similar to that of the Ordinary Least Squares (OLS) regression of announcement returns on characteristics—that the residual is orthogonal to the regressors—but corrected for sample selection. Moreover, the sample selection correction is itself a function of the characteristic loadings because these determine the filing choices besides explaining announcement returns. Our ML estimator exploits the same model structure to recover the cost of activism: the estimate of this cost trades off the relative amounts of selection in the subsamples of each filing type.

We find that the average treatment effect of activism, which is equal to the difference in expected returns from filing Schedule 13D instead of Schedule 13G, represents 74.8% of the average Schedule 13D announcement return, that is, 4.74% of 6.34%. The estimated average stock picking component, which equals the counterfactual expected return from filing Schedule 13G, amounts to 13.4% of the observed announcement return, or 0.85% of 6.34%. Finally, the sample selection component, which results from the left censoring of the distribution of expected returns to Schedule 13D filings and, therefore, increases average announcement returns above their unconditional mean, represents 11.8% of announcement returns. For Schedule 13G filings, the sample selection component is small and stock picking accounts for almost all of the observed announcement return.

Our estimates indicate that variation in expected returns is a first-order driving primitive of variation in the outcome variables. Indeed, even while allowing for variation in activism costs or other random sources of heterogeneity, our model best fits the data by loading most heavily on expected returns variation. Further, we find that all determinants of expected returns that are not related to the investor's characteristics or to the existence of prior activist filings on the same target have equal estimated loadings on expected returns to Schedule 13D or Schedule 13G filings, even though the model places no such restrictions on their values. This finding implies that the market assigns an extra return to Schedule 13D vis-a-vis Schedule 13G filings based on the identity of the investor, not the target firm characteristics. In fact, the treatment component of announcement returns is determined almost entirely by the investors' Schedule 13D filing experience. Specifically, an investor with a higher number of past Schedule 13D filings is compensated with a higher return for filing Schedule 13D, but penalized with lower announcement returns for filing a Schedule 13G.

We quantify the benefits of activism to investors and dispersed shareholders. We estimate that the mean Schedule 13D filer earns a net return of 1.74%. Dispersed shareholders save the costs and, therefore, enjoy higher returns from Schedule 13D filings than the activist does. However, our estimates also suggest that 62% of Schedule 13G filings would offer better counterfactual expected returns under Schedule 13D. According to our estimates, these Schedule 13G filings occur because the treatment effect is not enough to cover the private cost of activism.

To validate the models' cross equation restrictions that tie the variation in expected returns to both filing choices and announcement returns, we compare its performance to the performance of reduced-form approaches used in the activism literature. To our knowledge, researchers to date have only used reduced-form models of either filing choices (e.g., probit models) or announcement returns (e.g., OLS regressions) ignoring the information content of either about the other. We show that the structural model is just as good as the reduced-form models at matching the first and second moments of announcement returns, but is significantly better at matching the distribution of filing choices. Our structural model is also significantly better at matching the distribution of filing choices than the two-step Heckman approach, which uses an ad hoc correlation between announcement returns and filing probabilities.

A critical assumption in our exercise is that announcement returns to Schedule 13D filings reflect, albeit noisily, shareholders' anticipated value creation by activists. Because our model-inferred components of announcement returns are not part of the noise, we hypothesize that they would subsume or improve the informational content about the target firm's future performance. Specifically, we test whether the estimated treatment effect predicts subsequent improvements in firm performance over and above the information in the total announcement return. We find that whereas both the treatment and stock-picking components of expected returns to Schedule 13D filings positively predict improvements in ROA and sales turnover, announcement returns do not. Moreover, the treatment component of expected returns to Schedule 13D filings negatively predicts the likelihood of a proxy contest, suggesting that a higher estimate of treatment identifies more effective activism campaigns that do not need to escalate into a proxy contest.

One concern about the quality of our estimates is that, because our sample includes a very heterogeneous set of investors, the results may be spuriously driven by those least likely to satisfy our model assumptions. As a robustness test, we conduct our analysis in the subsample of 7,551 Schedule 13D and 13G filings by activist hedge funds. The model fits the data equally well in this subsample, with qualitatively similar results.

Our paper contributes to several strands of the literature on shareholder activism. First, our paper contributes to the literature that studies stock price reactions to announcements of shareholder activism campaigns (e.g. Holderness and Sheehan, 1985; Guercio and

Hawkins, 1999; Brav et al., 2008; Becht et al., 2008; Clifford, 2008; Klein and Zur, 2009).[3] Holderness and Sheehan (1985) are the first to document positive abnormal returns to Schedule 13D filings. They reject the hypothesis that activist investors are corporate raiders in favor of value creation and stock picking. Brav et al. (2008) document positive abnormal returns to Schedule 13D filings by activist hegde funds. This paper contributes by quantifying the various components in expected returns to Schedule 13D filings.

Second, our paper contributes to the literature that studies changes in corporate policies following shareholder activism (e.g. Brav et al., 2008, 2015; Bebchuk et al., 2015).[4] For instance, Brav et al. (2008) describe the rate of success by activists in achieving their goals and actual policy changes of target firms. Brav et al. (2015) and Bebchuk et al. (2015) focus on long term changes in productivity of target firms. This paper contributes by showing that higher treatment components in Schedule 13D announcement returns predict larger improvements in firm performance and lower proxy contest probabilities.

Third, our paper informs the literature on the costs of activist engagements. Gantchev (2013) infers the cost of activism using a structural model of the staged decisions along an activist campaigns, estimating that a campaign can costs several millions dollars. Our identification strategy uses instead the joint distribution of announcement returns and filing choices. We find that activist expected returns net of the cost of activism are large and positive on average. This evidence coupled with the estimated loadings on investor-based experience variables suggest that there are limits to free entry in the market for activism. Our analysis also goes further and quantifies large gains from sharing the cost of activism amongst all shareholders.

Finally, our paper is the first to use structural estimation to quantify value creation in shareholder activism.[5] Beginning with Brav et al. (2015), the literature relies on activists

[3] See Brav et al. (2010) for a survey of evidence on hedge fund activism.

[4] See also Greenwood and Schor (2009), Boyson et al. (2017), and Jiang et al. (2018) for the analysis of the role of activist hedge funds in corporate takeovers.

[5] In the M&A literature, Li et al. (2018) develop a structural model to evaluate the role of mispricing

that switch from a passive Schedule 13G filing to a Schedule 13D filing on the same target firm to separate value creation from stock picking. The assumption is that the stock picking return is fully realized when the Schedule 13G is filed, and the value of treatment is only added as the announcement return of the switch to Schedule 13D status. Our structural model builds on this insight that investors choose between Schedule 13D and Schedule 13G and uses the information from actual Schedule 13G filings to inform the counterfactual gains to a Schedule 13D filing. Our results do not however rely on the subsample of switchers. In fact, our approach allows for firm and investor characteristics to change between the Schedule 13G and the consequent Schedule 13D filing. That is, in our model the stock picking component obtained when a Schedule 13G is filed can change, and does change, by the time the consequent Schedule 13D is filed.

2. A Structural Model of the Filing Decision

We model an investor's decision to engage in activism or to remain passive and the stock price reaction to the Schedule 13D or a Schedule 13G filing announcement. The model predicts a joint distribution of filings and announcement returns. In the model, the cross-sectional variation in expected returns is the driving force in explaining the relation between filing choices and announcement returns.

2.1. Valuation gains

Consider an investor that has identified a target firm as an investment opportunity and has acquired a stake in order to benefit from the stock's valuation gains.[6] We denote by Δ_D the random variable that describes the return following the announcement that the investor filed Schedule 13D, and denote by Δ_G the random variable that describes the

and economic synergies in takeovers. Albuquerque and Schroth (2010, 2015) study value creation in block transactions.

[6]We take the stake size as given and focus on the activist's choice to be an active or a passive investor. Back, Collin-Dufresne, Fos, Li and Ljungqvist (2018) provide a model of an activist's trading behavior and study the trade off between the impact of activist investors on firm value and market liquidity.

return following the announcement that the investor filed Schedule 13G. We interpret the former as the gains from a potentially costly intervention campaign, and the later as the gains from picking underpriced stocks. These are public valuation gains that benefit every investor in the firm.

Valuation gains are given by $\Delta_D = \mu_D + \epsilon_{\Delta_D}$ and $\Delta_G = \mu_G + \epsilon_{\Delta_G}$. One component of valuation gains is the expected return represented by μ_D and μ_G. These expected returns are common knowledge among investors. The other, unpredictable, component is represented by independent normal error terms, $\epsilon_{\Delta_D} \sim N(0, \sigma^2_{\Delta_D})$ and $\epsilon_{\Delta_G} \sim N(0, \sigma^2_{\Delta_G})$. This information is summarized by the normal density functions $f_D(\Delta_D)$ and $f_G(\Delta_G)$.

In this setup, if $\mu_G > 0$, then filing a Schedule 13G results in an expected price increase that benefits all investors. If $\mu_D > \mu_G$, then filing a Schedule 13D results in higher expected returns than filing a Schedule 13G. Our model is silent about how the valuation gains come about. Instead, we will adopt a parametric linear mapping of observable firm and investor characteristics to expected returns, conditional on the filing choice. The model also makes no assumption on when the investor made the decision to be passive or active. The relevant modeling assumption is rather that the type of filing announces the investor's decision.

2.2. Investor's due diligence

The investor does not observe Δ_D or Δ_G before the filing. However, she conducts due diligence on the target firm before making her investment decision. The due diligence results in private information signals,

$$\begin{aligned} s_D &= \Delta_D + \varepsilon_{s_D}, \\ s_G &= \Delta_G + \varepsilon_{s_G}. \end{aligned}$$

The errors in the signals are independent normal, $\varepsilon_{s_D} \sim N\left(0, \sigma^2_{s_D}\right)$ and $\varepsilon_{s_G} \sim N\left(0, \sigma^2_{s_G}\right)$. By letting $\sigma^2_{s_D}$ and $\sigma^2_{s_G}$ differ, we let the precision of the signals vary by filing type.[7]

Using the projection theorem, we obtain the investor's mean and variance of returns to filing Schedule 13D conditional on the value of her signal:

$$\begin{aligned} E\left(\Delta_D | s_D\right) &= \mu_D + \frac{\sigma^2_{\Delta_D}}{\sigma^2_{\Delta_D} + \sigma^2_{s_D}} \left(s_D - \mu_D\right), \\ V\left(\Delta_D | s_D\right) &= \frac{\sigma^2_{\Delta_D} \sigma^2_{s_D}}{\sigma^2_{\Delta_D} + \sigma^2_{s_D}}. \end{aligned}$$

Similar formulas can be derived for $E\left(\Delta_G | s_G\right)$ and $V\left(\Delta_G | s_G\right)$. The ratio $\sigma^2_{\Delta_D}/\sigma^2_{s_D}$ is the signal-to-noise ratio. A larger ratio $\sigma^2_{\Delta_D}/\sigma^2_{s_D}$ implies that the investor puts a greater weight on the signal when computing $E\left(\Delta_D | s_D\right)$. This ratio regulates the signal's usefulness relative to the unconditional mean of μ_D in the investor's filing choice.

2.3. Investor's choice

Activism campaigns are costly. They involve effort spent in affecting control in the firm as well as of proxy advisory and legal expenses (Gantchev, 2013). Let C denote the expected value of these costs. We expect $C > 0$, but because the investor chooses activism over being passive, the cost C should be viewed as net of any costs involved in filing Schedule 13G. Below, we provide further discussion on the cost C. This cost is borne only by the investor and not shared with other shareholders of the target firm.

We assume that the investor is risk neutral and seeks to maximize her expected returns from filing either Schedule 13D or Schedule 13G.[8] The investor's expected utilities under each alternative are

$$EU_D = E\left(\Delta_D | s_D\right) - C,$$

[7] Correlation between these errors would affect the variance, but not expected returns, of comparing either investment strategy. Allowing for such correlations may improve the model's performance if investors are sufficiently risk averse. We leave this question to future research.

[8] The model with risk aversion is developed in the Internet Appendix A.

and

$$EU_G = E\left(\Delta_G | s_G\right).$$

The investor chooses to be active and files a Schedule 13D if, and only if,

$$EU_D > EU_G. \tag{1}$$

Otherwise, she stays passive and files Schedule 13G. Moreover, EU_D is given by

$$\begin{aligned} EU_D &= \mu_D + \frac{\sigma^2_{\Delta_D}}{\sigma^2_{\Delta_D} + \sigma^2_{s_D}}\left(s_D - \mu_D\right) - C, & (2) \\ &= \mu_D + \frac{\sigma^2_{\Delta_D}}{\sigma^2_{\Delta_D} + \sigma^2_{s_D}}\left(\epsilon_{\Delta_D} + \epsilon_{s_D}\right) - C. & (3) \end{aligned}$$

The expression for EU_G is similar, with subindices G instead of D, but no cost, C.

Equation (3) shows that the expected utility of activism can be decomposed into the predictable component of the announcement return from filing Schedule 13D net of the cost of activism, $\mu_D - C$, and the unpredictable component, $\epsilon_{\Delta_D} + \epsilon_{s_D}$. Moreover, the weight placed on the latter is determined by the signal-to-noise ratio, $\sigma^2_{\Delta_D}/\sigma^2_{s_D}$. Intuitively, we build the model to test the extent to which variation in expected returns–the predictable component–explains filing choices. However, we allow for alternative explanatory variation through the unpredictable noise components. The signal-to-noise ratio calibrates the tension between the two explanations.

2.4. Properties of announcement returns from the econometrician's perspective

We assume the econometrician does not observe the due-diligence signals, s_D or s_G. She knows they are normally distributed, but does not know the parameters of the normal distributions $f_D\left(\Delta_D\right)$ and $f_G\left(\Delta_G\right)$. Let the random variable $z \equiv EU_D - EU_G$. From the perspective of the econometrician, $z \sim N(E(z), V(z))$, with

$$E(z) = \mu_D - \mu_G - C, \tag{4}$$

$$V(z) = \frac{\sigma^4_{\Delta_D}}{\sigma^2_{\Delta_D} + \sigma^2_{s_D}} + \frac{\sigma^4_{\Delta_G}}{\sigma^2_{\Delta_G} + \sigma^2_{s_G}}. \tag{5}$$

Further, the econometrician equates the event "Filing Schedule 13D" with the event $\{z > 0\}$, and, likewise, the event "Filing Schedule 13G" with the event $\{z \leq 0\}$.

The econometrician infers that the observed returns to any Schedule 13D filing are not distributed with density $f_D(\Delta_D)$ because the econometrician only observes realizations of Δ_D for which $z > 0$. Indeed, the econometrician computes the posterior density of announcement returns to a Schedule 13D filing as the density of Δ_D conditional on $\{z_i > 0\}$. Following Arnold, Beaver, Groeneveld and Meeker (1983), the conditional density, $f_D(\Delta_D|z > 0)$, satisfies

$$\frac{f_D(\Delta_D|z > 0)}{f_D(\Delta_D)} = \frac{1 - \Phi(\alpha_D)}{1 - \Phi(\alpha)}. \tag{6}$$

In this expression, $\alpha = -E(z)/\sqrt{V(z)}$ and Φ is the cumulative standard normal distribution. Hence, $1 - \Phi(\alpha)$ is the unconditional probability of filing Schedule 13D. Also, $\alpha_D = -E(z|\Delta_D)/\sqrt{V(z|\Delta_D)}$ andt $1 - \Phi(\alpha_D)$ is the probability of filing Schedule 13D conditional on the observed announcement return. Finally,

$$E(z|\Delta_D) = E(z) + \frac{\sigma^2_{\Delta_D}}{\sigma^2_{\Delta_D} + \sigma^2_{s_D}}(\Delta_D - \mu_D),$$

$$V(z|\Delta_D) = V(z)\left(1 - \rho^2_{zD}\right),$$

for $\rho_{zD} = Cov(\Delta_D, z)/\sqrt{\sigma^2_{\Delta_D} V(z)} > 0$.

It is straightforward to check that the right hand side of (6) is an increasing function of Δ_D that equals zero when $\Delta_D \to -\infty$, and equals $1/(1 - \Phi(\alpha)) \geq 1$ when $\Delta_D \to \infty$. That is, higher value gains are more likely under the conditional distribution for Schedule

13D filings than under the unconditional distribution.

We use equation (6) to derive a familiar expression for the mean observed announcement return following a Schedule 13D filing (see Greene (2008) and Arnold et al. (1983)):[9]

$$E\left(\Delta_D | z > 0\right) = \mu_D + \rho_{zD}\sigma_{\Delta_D}\lambda_D\left(\alpha\right), \tag{7}$$

where $\lambda_D\left(\alpha\right) \equiv \phi\left(\alpha\right) / \left(1 - \Phi\left(\alpha\right)\right)$ is the Inverse Mills Ratio (IMR), and ϕ is the standard normal density function. This expression shows that the ex post average return to filing Schedule 13D is higher that the unconditional mean, μ_D. This result obtains because investors expecting low returns from filing a Schedule 13D compared to filing a Schedule 13G choose instead to be passive. The sampling distribution of announcement returns to Schedule 13D filings is therefore censored. Its mean is biased upwards by an amount proportional to the IMR.

The conditional variance of the announcement return is

$$V\left(\Delta_D | z > 0\right) = \sigma^2_{\Delta_D}\left[1 - \rho^2_{zD}\lambda_D\left(\alpha\right)\left(\lambda_D\left(\alpha\right) - \alpha\right)\right]. \tag{8}$$

Since $0 < \lambda_D\left(\alpha\right)\left(\lambda_D\left(\alpha\right) - \alpha\right) < 1$, then $V\left(\Delta_D | z > 0\right) < V\left(\Delta_D\right)$, i.e., the variance of announcement returns is biased downwards. Combining the last two results, sample selection in Schedule 13D filings creates an upward bias on empirical t-statistics of average announcement returns.

[9] Similar expressions can be obtained for moments of the random variable $\Delta_G | z < 0$:

$$E\left(\Delta_G | z < 0\right) = \mu_G - \rho_{zG}\sigma_{\Delta_G}\lambda_G\left(\alpha\right),$$

and

$$V\left(\Delta_G | z < 0\right) = \sigma^2_{\Delta_G}\left[1 - \rho^2_{zG}\lambda_G\left(\alpha\right)\left(\lambda_G\left(\alpha\right) + \alpha\right)\right],$$

where $\rho_{zG} = Cov\left(\Delta_G, z\right) / \sqrt{\sigma^2_{\Delta_G} V\left(z\right)}$, and $\lambda_G\left(\alpha\right) = \phi\left(\alpha\right) / \Phi\left(\alpha\right)$, with $\alpha = -E\left(z\right) / \sqrt{V\left(z\right)}$ as before. Note that $\rho_{zG} < 0$. Hence, the mean announcement return is higher than the unconditional mean return for Schedule 13G filings as well.

2.5. Announcement returns decomposition

Using equation (7), we decompose announcement returns to Schedule 13D filings into three components:

$$E\left(\Delta_D|z>0\right) = \underbrace{\mu_D - \mu_G}_{\substack{\text{Treatment}\\ \text{effect}}} + \underbrace{\mu_G}_{\substack{\text{Stock picking}\\ \text{effect}}} + \underbrace{\rho_{zD}\sigma_{\Delta_D}\lambda_D\left(\alpha\right)}_{\substack{\text{Sample selection}\\ \text{effect}}}. \tag{9}$$

The stock picking effect is the return the investor gets by remaining passive and filing Schedule 13G, μ_G. The value creation or treatment effect, $\mu_D - \mu_G$, is the added benefit of being active and filing a Schedule 13D. The last term in the decomposition is the sample selection effect described above.

Likewise, we decompose announcement returns to Schedule 13G filings as

$$E\left(\Delta_G|z<0\right) = \underbrace{\mu_G}_{\substack{\text{Stock picking}\\ \text{effect}}} - \underbrace{\rho_{zG}\sigma_{\Delta_G}\lambda_G\left(\alpha\right)}_{\substack{\text{Sample selection}\\ \text{effect}}}. \tag{10}$$

The sample selection bias in announcement returns to Schedule 13G filings is also positive because investors do not file a Schedule 13G when μ_G is sufficiently low relative to μ_D.

Equations (9) and (10) highlight two key properties of the estimation method. First, the estimation of the treatment component of Schedule 13D announcement returns requires knowledge of the counterfactual valuation, μ_G. Second, the decomposition emphasizes that one cannot use actual Schedule 13G filing returns as the counterfactual valuation for Schedule 13D filings–and to construct estimates of selection and treatment effects–because neither sample is randomly selected. In our model, investors file a Schedule 13D or a Schedule 13G based on the different in their expected returns and the cost of activism. The last term in each decomposition accounts for this sample selection.

2.6. Discussion

The activism cost parameter, C, has a central role in the model. As we explain below, this cost helps explain filing choices, filing announcement returns, and volatilities of announcement returns. As a parameter, it captures various aspects of activism. First, it represents expected pecuniary costs of affecting control as indicated in subsection 2.3.

Second, C includes also the disutility from the risk in announcement returns and in the due diligence signals. The Internet Appendix shows that the model in the main text is isomorphic to a model with risk averse investors if we adjust the cost parameter appropriately. Third, the activist investor may enjoy private benefits from her large stake (Coffee, 2017). Then, C should be viewed as the activism cost net of these private benefits.

Fourth, there are transaction costs to accumulating a large stake in a company. For instance, buying towards a 5% target is likely to cause upward price pressure before reaching it and filing with the SEC. Hence, Schedule 13D and Schedule 13G filers are unlikely to capture all the value they create, implying that C may include the difference, if any, between the expected transaction costs in acquiring a position towards a Schedule 13D or a Schedule 13G filing. It remains unclear, however, whether a transaction costs differential exists, unless the market not only forecasts the intention to cross the 5% threshold that triggers disclosure, but also the investment strategy.

We assume that C is constant across all filings in the data. One reason for this assumption is the lack of proxies for or determinants of these potential individual cost components. The main reason, though, is to keep the model parsimonious. This assumption allows us to focus on the role of expected returns as the first order effect in explaining the cross section of filings. In Section 8 we relax this assumption and allow C to be a function of firm and investor characteristics.

To conclude this section, we summarize our reasons for the model's chosen parsimony. To be clear, the model has two parameters, mean and volatility, for each of the distributions of announcement returns. These parameters would be needed by almost all models of returns. In addition, the model has three more parameters, the cost C and the two volatilities of the due diligence $\sigma^2_{s_D}$ and $\sigma^2_{s_G}$. The cost parameter has been extensively discussed above. The volatilities on due diligence are important because they allow for a source of noise that affects selection that is unrelated to expected returns.

3. Estimation Approach

Our main identifying assumption is that each filing choice and the price reaction to its announcement are jointly determined as a function of the announcement's expected return. In this section, we construct the likelihood function that results from our model and that captures the main identifying assumption.

3.1. Specification of expected returns

We assume that the expected returns from filing either a Schedule 13D or a Schedule 13G vary cross sectionally as a function of given target firm and investor characteristics. We specify the expected returns, $\mu_{D,i}$ and $\mu_{G,i}$ for each filing $i = 1, ..., N$, as linear functions of a vector of fixed determinants $\mathbf{x}_i$,

$$\mu_{D,i} = \mathbf{x}_i' \boldsymbol{\beta}_D,$$

and

$$\mu_{G,i} = \mathbf{x}_i' \boldsymbol{\beta}_G,$$

where $\boldsymbol{\beta}_D$ and $\boldsymbol{\beta}_G$ are vectors of parameters to estimate.

Our model is silent about which characteristics influence expected returns and why. We therefore resort to a large literature modeling expected stock returns. The target firm characteristics included in $\mathbf{x}_i$ are financial leverage, book-to-market value of equity, return on assets, stock illiquidity, analyst coverage, share of institutional ownership, idiosyncratic volatility of stock returns, recent stock return performance, size, firm age, sales growth, and industry sales concentration. All variables are measured as of the end of the fiscal year that precedes the filing and are defined in Table 1. Potentially unbounded variables are winsorized at 1% and 99% for every year in our sample.

The vector $\mathbf{x}_i$ also includes two measures of the investor's past experience in either Schedule 13D or Schedule 13G filings. Specifically, we include the number of previous Schedule 13D filings as well as the number of previous Schedule 13G filings by each investor.[10] An indicator variable for activist hedge funds completes the set of investor-specific characteristics.[11] In addition, the presence of passive or activist investors at the time of a filing may also influence its expected returns. Accordingly, the vector $\mathbf{x}_i$ includes two binary indicators, each equal to one if a prior Schedule 13D or a Schedule 13G, respectively, has been filed during the year before filing i.

Finally, the vector $\mathbf{x}_i$ includes the three Fama-French factors. The reason for this inclusion is that, even if the stock's cumulative abnormal returns are measured in excess of the three factors, the adjustment uses backward looking loadings (betas). Controlling for these factors on top of the adjustment accounts for possible changes in the loadings in response to the news of the SEC filing (Patton and Verardo, 2012).

3.2. Likelihood function

The empirical counterpart to the investor's decision to engage in activism or be passive is a filing choice. Let $l_i = 1$ if the investor files Schedule 13D and $l_i = 0$ if the investor files Schedule 13G. The empirical counterpart to the valuation gains Δ_G and Δ_D are the stock market cumulative announcement returns from 30 days before the filing to 10 days after the filing, denoted by r_i. We begin the event window 30 days before the filing because

[10]Brav et al. (2008) use the historical average announcement returns from past filings as a proxy for a hedge fund's experience, but find no significant association between the proxy and abnormal announcement returns.

[11]We thank Wei Jiang for providing the list of activist hedge funds.

Collin-Dufresne and Fos (2015) show that price appreciation prior to Schedule 13D filings likely reflects the price impact of activist's trades. We end the event window 10 days after the filling to make sure prices fully reflect the information about the filing. Indeed, Brav et al. (2008) show that there is no significant return reversal during the year subsequent to the filing. Cumulative abnormal announcement returns thus measured are a good proxy for valuation gains. The data available to the econometrician is therefore $\{l_i, r_i, \mathbf{x}_i\}_{i=1,\ldots,N}$.

The likelihood of observing N independent Schedule 13D or Schedule 13G filings in the data and the corresponding announcement returns is

$$\begin{aligned}&\mathcal{L}(\{l_i, r_i\}_{i=1,\ldots,N} \,|\, \{\mathbf{x}_i\}_{i=1,\ldots,N}\,, \boldsymbol{\theta})\\&= \Pi_{i=1}^{N} \left([\Pr(z_i > 0)\, f_D(r_i|z_i > 0)]^{l_i} \, [\Pr(z_i < 0)\, f_G(r_i|z_i < 0)]^{1-l_i} \right),\end{aligned}$$

where the parameter vector to be estimated is $\boldsymbol{\theta} = \left\{\boldsymbol{\beta}_D, \boldsymbol{\beta}_G, C, \sigma^2_{\Delta_D}, \sigma^2_{\Delta_G}, \sigma^2_{s_D}, \sigma^2_{s_G}\right\}$, $\Pr(z_i > 0)\, f_D(\Delta_D|z_i > 0)$ is the joint density of observing a Schedule 13D filing and the announcement returns Δ_D, and $\Pr(z_i > 0) = 1 - \Phi(\alpha_i)$.

Substituting (6) in the likelihood function, taking logarithms and rewriting as a function of the unknown parameters, we have

$$\begin{aligned}&\ln \mathcal{L}\left(\boldsymbol{\theta} |\, \{l_i, r_i, \mathbf{x}_i\}_{i=1,\ldots,N}\right)\\&= \sum_{i=1}^{N} \left[l_i \left(\ln f_D(r_i) + \ln(1 - \Phi(\alpha_{D,i})) \right) + (1 - l_i) \left(\ln f_G(r_i) + \ln \Phi(\alpha_{G,i}) \right) \right].\end{aligned}$$

The maximum likelihood (ML) estimator $\hat{\boldsymbol{\theta}}_{ML}$ maximizes $\ln \mathcal{L}\left(\boldsymbol{\theta} |\, \{l_i, r_i, \mathbf{x}_i\}_{i=1,\ldots,N}\right)$.

3.3. Parameter identification

In this section, we explain the identification of parameters and which features of the data drive the value of the estimates obtained via the system of ML's first order optimality conditions. Intuitively, the identification strategy uses the assumption that the announcement return following a Schedule 13G filing is useful to estimate the counterfactual expected return to a Schedule 13D filing, and vice-versa. That is, expected returns extracted from announcements of Schedule 13G filings must vary with firm and investor characteristics in a way that is consistent with the investor preferring to file Schedule 13D versus Schedule 13G every time expected returns to the former (net of the activism cost) dominate the latter. "The road not taken" is informative about the path the investor ultimately chooses.

3.3.1. Expected return loadings, $\boldsymbol{\beta}_D$ and $\boldsymbol{\beta}_G$

Consider the first order conditions of the ML problem with respect to the sensitivities $\hat{\boldsymbol{\beta}}_D$. After some simplification, we obtain

$$\sum_{i=1}^{N} l_i \mathbf{x}_i \left[\left(r_i - \mathbf{x}_i' \hat{\boldsymbol{\beta}}_D \right) - \hat{\sigma}_D \hat{\rho}_{zD} \lambda_D \left(\hat{\alpha}_{D,i} \right) \right] = 0. \tag{11}$$

There are two terms to consider. The first term in the square bracket would give the OLS estimate of $\hat{\boldsymbol{\beta}}_D$ in a linear regression of returns, r_i, on characteristics, $\mathbf{x}_i$. OLS requires that the estimation residuals, $r_i - \mathbf{x}_i' \hat{\boldsymbol{\beta}}_D$, be orthogonal to the regressors, $\mathbf{x}_i$. Now consider the second term. The ML estimator of the structural model chooses $\hat{\boldsymbol{\beta}}_D$ considering also its impact on the probability the investor files Schedule 13D. This feature explains the presence of an IMR, $\lambda_D \left(\hat{\alpha}_{D,i} \right)$, which corrects for the non-random selection of the Schedule 13D sample. In other words, in the structural model, the orthogonality condition is written with respect to the residuals that take into account selection, i.e. the endogenous choice of filing type. This statement can be made formally. Using equation (7), $\mathbf{x}_i' \hat{\boldsymbol{\beta}}_D + \hat{\sigma}_D \hat{\rho}_{zD} \lambda_D \left(\hat{\alpha}_{D,i} \right)$ is the predicted mean announcement return given that the investor filed a Schedule 13D, i.e., $\hat{E} \left(\Delta_{D,i} | z > 0 \right)$. Hence, we may write equation (11) as

$$\sum_{i=1}^{N} l_i \mathbf{x}_i \left(r_i - \hat{E} \left(\Delta_{D,i} | z > 0 \right) \right) = 0.$$

Solving for $\hat{\boldsymbol{\beta}}_D$, we obtain

$$\hat{\boldsymbol{\beta}}_D = \left(\sum_{i=1}^{N} l_i \mathbf{x}_i \mathbf{x}_i'\right)^{-1} \sum_{i=1}^{N} l_i \mathbf{x}_i \left(r_i - \hat{\sigma}_D \hat{\rho}_{zD} \lambda_D \left(\hat{\alpha}_{D,i}\right)\right). \tag{12}$$

Hence, target firm and investor characteristics that are associated with higher selection-adjusted returns carry higher loadings.

There is another difference between the structural and OLS estimation. The solution to equation (12) is nonlinear because the selection term also depends on $\hat{\boldsymbol{\beta}}_D$.[12] Intuitively, the expected return parameters have a dual role in the model: to explain the likelihood of Schedule 13D filings in the cross section as well as the cross sectional variation in announcement returns to Schedule 13D filings. This non-linearity illustrates how the model imposes constraints about how the outcome variables—filing choices and announcement returns—are related to each other and to the determinants, $\mathbf{x}$.

We omit the discussion of the identification of $\hat{\boldsymbol{\beta}}_G$ because the system of first order conditions with respect to this parameter vector is isomorphic to that with respect to $\hat{\boldsymbol{\beta}}_D$.

3.3.2. Activism cost, C

Consider now the first order condition with respect to $\hat{C}$. Assuming an interior solution, this condition simplifies to

$$\sum_{i=1}^{N} \left(l_i \frac{\lambda_D \left(\hat{\alpha}_{D,i}\right)}{\sqrt{V\left(z|\Delta_D\right)}} - (1 - l_i) \frac{\lambda_G \left(\hat{\alpha}_{G,i}\right)}{\sqrt{V\left(z|\Delta_G\right)}} \right) = 0. \tag{13}$$

The cost $\hat{C}$ equates the average selection effect, i.e., the IMR, across all Schedule 13D and Schedule 13G filings weighted by the conditional variances $V\left(z|\Delta_D\right)$ and $V\left(z|\Delta_G\right)$, respectively. In the structural model, a marginal increase in $\hat{C}$ forces the investor to be more selective when choosing in which firms to be activist. By symmetry, the marginal

[12] While $\hat{\boldsymbol{\beta}}_D$ enters $\hat{\alpha}_{D,i}$, it is easy to show that the right hand side of this expression is monotonically decreasing in $\hat{\boldsymbol{\beta}}_D$. Hence, $\hat{\boldsymbol{\beta}}_D$ is uniquely identified.

increase in $\hat{C}$ makes filing Schedule 13G more likely, which decreases the amount of selection in Schedule 13G filings. In other words, our model and estimation strategy would infer a higher $\hat{C}$ from an otherwise equal dataset with a lower proportion of Schedule 13D filings, or an otherwise equal dataset with a higher difference between Schedule 13D and 13G average announcement returns.

3.3.3. Variance parameters

The first order condition with respect to $\hat{\sigma}^2_{\Delta_D}$ can be written as

$$\hat{\sigma}^2_{\Delta_D} = \frac{1}{N_D}\sum_{i=1}^{N} l_i \left(r_i - \hat{\mu}_{D,i}\right)^2 - \frac{2\hat{\sigma}^4_{\Delta_D}}{N_D}\sum_{i=1}^{N}\left(l_i \lambda_D\left(\hat{\alpha}_{D,i}\right)\frac{d\alpha_{D,i}}{d\hat{\sigma}^2_{\Delta_D}} - (1-l_i)\lambda_G\left(\hat{\alpha}_{G,i}\right)\frac{d\alpha_{G,i}}{d\hat{\sigma}^2_{\Delta_D}}\right), \tag{14}$$

where N_D is the number of Schedule 13D filings. Under the assumption that $\Delta_{D,i} \sim N\left(\mathbf{x}_i'\boldsymbol{\beta}_D, \sigma^2_{\Delta_D}\right)$, the first term on the right-hand side of this expression is the OLS estimate of $\sigma^2_{\Delta_D}$. The second term in equation (14) recognizes that selection introduces conditional heteroskedasticity in announcement returns (see Eq. (8)). The first order condition synthesizes the restrictions imposed by the structural model to back out an estimate of the constant $\sigma^2_{\Delta_D}$ from conditionally heteroskedastic announcement returns. A similar conclusion applies to the estimate of $\sigma^2_{\Delta_G}$.

Consider last the first order condition with respect to $\hat{\sigma}^2_{s_D}$,

$$\sum_{i=1}^{N}\left[l_i \lambda_D\left(\hat{\alpha}_{D,i}\right)\frac{d\alpha_{D,i}}{d\hat{\sigma}^2_{s_D}} + (1-l_i)\lambda_G\left(\hat{\alpha}_{G,i}\right)\frac{d\alpha_{G,i}}{d\hat{\sigma}^2_{s_D}}\right] = 0.$$

When $\hat{\sigma}^2_{s_D}$ is small, the investor has valuable information via her due diligence about Δ_D (i.e., the signal to noise ratio $\hat{\sigma}^2_{\Delta_D}/\hat{\sigma}^2_{s_D}$ is high). In that case, the choice of filing is more affected by randomness from the structural shocks than from cross sectional variation in expected returns. Thus, $\hat{\sigma}^2_{s_D}$ helps control the source of variation in selection. At the margin, an increase in $\hat{\sigma}^2_{s_D}$ equates the marginal increase in selection in Schedule 13D filings against the marginal decrease in selection in Schedule 13G filings. A similar conclusion applies to $\hat{\sigma}^2_{s_G}$.

3.4. Structural vs reduced form estimation

We conclude this section with a formal illustration of the difference between the inference made by structural estimation of our model and by previous reduced-form approaches to the same data. Formally, let $\Pr(\text{Filing 13D}|\mathbf{x}) = F(\mathbf{x}_i'\boldsymbol{\delta})$ be the model for filing a Schedule 13D versus filing Schedule 13G, with $F(.)$ being a cumulative distribution function. Let $F(.)$ be a non-linear function so no exclusion restrictions are needed in the reduced form analysis, enabling a comparison of coefficients for all variables. Also, let $g_D(r_i;\mathbf{x}_i'\boldsymbol{\eta}_D)$ be the density of returns to Schedule 13D filings with expected returns $\mathbf{x}_i'\boldsymbol{\eta}_D$, and $g_G(r_i;\mathbf{x}_i'\boldsymbol{\eta}_G)$ be the density of returns to Schedule 13G filings with expected returns $\mathbf{x}_i'\boldsymbol{\eta}_G$. Then, treating announcement returns and filing choices independently as is commonly done in the activism literature, the likelihood of the data set is

$$\begin{aligned}
&\ln L\left(\{l_i, r_i\}_{i=1,\ldots,N} \,|\, \{\mathbf{x}_i\}_{i=1,\ldots,N}, \boldsymbol{\delta}, \boldsymbol{\eta}_D, \boldsymbol{\eta}_G\right) \\
&= \sum_{i=1}^{N} \left[l_i \ln\left[F\left(\mathbf{x}_i'\boldsymbol{\delta}\right) g_D\left(r_i;\mathbf{x}_i'\boldsymbol{\eta}_D\right)\right] + (1-l_i)\ln\left[\left(1-F\left(\mathbf{x}_i'\boldsymbol{\delta}\right)\right) g_G\left(r_i;\mathbf{x}_i'\boldsymbol{\eta}_G\right)\right]\right]. \qquad (15)
\end{aligned}$$

Without any constraints across equations, the reduced-form approach likelihood function can be split into the sum of three separate likelihood functions, each with a distinct set of parameters: one for the filing choices, $\boldsymbol{\delta}$, and two others for announcement returns, $\boldsymbol{\eta}_D$ and $\boldsymbol{\eta}_G$. Hence, the information content in the announcement returns distribution does not contribute to the inference of the filing choices model. Subsection 5.4 compares the performance of the structural model to the reduced form approach to validate the restrictions imposed by the former.

Note too that, in principle, one could impose correlation between announcement returns and filing probabilities in a reduced-form model. Thus, estimation would use information from both outcome variables to make inference about the two different sets of parameters. But this ad hoc approach would still not require restrictions across the parameters $\boldsymbol{\delta}$, $\boldsymbol{\eta}_D$, and $\boldsymbol{\eta}_G$, so that a counterfactual analysis would be impossible. An example would be the two-step Heckman estimator, in which a first-stage filing choice model is used to produce the IMR that corrects for sample selection bias in the second-stage returns model. This approach implies an expression for expected returns similar to equation (7) without the restriction that the IMR be evaluated at the model statistic α_D, itself a function of expected returns. We discuss further the implications of the two-step Heckman estimator in subsection 5.4.

The restrictions in our structural model come mainly from the model primitive that the investor decides to become an activist when she expects high returns from activism. As a result, estimation uses announcement returns data to predict filing decisions and vice-versa. These restrictions are useful not only to recover the parameters that are common to both distributions, $\boldsymbol{\beta}_D$ and $\boldsymbol{\beta}_G$, but also to recover the counterfactual quantities that a reduced-form approach cannot: the treatment, the stock picking, and the selection components of announcement returns.

4. Data

Data are compiled from several sources. Stock returns, volume, and prices come from the Center for Research in Security Prices (CRSP). Target firm characteristics come from Compustat. Data on institutional ownership come from Thomson Reuters. Data on Schedule 13D filings and Schedule 13G filings come from EDGAR and are described next.

First, we identify the universe of all Schedule 13D and Schedule 13G filings in EDGAR from 1996 to 2017. The universe includes 50,708 Schedule 13D filings and 171,051 Schedule 13G filings. For each filing, we extract the CUSIP of the underlying security and the filing date. Second, we drop duplicate filings, merge target firms with the CRSP and Compustat databases, requiring that data on stock returns be available. This step results in 23,391 Schedule 13D filings and 121,373 Schedule 13G filings.

Third, we drop the 28,663 Schedule 13G filings that were filed on February 14 (45 days after calendar year-end) because this date indicates filings by exempt investors. Exempt investors are not required to file within 10 days of crossing the 5% equity stake and can file up to 45 days after calendar year-end. Hence, these filings are unlikely to carry any informational content. Indeed, the average announcement return on Schedule 13G filings filed on February 14 is -0.08% (statistically indistinguishable from 0), whereas Schedule 13G filings filed on any other day experience an average 0.59% announcement return (highly statistically significant). Finally, we require firm characteristics used in the analysis to be non-missing during the fiscal year that precedes the filing.

[Tables 1 and 2 about here.]

The final sample includes 69,937 filings, of which 8,703 are Schedule 13D filings and 61,234 are Schedule 13G filings. All variables are defined in Table 1. Summary statistics are reported in Table 2. Panel A of Table 2 shows that the average announcement return is 1.31%. The price response to a filing announcement varies substantially with the type of filing. Specifically, the average announcement return is 6.34% for Schedule 13D filings and 0.59% for Schedule 13G filings. When we consider the sub-sample of filings done by activist hedge funds, we find that the average announcement return is 6.04% for Schedule 13D filings and 1.19% for Schedule 13G filings. As expected, activist hedge funds file Schedule 13D filings more often than a typical investor. Specifically, Schedule 13D filings constitute about 37% (2,523/6,742) of activist hedge funds' filings and 12% (8,703/69,937) for all investors in our sample. In Section 7, we report the main results from our model estimated on the sub-sample of activist hedge funds.

Panel B reports descriptive statistics of firm characteristics. Since most firm characteristics are standard in the literature, we omit their discussion. Panel C reports three investor characteristics. 13D Experience (13G Experience) is the number of Schedule 13D (Schedule 13G) filings by each investor in the data up to the filing date. In our sample, the average investor filed six Schedule 13D filings and 536.7 Schedule 13G filings. Most investors have little experience with Schedule 13D filings. The median investor never filed a Schedule 13D prior to the current filing, but filed a Schedule 13G 62 times previously. Untabulated results show, however, that about 78% of investors that have filed a Schedule 13D have also filed at least one Schedule 13G in the whole sample. This evidence suggests that a typical Schedule 13D filer is experienced with both Schedule 13D and Schedule 13G. Finally, 10.8% of filers in our sample are activist hedge funds.

5. Estimation Results

Table 3 presents the estimates of our model parameters. We estimate the model under four different specifications of μ_D and μ_G. In specification (1), we only include target firm variables: Market capitalization, Amihud illiquidity, Analyst coverage, Book-to-market equity, Firm age, Sales growth, HHI, Institutional ownership, Idiosyncratic volatility, Leverage, ROA, and the average stock return of the last twelve months, besides a constant term. Specification (2) adds the investor experience variables and a dummy variable for activist hedge funds, specification (3) adds dummy variables of whether prior Schedule 13D or Schedule 13G filings were made on the same target withing the last year, and specification (4) adds three stock return risk factors, the market excess return, SMB, and HML.

[Table 3 about here.]

Panel A shows that the coefficients on target firm variables in specification (1) are jointly significantly different from 0 with a p-value of the likelihood-ratio statistic smaller than 0.001. Likelihood-ratio tests also reject the hypotheses that the coefficients of the investor's filing experience variables and the activist hedge fund indicator(specification (2)), of prior

13D and 13G filings (specification (3)), or of the stock return risk factors (specification (4)), are also respectively different from zero.[13]

5.1. Estimates of expected return loadings, $\boldsymbol{\beta}_D$ and $\boldsymbol{\beta}_G$

A key result in panel A is that, for all specifications, the point estimates of the parameters in $\boldsymbol{\beta}_D$ and $\boldsymbol{\beta}_G$ associated with target firm characteristics or stock return factors have similar magnitudes. For example, a one-sample standard deviation increase in the book-to-market ratio is associated with an equal increase in the expected announcement return of 65 basis points for Schedule13D or Schedule 13G filings (0.011×0.592). This is not the case for the estimated coefficients of investor experience variables, the activist hedge fund indicator, and for prior Schedule 13D filings. To wit, Schedule 13D filings by an activist hedge fund investor show a significant return increase between 50 and 60 basis points (specifications (3) and (4)) relative to Schedule 13D filings by non-hedge fund investors. On average, there is no significant estimated hedge fund activist effect on Schedule 13G filings. Similarly, returns from filing Schedule 13D and Schedule 13G are expected to be higher by 70 and 40 basis points, respectively, if there exist prior Schedule 13D filings on the same target within the last year. These results suggest that the presence of activists complements rather than preempts the value creation efforts by new activists. The existence of prior Schedule 13G filings on the target is not associated with changes in expected returns.

As for the investor experience variables, for every 10 additional Schedule 13D filings of prior experience, the next Schedule 13D filing by the same investor has an additional expected return of 17 basis points whereas the next Schedule 13G filing is associated with a lower expected return by almost 21 basis points (specification (2)). In contrast,

[13] Our sample includes cases in which investors file a Schedule 13D straight after crossing the 5% threshold or in which investors switch their filing status from Schedule 13G to Schedule 13D. The latter are not a common strategy: We identify in our data 968 cases in which a Schedule 13D filing follows a Schedule 13G filing on the same target firm by the same investor. A robustness check in the Internet Appendix F further confirms that these switchers do not play a role in the inference made by our model: Excluding the filing switches from our sample (1.5% of filings) has no effect on the parameter estimates.

additional Schedule 13G experience predicts lower Schedule 13D returns, and it is unrelated to subsequent Schedule 13G filing returns. The evidence that greater experience in filing Schedule 13Ds contributes to higher announcement returns to Schedule 13D filings on average, but additional experience in Schedule 13G filings contributes to lower Schedule 13D returns, is consistent with the market being able to recognize those investors attempting to file Schedule 13Ds to enjoy the larger average announcement returns without actual intentions to engage in activism from those that create value.

There are two important consequences regarding the key result highlighted above that the point estimates of the parameters associated with target firm characteristics or stock return factors have similar magnitudes for 13D or 13G filings. First, the treatment effect from activism, which equals the difference between expected returns from each filing schedule, $\mu_D - \mu_G = \mathbf{x}_i'(\boldsymbol{\beta}_D - \boldsymbol{\beta}_G)$, is not explained by any of the target firm and risk factor variables. Rather, it is the investor variables that almost exclusively explain the treatment effect.

Second, the target firm variables contribute only to explaining variation in the stock picking effect. Hence, we cannot conclude that a particular variable carries a treatment effect based solely on its loading on Schedule 13D expected returns. Indeed, the finding that Schedule 13D and Schedule 13G expected returns covary positively with book-to-market and negatively with sales growth and past stock return performance is consistent with investors pursuing stock-picking strategies.[14] Similarly, we find that investments in less liquid securities appear to be compensated by higher expected returns regardless of the filing schedule, consistent with an illiquidity premium as in Amihud (2002). Conversely, this finding implies that investors are willing to accept lower expected returns when the stock is more liquid, suggesting that stock market liquidity facilitates Schedule 13D or Schedule

[14]The estimated sign of the average past return performance loading on μ_D is consistent with the finding in Brav et al. (2008).

13G filings (Collin-Dufresne and Fos, 2015, 2016). Interestingly, this result contrasts with Edmans et al. (2013), where liquidity is positively associated with abnormal returns to Schedule 13G filings of hedge funds. We discuss potential reasons for this difference in sub-section 5.4.

Finally, the estimated coefficients of the SMB and HML factors are positive and negative, respectively, both for the expected returns to Schedule 13D or 13G filings. Since abnormal filing announcement returns are estimated using backward looking three-factor model betas, this evidence indicates that the SMB beta must have increased and the HML beta must have decreased following the filing the announcement. Since the magnitudes of the loadings on either type of filing are equal for each risk factor, adjustments to the firm's risk profile are not due to the expected activist intervention but to the stock picking. The stock picking effect is more likely to be related to the market correcting a perception about the risk of the company following a filing announcement.

Given the remarkable stability of the parameter estimates across specifications, we focus the discussion around the estimates in specification (4) for the remainder of the section.

5.2. Estimates of the cost of activism, C

The estimated cost of activism is 4.6 percentage points (Panel B of Table 3) of the ex post value of the filer's stake. This estimate is significantly different from zero with a p-value under 0.01. The estimate of C is equivalent to an average \$2.43 million. Noting from Table 2 that the mean abnormal return in Schedule 13D filings is 6.34%, the net average abnormal return to activist is thus 1.74%.[15] The estimated loading on the investor experience variables suggests that there is no free entry in the industry and, therefore, that our estimated net abnormal return to activism constitutes an economic rent to activists.

Figure 1 provides a useful illustration of how our estimate of $\hat{C}$ is obtained. The left

[15] This number is higher than the annualized mean value weighted abnormal return of 0.23% found in (Gantchev, 2013).

panel plots the theoretical values of the announcement returns to Schedule 13D and to Schedule 13G filings against possible values of the cost parameter, C, holding all other parameters constant at their maximum likelihood estimates. Because we are holding the average values of $\hat{\mu}_D$ and of $\hat{\mu}_G$ constant, the only source of variation in either line is the size of the selection bias. Moreover, the amount of selection bias in Schedule 13D filings is increasing in C because, the higher the cost, the higher the required difference in expected returns so that the investor chooses to file a Schedule 13D instead of a Schedule 13G. By the symmetry of the problem, the amount of selection bias in Schedule 13G filings is decreasing in C. The right panel of Figure 1 plots the theoretical probability of a Schedule 13D filing, as a function of C. Clearly, this probability is decreasing in C. Consider now the first order condition for C (Eq. (13)). The ML estimate of the cost parameter trades off the amount of sample selection bias in Schedule 13D returns against the amount of sample selection bias in Schedule 13G returns. Figure 1 shows that, given the values of $\hat{\mu}_D$ and $\hat{\mu}_G$, the estimate of C is able to produce a sample selection effect that matches the observed mean announcement return to Schedule 13D fillings as well as the proportion of Schedule 13D filings, but overestimates slightly the amount of sample selection in Schedule 13G filings and the observed mean announcement return to Schedule 13G fillings.

[Figure 1 about here.]

5.3. Estimates of volatilities

Panel B of Table 3 shows that the announcement return volatilities, σ_{Δ_D} and σ_{Δ_G}, as well as the due diligence signal volatilities, σ_{s_D} and σ_{s_G}, are all precisely estimated. Notably, the latter are significantly larger than the former. In other words, the model infers low signal-to-noise ratios from the data, implying that more of the variation in filing choices is determined by the predictable variation in announcement returns μ_D and μ_G rather than by the unpredictable variation in ϵ_{Δ_D} and ϵ_{Δ_G}, or in ϵ_{s_D} and ϵ_{s_G}.

Figure 2 is useful to understand why the ML estimator makes this inference. Recall that our estimation procedure targets the joint distribution of announcement returns and filing choices. The two panels of the figure illustrate how the ML estimates of σ_{s_D} and σ_{Δ_D} are identified by two important moments of the joint distribution: the frequency of Schedule 13D filings and the volatility of Schedule 13D announcement returns. Indeed, the solid black line represents the $(\sigma_{s_D}, \sigma_{\Delta_D})$-combinations for which the model-implied Schedule 13D return volatility equals its data analog (0.222). The indifference curve has a negative slope because, in the model, there is a trade off between either source of noise to produce any given level of announcement returns volatility. When the due diligence signal is sufficiently imprecise, then the volatility of the announcement return, σ_{Δ_D}, is set to equal the sample standard deviation of announcement returns, implying from inspection of the first order condition (14) that the effect of σ_{Δ_D} on selection is zero.

The grey line denotes the $(\sigma_{s_D}, \sigma_{\Delta_D})$-combinations for which the model-implied frequency of Schedule 13D filings equals the frequency in the data (0.124). The slope of this indifference curve is positive and increasing, meaning that, in the model, more volatile announcement returns can only imply the same Schedule 13D filing probabilities for significantly more volatile due diligence signals.

The left panel also shows the sensitivity of both estimates to the volatility of Schedule 13D announcement returns. All other moments constant, had the sample standard deviation of Schedule 13D returns been 25% higher, then the iso-volatility curve would have been to the North East of the solid black line, i.e., the dashed black line. In this case, the model would infer an even lower signal-to-noise ratio in order to match the same proportion of Schedule 13D filings. Conversely, a lower announcement returns volatility (dotted line) would lead to infer a higher signal-to-noise ratio.

Finally, the right panel shows that a higher (lower) frequency of Schedule 13D filings in the data would imply an indifference curve to the southeast (northwest) of the solid black line, i.e., the dashed (dotted) gray line. Therefore, a higher frequency of Schedule 13D filings while keeping the Schedule 13D announcement returns volatility constant would lead to higher (lower) estimated signal-to-noise ratio.

The same reasoning applies for the identification of σ_{s_G} and σ_{Δ_G}. As the figures are isomorphic to those for σ_{s_D} and σ_{Δ_D}, they are omitted.

[Figure 2 about here.]

5.4. Structural versus reduced-form estimates

For comparison with the ML estimates of expected return loadings in our structural model, we also estimate the reduced-form analog parameters in the log-likelihood function (15). We implement the reduced-form estimation via two separate OLS regressions of announcement returns to Schedules 13D and 13G filings and a Probit model of the type of filing. Table 4 presents the results. The first two columns reproduce the estimates of the structural parameters $\boldsymbol{\beta}_D$ and $\boldsymbol{\beta}_G$ from specification (4) in Table 3. Columns 3 and 4 present the OLS estimates of abnormal returns to Schedule 13D and 13G filings, respectively. Column 5 provides estimates of the Probit model.

[Table 4 about here.]

The OLS estimates in Table 4 reproduce some reduced-form results in previous literature. For example, like Brav et al. (2008), we obtain negative coefficients for market capitalization and leverage for Schedule 13D filings. There are also many differences between the structural and the reduced-form parameter estimates.

Importantly, note that when the structural and reduced-form parameters of announcement returns differ in their signs, generally the signs of the former coincide with the signs of the Probit model estimates. For example, note that the investor's Schedule 13D filing experience, the activist hedge fund indicator or the book-to-market ratio load positively on expected returns to Schedule 13D filings in our model, whereas Schedule 13G experience and institutional ownership load negatively. These variables load with the same sign in the Probit model for Schedule 13D filings versus Schedule 13G filings, but with the opposite sign or insignificantly in the OLS regression. The reason for this result is that the model imposes the restriction that high expected returns to Schedule 13D explain why realized abnormal returns are high, but they also explain why the investor chose to file Schedule 13D. Formally, equation (12) shows that estimates of the structural parameters depend on how firm characteristics correlate with selection-adjusted returns.

Table 5 evaluates the performance of the model and the reduced-from approach in matching some first and second moments of the data. The numbers for the model-implied moments in this table refer to predicted, rather than actual filings. In panel A, we show that the model is able to match the frequencies of Schedules 13D and 13G filings, whereas the Probit model severely overestimates the proportion of Schedule 13G filings. Our model also predicts the individual filing choices much better than the Probit, with a pairwise correlation with the actual choices of 0.54 against 0.26, respectively. Most importantly, the superior ability to match the distribution of filing choices does not compromise our model's ability to match moments of the cross sectional distribution of returns, where our model performs as well as OLS. To summarize, the evidence in Table 5 supports the restrictions imposed by our model via the joint distribution of filing choices and returns.

[Table 5 about here.]

An alternative reduced-form estimation is the two-step Heckman correction model with normally distributed first-stage errors. Clearly, this reduced-form alternative cannot do better than our structural ML estimator: it produces exactly the same results as the Probit model in panel A of Table 5, while only possibly matching the first and second moments of announcement returns as well as our model (see the Internet Appendix B for the detailed results).

6. Additional Implications from Model Estimates

6.1. Expected returns to activism

Table 6 summarizes the properties of estimated unconditional expected returns to activism, μ_D, and to passive investing, μ_G. These returns differ from announcement returns because they are free from sample selection biases, besides the realized noise in returns. They are, however, important for our return decompositions (equations (9) and (10)). Panel A focuses on the subsample of actual Schedule 13D filings and panel B on the subsample of actual Schedule 13G filings.

[Table 6 about here.]

Panel A shows that the mean unconditional expected return to a Schedule 13D filing, $\hat{\mu}_D$, is 5.58% and the counterfactual mean unconditional expected return, $\hat{\mu}_G$, to those filings is 0.85%. Thus, the mean value creation by activists is $5.58\% - 0.85\% = 4.74\%$, and the mean value of stock picking is 0.85%. These numbers represent 74.8% and 13.4%, respectively, of the predicted announcement return of 6.34% shown in Table 5. The mean estimated value of sample selection bias is 0.75%, or 11.8% of the mean predicted announcement return. For Schedule 13G filings, panel B shows that the mean unconditional expected return, $\hat{\mu}_G$, is 0.64%. Therefore, the average value of stock picking is similar across samples (0.64% versus 0.85%), though a target firm that was the subject of a Schedule 13D filing would have experienced slightly higher than average announcement returns if a Schedule 13G had been filed instead.[16] The mean value of stock picking in Schedule 13G filings represent 94% of the predicted announcement return of 0.68% shown in Table 5, and the average sample selection component in Schedule 13G announcement returns is 0.04%, or about 6% of the

[16]The higher average stock picking effect in Schedule 13D filings with respect to 13G filings is explained by the relatively higher average values of the Amihud Illiquidity, Analyst coverage, Book-to-market ratio, and Idiosyncratic volatility in the subsample of Schedule 13D filings. These variables load positively and significantly on the Schedule 13G expected returns.

mean announcement return.[17]

Our model uses information from the filing choices and from the observed announcement returns to identify the treatment effect of Schedule 13D filings based on the comparison of Schedule 13D announcement returns to the counterfactual Schedule 13G returns. In Figure 3, we plot the estimated empirical distributions of the three announcement return components for actual Schedule 13D filings. The sample selection component and the treatment components are positively skewed, whereas the empirical distribution of the stock picking component is more volatile and almost symmetric.

[Figure 3 about here.]

Panel A of Figure 4 presents the cumulative average buy-and-hold abnormal stock return around the date of Schedule 13D filings in our sample.[18] (We discuss Panel B in Section 7.) We super impose on the figure the breakdown of the average price response into its three components. The mean of the treatment effect over all Schedule 13D filings is 74.8% of the mean announcement return (dark gray bar in the figure). The estimated average stock picking effect accounts for 13.4% of the mean announcement return (gray bar in the figure). The average sample selection component for Schedule 13D filings is 11.8% of the mean announcement return (light gray bar in the figure).

[Figure 4 about here.]

[17]One less intuitive finding is that for Schedule 13G filings, the cross sectional dispersion of the counterfactual estimate of $\hat{\mu}_D$ is much larger than that in the subsample of Schedule 13D filings. Section 8 presents results from a version of the model where we allow for activism costs to vary. We find there that the estimated $\hat{\mu}_D$ is equally volatile in the Schedule 13D and Schedule 13G subsamples. With heterogeneous costs, much of the extra volatility is now exhibited by the estimated costs.

[18]The small discrepancy between the average abnormal return on day $t+10$ in Figure 4 and the average abnormal return for Schedule 13 filings reported in Table 2 is due to the fact that the latter follows from the winsorized full sample of filings and the former from the winsorized subsample of Schedule 13D filings only.

6.2. Cross-time and cross-industry model performance

Next, we assess the performance of the model across different time periods and industries. If the net returns from activism were changing over time (Krishnan et al., 2016) for reasons not specified in vector $\mathbf{x}$, then the performance of our model could weaken in some periods, specifically by not predicting correctly the proportions of Schedule 13D filings in those periods. To see if this is the case, we examine the model's performance in five different periods: the first 4 five-year periods in the sample and the shorter period at the end, from 2016 to 2017. With the exception of the last period, the total number of filings is about uniformly distributed across all five-year periods (see Internet Appendix G.1). Importantly, in this exercise, we do not re-estimate the model in each sub-sample but use estimates from the full sample.

We observe that the fraction of Schedule 13D filings has decreased over time, from 0.15 in the 1996-2000 period to 0.10 in 2016-2017, while the average returns from Schedule 13D and 13G filings have remained rather stable. The model matches well the time-varying filing frequencies and announcement returns (see Table IA.27 in the Internet Appendix for the full detail of this analysis). Our model captures these time series patterns even though time dummies are not included in expected returns. These results underscore the effectiveness of the specified target and investor characteristics in explaining variation in expected returns over time.

Figure 5 illustrates the decomposition of 13D announcement returns over time implied by time variation in the specified investor and target characteristics. The treatment effect is between 69% and 76% of total announcement returns across all periods, and takes on an elevated value of 88% in the 2011-2015 period. The stock picking and selection components are remarkably steady and of similar magnitudes, except for the 2011-2015 period, when stock picking returns are zero.

[Figures 5 and 6 about here.]

It is also possible that net returns from activism vary across industries. To explore this possibility, we conduct the same analysis as above but across the 12 Fama-French (Fama and French, 1997) industries. Again, we do not re-estimate the model in each sub-sample but use estimates from the full sample. We note that our sample is not evenly distributed across the FF12 industries, which may affect the quality of the inference for those with relatively few observations (see Internet Appendix G.2). For example, the frequency of Schedule 13D filings is a relatively high 0.19 amongst Telephone and Television Transmission firms (FF7) and a relatively low 0.07 amongst Utilities (FF8), the two industries with the fewest observations (2,241 and 1,258). Yet, despite the heterogeneity across industries, the model still closely matches the proportions of Schedule 13D filings for each industry and the mean and standard deviation of Schedule 13D and 13G announcement returns for all but the least covered industries. The full details are reported in Table IA.28 of the Internet Appendix. Figure 6 shows that the treatment effect represents the largest component of Schedule 13D announcement returns also for each of the Fama-French industries.

6.3. The informational content of expected returns

Our model and estimation assume that the abnormal announcement return to a Schedule 13D filing reflects the shareholders' anticipation of the value creation by activists, albeit with noise. While this assumption is pervasive in the literature since Holderness and Sheehan (1985), to the best of our knowledge no study has verified whether abnormal announcement returns effectively forecast changes in target firm performance.[19]

We next perform such an analysis and take a step further, asking which of the components in our decomposition of filing announcement returns is most informative about future performance. Specifically, we hypothesize that the treatment effect in Schedule 13D

[19] For example, Klein and Zur (2009) show that announcement returns are higher for filings in which the activist eventually achieves the stated goals than those of filings in which the goals are not achieved, but they do not measure to what extent the resulting changes in firm performance are predicted by the size of the announcement returns.

filings is associated with improvements in firm performance, over and above the information in the announcement return. If verified, this result would imply that our model estimates provide a better indication of future value than announcement returns.

To address this question, we estimate the following regression:

$$y_i = \alpha_{t_i} + \alpha_{CAR,i} + \beta_1 CAR_i + \beta_2 Treatment_i + \beta_3 Stockpicking_i + \beta_4 Selection_i + \varepsilon_i, \quad (16)$$

where y_i is change in a performance metric for Schedule 13D filing i, CAR_i is the announcement return, $Treatment_i$ is the predicted treatment effect, $Stockpicking_i$ is the predicted stock-picking effect, $Selection_i$ is the predicted sample selection bias, α_{t_i} are calendar year fixed effects, and $\alpha_{CAR,i}$ are 500 dummy variables on announcement return groupings (each group captures 0.2% of the sample). Relative to controlling for a linear relation between announcement returns and future outcomes using CAR_i, these dummy variables provide a more granular control for the relation between announcement returns and future outcomes. In the regressions, we include only CAR_i or $\alpha_{CAR,i}$ at a time. For ease of interpretation of the coefficients, the variables have been normalized by their sample standard deviation. Note that our estimation procedure provides the decomposition of expected returns rather than announcement returns for each specific filing, implying that $Treatment_i$, $Stockpicking_i$, and $Selection_i$ do not necessarily add up to CAR_i. Therefore, we can include all three components of expected returns as well as the announcement return in the regression.

Panel A in Table 7 reports the results for the change in ROA, from one fiscal year prior to the filing year to one fiscal year after the filing year. Column (1) shows that cross-filing variation in announcement returns is significantly related to firm performance, as measured by ROA. Specifically, one standard deviation increase in the announcement returns leads to 0.54 percentage points increase in ROA, corresponding to about 10% of the unconditional ROA mean (see Table 2). This finding suggests that the stock price response at announcement correctly reflects improvements in future performance.

[Table 7 about here.]

Column (2) shows that $Treatment_i$ and $Stockpicking_i$ also positively predict improvements in ROA, whereas the relation between $Selection_i$ and future performance is insignificant. One standard deviation increase in $Treatment_i$ and $Stockpicking_i$ leads to 2.9 and 1.4 percentage points increase in ROA, respectively. Thus, the economic magnitude of $Treatment_i$ and $Stockpicking_i$ coefficients is much larger than that of CAR_i coefficient. Interestingly, column (3) shows that when we include CAR_i and the three components of the expected return in the regression, the relation between CAR_i and future performance becomes insignificant. In contrast, we see little change in the relation between $Treatment_i$ and $Stockpicking_i$ and future performance.

This finding suggests that the informational content of $Treatment_i$ and $Stockpicking_i$ is far larger than the informational content of CAR_i. To further support this conclusion, we next replace CAR_i with $\alpha_{CAR,i}$ dummies. Column (4) shows that the inclusion of these dummies in the regression has little effect on the relation between $Treatment_i$ and $Stockpicking_i$ and future performance. If anything, their coefficients slightly increase.

Panel B reports results for regressions of changes in sales turnover (equal to sales to assets) on the various components of expected returns as well as on actual announcement returns. Our findings are qualitatively similar. Whereas the relation between CAR_i and changes in sales turnover is positive but insignificant, $Treatment_i$ and $Stockpicking_i$ are positively and significantly associated with improvements in sales turnover. One standard deviation increase in $Treatment_i$ and $Stockpicking_i$ leads to 7.4 and 2.6 percentage points increase in sales turnover, respectively.[20]

[20] The finding that CARs have little or no explanatory power for firm performance is consistent with the finding in Ben-David et al. (2020) for corporate acquisitions. In addition, we show that the treatment component contains information value.

The results so far indicate that Schedule 13D filings with higher $Treatment_i$ and $Stockpicking_i$ experience larger improvements in future performance, as measured by ROA and sales turnover. The positive relation between $Treatment_i$ and future performance suggests that higher $Treatment_i$ could reflect a higher probability that the investor succeeds in inducing changes in corporate policies as well as a higher gain in case of successful activism campaign. In the former case, higher $Treatment_i$ should also predict a lower likelihood that the activism campaign initiated with a Schedule 13D filing evolves into a hostile activism campaign. We therefore hypothesize that higher $Treatment_i$ should be negatively related to the probability of a future hostile engagement.

To investigate this hypothesis empirically, we next study the relation between the three components of expected returns for Schedule 13D filings, the Schedule 13D filing announcement returns, and the probability of a proxy contest. Proxy contests are one of most hostile forms of shareholder activism (e.g. Dodd and Warner, 1983; DeAngelo and DeAngelo, 1989; Pound, 1988; Fos, 2018). If a Schedule 13D filing has a large treatment component, future hostile activism may not be necessary.

In panel C of Table 7, we report the estimates of the coefficients of the regression in (16), in which the dependent variable is an indicator that equals 1 if there is a proxy contest for the target firm during the fiscal year after the Schedule 13D filing. We find that $Treatment_i$ exhibits a robust significant relation with the probability of a proxy contest: a higher treatment component of expected returns is associated with a lower likelihood of a proxy contest. The result that treatment is negatively associated with a lower probability of proxy contests is consistent with arguments in Fos and Tsoutsoura (2014) and Johnson and Swem (2021). One of the main drivers of treatment in our model is investor experience, which is likely to be correlated with investor reputation, a variable that Fos and Tsoutsoura (2014) and Johnson and Swem (2021) predict is linked to fewer proxy contests. Overall, this finding further validates that Schedule 13D filings with high $Treatment_i$ identify more effective activism campaigns.

6.4. Counterfactual Exercises on the Costs of Activism

6.4.1. Cost sharing in activism

In our model, the investor becomes an activist if and only the expected treatment effect exceeds the private activism cost, i.e., if $\mu_D - \mu_G > C$. Panel B of Table 6 shows that the median value of $\hat{\mu}_D$ in the subsample of Schedule 13G firms is higher than the median value of $\hat{\mu}_G$, implying that a large number of those firms could have been instead targets of activism in the absence of the costs. In fact, a striking 62% of Schedule 13G filings in the data satisfy the condition that $\hat{\mu}_D - \hat{\mu}_G > 0$.

To assess the extent to which activism costs deter passive investors from being activists, our model can simulate the counterfactual in which the costs of activism are shared by all the shareholders. In that case, the average firm value gained by each Schedule 13G filing becoming a Schedule 13D filings instead would be $36.4 million, or about $66 billion on average per year (untabulated).[21] We note that these estimates are meant to provide guidance of the potential gains from reducing the impact of private activism costs rather than to endorse cost-sharing as the actual mechanism. Indeed, one caveat of these calculations is that they rule out ex post renegotiation of the cost-sharing arrangement. Another caveat is that some of the costs, such as the risk aversion disutility or the reputational costs from potential failure to enact changes may not be shareable. Additionally, cost sharing may induce further activism, coming not only from existing passive investors but also from new investors outside our sample of Schedule 13G filers. A more rigorous analysis of economic incentives would be necessary before discussing concrete policy implications.

[21] We also use the parameter estimates to calculate the number of actual Schedule 13D filings with an estimated negative treatment effect, i.e., where $\hat{\mu}_D < \hat{\mu}_G$. We find that the proportion of predicted filings with negative estimated treatment is less that 0.1%.

6.4.2. Precision of due diligence signal

Incumbent shareholders can also increase investors' propensity to engage in activism and enhance value creation by increasing the transparency of the due diligence process, e.g., by disclosing more private information. In the model, this mechanism corresponds to increasing the precision of the Schedule 13D due diligence signal, i.e., by lowering the volatility σ_{s_D}.

[Table 8 about here.]

The results of this exercise are shown in Table 8. Our estimates imply that the proportion of Schedule 13D filings could be almost doubled if σ_{s_D} were 75% lower than its point estimate. More importantly, our simulations show that a more transparent due diligence process has an advantage over cost sharing. To wit, with shared activism costs, more investors choose activism in targets with lower expected Schedule 13D returns, adding Schedule 13D filings with lower treatment values. In contrast, higher due diligence precision has the opposite effect: it adds on average deals with higher treatment value. As shown in Table 8, the average treatment effect increases from 4.74% to 5.47% if σ_{s_D} were 75% lower. Equation (3) explains why this is the case. A higher signal-to-noise ratio makes investors' decisions more sensitive to the due diligence signals, which, by construction are informative of higher activist returns and treatment values. Intuitively, a more precise due diligence process enables investors to discriminate targets better and results in higher returns on average.

These comparative statics also warrant some caution. More transparency towards prospective activists may itself be costly to shareholders, e.g., by revealing information to the firm's competitors, or have other benefits, e.g., by attracting competing activists.

7. Activist Hedge Funds

The full sample contains investors that never file a Schedule 13D, or Schedule 13D filers without the alternative to file a Schedule 13G, such as executive suite whose equity stake crosses the 5% threshold. We therefore conduct a robustness test of re-estimating the model on the sub-sample of filings by activist hedge funds. Whereas Klein and Zur (2009) show that activist campaigns by hedge funds are similar to those by other investors in many respects, focusing on activist hedge funds brings several advantages. First, we exclude the uninformative cases of executives whose equity stake raises above 5%. Second, if a large fraction of passive investors tracks performances of indices and never files a Schedule 13D, 74% of activist hedge funds have filed both Schedule 13D and Schedule 13G in our sample. Third, activist hedge funds are reputed to be good stock pickers, facilitating concerns that a firm that is the subject of a Schedule 13D filing by an activist hedge fund would have experienced higher than average announcement returns had a Schedule 13G been filed instead. One disadvantage of focusing on the sub-sample of activist hedge funds is that these investors are responsible for only 10.8% of the filings in our sample.

The full details of this estimation are included in the Internet Appendix C. In a nutshell, in the subsample of active hedge funds, the model matches the mean and variance of announcement returns and the proportions of Schedule 13D and Schedule 13G filings in this subsample as well as it did in the full sample. This result underscores the robustness of the model's assumptions, as the model fits the data in the subsample where they are most likely to hold. Additionally, with the exception of the cost of activism, the parameter estimates using this subsample are virtually unchanged. The estimated cost of activism is 2.4% in the activist hedge fund sample versus 4.6% in the full sample. Aside from the cost of activism, the model makes the same inference about the unobserved parameters in a subsample with different moments. To wit, the subsample of filings by activist hedge funds contains a significantly higher proportion of Schedule 13D filings but slightly lower announcement returns than in the full sample. The model interprets these features of the data as a cost difference, implying that activist hedge funds, use the cost advantage to pursue more activism on targets with lower expected returns. Remarkably, the correlation between the estimated treatment effect in the activist hedge fund sample and the estimated treatment in the full sample for the same investors is 0.9955. Note too that the estimates also imply significantly larger signal-to-noise ratios, suggesting that active hedge fund investors acquire more relevant private information than most other investors.

If the parameters are very similar, the sample differences do imply a somewhat different decomposition of announcement returns for filings by activist hedge funds. Panel B of Figure 4 shows that the cumulative average buy-and-hold abnormal stock return around the date of Schedule 13D filings for hedge fund activists includes an equally important sample selection component as in the full sample (panel A), but a relatively higher treatment effect at the expense of a negative but smaller stock picking effect.

8. Cost heterogeneity

One of our main results in the paper so far is that variation in expected returns is an important driver of the announcement returns and of filing choices. Since filing choices are driven by the expected profit of the activist net of activism costs, it is possible that variation in filing choices may also be explained by activism costs, were they allowed to vary across deals. Note however that cost variation alone cannot explain the data because activism costs are only paid by the activist and therefore do not affect the filing announcement returns. We verify this claim by estimating the model shutting down the expected returns channel and allowing only cost of activism heterogeneity. This version of the model not only fails to match any variation in filing announcement returns by construction, but also performs significantly worse in matching the distribution of filing choices: the correlation between actual and predicted filing choices drops from 0.54 for the main model (see Table

5) to 0.35. In conclusion, expected returns variation is necessary to explain the data.[22]

We study next the consequences of relaxing the homogeneous costs assumption. With homogeneous costs, the treatment effect equals $\mu_{D,i} - \mu_{G,i}$ while the decision to be an activist depends on the expected net return $\mu_{D,i} - \mu_{G,i} - C$ (see Equation (4)). Therefore, inference about the value of treatment uses the result that any variable, x_j, has the same marginal impact on treatment and on selection: $\beta_{D,j} - \beta_{G,j}$. Allowing for cost heterogeneity relaxes this identifying assumption. Let the activism costs be given by the function

$$C_i = \mathbf{w}_i'\boldsymbol{\kappa}, \tag{17}$$

where $\mathbf{w}_i$ includes all cost determinants and $\boldsymbol{\kappa}$ their coefficients. The effect on selection of a variable x_j that is included in $\mathbf{w}_i$ and in $\mathbf{x}_i$, i.e., a cost and expected returns determinant, is now $\beta_{D,j} - \beta_{G,j} - \kappa_j$. Thus, a degree of freedom is added in explaining the joint distribution of filing choces. Without it, the model may infer lower treatment sensitivity for variables that are associated with announcement returns but not filing choices. With it, the model may attribute such moments to higher treatment *and* costs sensitivities, while better explaining the variation in returns.

We explore a costs specification that includes the same variables as the expected returns specification, i.e., $\mathbf{w} = \mathbf{x}$. We find that not many variables in it nor other traditional measures of the quality of firm governance appear to be important cost drivers (see Internet Appendix D.2 for details). In Table 9, we present a summary of the estimates, implied moments and announcement returns decomposition, when activism cost determinants include only those variables with robust significant coefficient estimates: all the investor variables, Prior Filing, Institutional ownership, and ROA (see Internet Appendix D.3 for a complete set of results).

[22] We present these results in detail in the Internet Appendix D.1.

[Table 9 about here.]

Table 9 shows that most estimates of the expected returns's sensitivities, i.e., parameters β_D and β_G, do not change materially. Two important differences in the expected return parameter estimates are that (i) activist hedge funds have a cost advantage rather than an expected returns advantage over other types of investors; and (ii) more Schedule 13G filing experience is no longer associated with lower expected returns to activism but is associated with higher costs. Allowing for cost heterogeneity lets the model infer that 13G Experience or the activist hedge fund characteristic are better predictors of selection than of treatment. Also, the estimated average treatment effect is now slightly larger: from 4.74% to 5.30%.

Otherwise, the rest of Table 9 shows that the overall performance of the model does not improve significantly when allowing for cost heterogeneity relative to the model with fixed costs. The main results that investor characteristics appear to be responsible for value creation and that target firm characteristics mostly explain stock picking remain. In addition, estimated treatment under cost heterogeneity predicts future performance as well as in Table 7 (see Table IA.16).

9. Conclusion

The value created by activist investors is measured via the decomposition of Schedule 13D filings announcement returns into the treatment, stock picking, and sample selection components. This decomposition is achieved via structural estimation of a model of the joint distribution of the proportions of and announcement returns to Schedule 13D and 13G filings. The target firm characteristics explain the stock picking component whereas value creation is almost exclusively explained by the investor's experience. The estimated treatment effect predicts future improvements in performance, suggesting that our measure of value creation identifies more effective activism campaigns, something that abnormal returns at the time of the filing cannot do.

Our results suggest that variation in expected returns is a first order determinant of the joint distribution of announcement returns and filing choices. Yet, the admittedly more complex decision process behind activist interventions could be extended in different ways. Our model could accommodate heterogeneity in the precision of the due diligence signal across investors or target firms. Our model could also be extended to include a do nothing option, whereby the investor precludes disclosure keeping its stake below 5%.

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Table 1: **Variable Definitions.** This table defines the variables used in this study. The data consists of 8,703 Schedule 13D and 61,234 Schedule 13G filings from 1996 to 2017. Unless noted, all variables are measured at the end of the calendar year preceding the year of each filing.

Variable	Definition
CAR	Cumulative abnormal (Fama-French three factor model) returns over the $[t-30, t+10]$ window around the Schedule 13D or 13G filing date (t)
Market capitalization	Market capitalization, in $ millions
Amihud illiquidity	Average of all the previous calendar year's daily statistic: 1000*sqrt(abs(ret)/(abs(prc)*vol))
Analyst coverage	Number of IBES analyst covering the stock, scaled by 10
Book-to-market	The ratio of book value of equity to market value of equity
Firm age	Number of years since the stock's first appearance on CRSP, scaled by 10
Sales growth	Annual sales growth over the previous calendar year
HHI of SIC3	The Herfindahl index of sales among all firms in the same SIC 3-digit
Institutional Ownership	Total share of institutional ownership
Idiosynchratic Vol.	Annualized idiosyncratic volatility, from daily data, using the Fama-French three factor model
Leverage	The ratio of book value of debt to total assets
ROA	The ratio of EBITDA to total assets
Avg. Stock return	The arithmetic mean of the preceding calendar year's monthly returns
Prior 13D filing	Equals 1 if firms experienced a 13D filing during prior 365 days
Prior 13G filing	Equals 1 if firms experienced a 13G filing during prior 365 days
13D Experience	The number of prior Schedule 13D filings by the same investor
13G Experience	The number of prior Schedule 13G filings by the same investor
Activist HF	Equals 1 if the filer is an activist hedge fund

Table 2: **Summary statistics.** This table summarizes the variables used in this study, which are all defined in Table 1. The data consists of 8,703 Schedule 13D and 61,234 Schedule 13G filings from 1996 to 2017. The table presents for each variable the number of observations 'n', and its mean 'mean', standard deviation 'std', and the first, 25th, 50th, 75th, and 99th percentiles 'p'.

Variable	n	mean	std	p1	p25	p50	p75	p99
Panel A: Abnormal returns								
CAR, Full sample	69,937	1.31%	17.99%	-51.18%	-7.57%	0.46%	9.23%	66.11%
CAR, Schedule 13D filings	8,703	6.34%	22.15%	-52.12%	-5.65%	4.01%	16.79%	68.00%
CAR, Schedule 13G filings	61,234	0.59%	17.20%	-50.30%	-7.83%	0.11%	8.40%	58.19%
CAR, Activist hedge funds	6,742	3.01%	19.81%	-51.97%	-7.21%	1.55%	11.98%	67.80%
CAR, Schedule 13D filings, Activist hedge funds	2,523	6.04%	19.93%	-48.46%	-4.82%	4.03%	15.64%	67.80%
CAR, Schedule 13G filings, Activist hedge funds	4,219	1.19%	19.53%	-51.97%	-8.59%	0.18%	9.96%	67.80%
Panel B: Firm characteristics								
Market capitalization ($ million)	69,937	2,238	10,298	7	113	374	1,249	32,932
Amihud illiquidity	69,937	0.259	0.426	0.007	0.038	0.095	0.270	2.317
Analyst coverage (scaled by 10)	69,937	0.703	0.824	0.000	0.000	0.500	1.000	3.600
Book-to-market	69,937	0.624	0.592	-0.642	0.265	0.492	0.820	3.314
Firm age (scaled by 10)	69,937	1.443	1.517	0.000	0.400	1.000	2.000	7.700
Sales growth	69,937	23.04%	74.29%	-73.18%	-2.94%	8.29%	25.52%	467.74%
HHI of SIC3	69,937	15.43%	14.57%	1.58%	5.54%	10.89%	19.40%	80.72%
Institutional ownership	69,937	48.26%	35.28%	0.00%	11.16%	52.13%	80.08%	100.00%
Idiosynchratic Vol.	69,937	51.79%	29.46%	13.17%	30.91%	44.69%	64.54%	158.95%
Leverage	69,937	23.32%	24.42%	0.00%	1.83%	17.51%	35.83%	100.00%
ROA	69,937	5.62%	21.16%	-85.25%	1.98%	9.68%	16.11%	43.03%
Avg. Stock return	69,937	1.02%	5.09%	-12.40%	-1.69%	0.90%	3.49%	17.40%
Prior 13D filing	69,937	0.146	0.353	0.000	0.000	0.000	0.000	1.000
Prior 13G filing	69,937	0.676	0.468	0.000	0.000	1.000	1.000	1.000
Panel C: Investor characteristics								
13D Experience	69,937	6.0	32.3	0.0	0.0	0.0	2.0	55.0
13G Experience	69,937	536.7	1,018.0	0.0	7.0	62.0	416.0	4,225.0
Activist HF	69,937	0.108	0.310	0.000	0.000	0.000	0.000	1.000

Table 3: **Estimates of the Model's Structural Parameters**

This table shows the estimates of the costs of activism, C, the volatilties of returns, σ_{Δ_D} and σ_{Δ_G}, the volatilities of the due diligence signals, σ_{s_D} and σ_{s_G}, and the sensitivities of expected returns, $\boldsymbol{\beta}_D$ and $\boldsymbol{\beta}_G$ to their determinants, $\mathbf{x}$, for Schedule 13D and Schedule 13G filings, respectively. For each filing i, the expected returns from filing a 13D or 13G schedule are given by

$$\mu_{i,D} = \mathbf{x}_i'\boldsymbol{\beta}_D \text{ and } \mu_{i,G} = \mathbf{x}_i'\boldsymbol{\beta}_G.$$

The parameters are estimated by maximum likelihood, targeting the model-implied joint distribution of filing choices (13D v. 13G) and conditional abnormal announcement returns. The data consists of 8,703 Schedule 13D and 61,234 Schedule 13G filings from 1996 to 2017. Standard errors are shown in brackets under each estimate. Estimates followed by ***,**, and * are statistically different from zero at the 0.01, 0.05, and 0.1 significance levels, respectively. The Pseudo R2 statistic is the proportion of the total variation of abnormal returns from 13D or 13G filings that is explained by the model variation in expected returns, $\mu_{D,i}$ and $\mu_{G,i}$, respectively. The LR statistic is the likelihood ratio for the current specification with respect to the specification shown on its previous column. The p-value is for the null hypothesis that the parameters added to the current specification are zero.

(Table continues)

Table 3: continued

Panel A: Estimates of $\boldsymbol{\beta}_{\mathrm{D}}$ and $\boldsymbol{\beta}_{\mathrm{G}}$.

	(1)		(2)		(3)		(4)	
	$\boldsymbol{\beta}_D$	$\boldsymbol{\beta}_G$	$\boldsymbol{\beta}_D$	$\boldsymbol{\beta}_G$	$\boldsymbol{\beta}_D$	$\boldsymbol{\beta}_G$	$\boldsymbol{\beta}_D$	$\boldsymbol{\beta}_G$
Constant	-0.122^{***}	-0.002	0.037^{***}	-0.001	0.034^{***}	-0.002	0.038^{***}	0.000
	(0.000)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)
Market cap	-0.011^{***}	0.001^{**}	0.001	0.001^{**}	0.001	0.001^{**}	0.001	0.001^{**}
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Amihud illiquidity	0.040^{***}	0.017^{***}	0.021^{***}	0.019^{***}	0.021^{***}	0.020^{***}	0.021^{***}	0.019^{***}
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Analyst coverage	0.005^{***}	0.004^{***}	0.004^{***}	0.004^{***}	0.005^{***}	0.004^{***}	0.005^{***}	0.004^{***}
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Book-to-market	0.009^{***}	0.013^{***}	0.013^{***}	0.013^{***}	0.013^{***}	0.013^{***}	0.011^{***}	0.011^{***}
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Firm age	-0.001	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.001
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sales growth	-0.000	-0.003^{***}	-0.002^{**}	-0.002^{**}	-0.002^{***}	-0.002^{***}	-0.002^{***}	-0.002^{***}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
HHI of SIC3	-0.012^{*}	-0.009^{**}	-0.009^{**}	-0.009^{**}	-0.009^{**}	-0.009^{**}	-0.009^{**}	-0.009^{**}
	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Institutional ownership	-0.033^{***}	-0.000	-0.004	-0.001	-0.004	-0.002	-0.004^{*}	-0.002
	(0.000)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
Idiosynchratic vol.	-0.011^{***}	0.005	0.004	0.005	0.004	0.004	0.000	0.001
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Leverage	0.020^{***}	-0.000	0.003	0.001	0.002	0.000	0.001	-0.000
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
ROA	-0.016^{***}	-0.002	-0.003	-0.003	-0.003	-0.003	-0.004	-0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Average stock return	-0.533^{***}	-0.533^{***}	-0.535^{***}	-0.533^{***}	-0.535^{***}	-0.533^{***}	-0.541^{***}	-0.539^{***}
	(0.020)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.014)	(0.014)
13D Experience			0.170^{***}	-0.207^{***}	0.169^{***}	-0.197^{***}	0.173^{***}	-0.197^{***}
			(0.026)	(0.028)	(0.026)	(0.028)	(0.027)	(0.028)
13G Experience			-0.155^{***}	0.000	-0.151^{***}	0.000	-0.151^{***}	-0.000
			(0.003)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)
Activist HF			0.006^{**}	0.002	0.005^{**}	0.002	0.006^{**}	0.002
			(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Prior 13D filing					0.007^{***}	0.004^{**}	0.007^{***}	0.004^{**}
					(0.002)	(0.002)	(0.002)	(0.002)
Prior 13G filing					0.001	0.002	0.001	0.001
					(0.001)	(0.001)	(0.001)	(0.001)
Market premium							0.000^{**}	0.000^{*}
							(0.000)	(0.000)
SMB factor							0.002^{***}	0.002^{***}
							(0.000)	(0.000)
HML factor							-0.001^{***}	-0.001^{***}
							(0.000)	(0.000)
Pseudo R2	0.066	0.033	0.034	0.034	0.034	0.034	0.035	0.038
LR statistic (χ^2)		49,972		12,998		230		2,990
p-value		0.000		0.000		0.000		0.000

(Table continues)

Table 3: continued

Panel B: Estimates of activism costs and volatilities.

	(1)		(2)		(3)		(4)	
	Parameter estimate	Standard error	Parameter estimate	Standard error	Parameter estimate	Standard error	Parameter estimate	Standard error
C	0.050***	(0.000)	0.046***	(0.003)	0.045***	(0.003)	0.046***	(0.003)
σ_{Δ_D}	0.238***	(0.000)	0.219***	(0.001)	0.219***	(0.001)	0.219***	(0.001)
σ_{Δ_G}	0.169***	(0.000)	0.169***	(0.000)	0.169***	(0.000)	0.169***	(0.000)
σ_{s_D}	0.496***	(0.000)	5.988***	(0.000)	5.839***	(0.000)	5.916***	(0.402)
σ_{s_G}	8.182***	(0.841)	5.384***	(0.000)	6.338***	(0.000)	5.435***	(0.145)

Table 4: **Comparing Reduced-form and Structural Estimates**

This table shows the parameter estimates of reduced-form models of the filing announcement returns, and the probability of either type of filing using the same data set as in Table 3. The first column reproduces the structural parameter estimates from column (4) of Table 3. The next two columns show the OLS coefficients of the regressions of the filing announcement returns for 13D and 13G filings. The last column shows the estimates of a Probit model of whether the filing is a Schedule 13D or not. Standard errors are shown in brackets under each estimate. Estimates followed by ***,**, and * are statistically different from zero at the 0.01, 0.05, and 0.1 significance levels, respectively.

	Expected returns models				Filing choice model
	Structural parameters		Reduced form parameters		Reduced form parameters
	$\boldsymbol{\beta}_D$	$\boldsymbol{\beta}_G$	13D filings	13G filings	13D v. 13G filing
Constant	0.038^{***}	0.000	0.050^{***}	-0.001	-1.069^{***}
	(0.004)	(0.003)	(0.003)	(0.003)	(0.029)
Market cap	0.001	0.001^{**}	-0.003^{***}	0.002^{***}	-0.071^{***}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.007)
Amihud illiquidity	0.021^{***}	0.019^{***}	0.005^{**}	0.023^{***}	0.164^{***}
	(0.002)	(0.002)	(0.002)	(0.002)	(0.020)
Analyst coverage	0.005^{***}	0.004^{***}	0.010^{***}	0.004^{***}	0.061^{***}
	(0.001)	(0.001)	(0.002)	(0.001)	(0.015)
Book-to-market	0.011^{***}	0.011^{***}	-0.007^{***}	0.013^{***}	0.046^{***}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.013)
Firm age	-0.000	-0.001	-0.001^{*}	-0.001	0.013^{**}
	(0.000)	(0.000)	(0.001)	(0.000)	(0.006)
Sales growth	-0.002^{***}	-0.002^{***}	-0.001	-0.003^{***}	0.004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.009)
HHI of SIC3	-0.009^{**}	-0.009^{**}	-0.008	-0.009^{**}	-0.028
	(0.005)	(0.005)	(0.006)	(0.004)	(0.052)
Institutional ownership	-0.004^{*}	-0.002	0.025^{***}	-0.003	-0.306^{***}
	(0.003)	(0.003)	(0.004)	(0.002)	(0.029)
Idiosynchratic vol.	0.000	0.001	0.007^{***}	0.000	-0.063^{**}
	(0.003)	(0.003)	(0.003)	(0.003)	(0.030)
Leverage	0.001	-0.000	-0.024^{***}	0.002	0.179^{***}
	(0.003)	(0.003)	(0.003)	(0.003)	(0.029)
ROA	-0.004	-0.004	-0.034^{***}	0.001	-0.004
	(0.004)	(0.004)	(0.004)	(0.003)	(0.035)
Average stock return	-0.541^{***}	-0.539^{***}	-0.539^{***}	-0.536^{***}	-0.064
	(0.014)	(0.014)	(0.017)	(0.014)	(0.149)
13D Experience	0.173^{***}	-0.197^{***}	0.156	-0.040	23.988^{***}
	(0.027)	(0.028)	(0.011)	(0.076)	(0.859)
13G Experience	-0.151^{***}	-0.000	-0.039	-0.001	-4.682^{***}
	(0.003)	(0.001)	(0.008)	(0.001)	(0.124)
Activist HF	0.006^{**}	0.002	-0.016	0.005	0.405^{***}
	(0.002)	(0.002)	(0.002)	(0.003)	(0.020)
Prior 13D filing	0.007^{***}	0.004^{**}	0.005	0.004	0.290^{***}
	(0.002)	(0.002)	(0.002)	(0.002)	(0.018)
Prior 13G filing	0.001	0.001	0.010	0.001	-0.056^{***}
	(0.001)	(0.001)	(0.002)	(0.001)	(0.016)
Market return	0.000^{**}	0.000^{*}	-0.001	0.000	0.009^{***}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
SMB factor	0.002^{***}	0.002^{***}	0.002	0.002	-0.007^{***}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
HML factor	-0.001^{***}	-0.001^{***}	0.001	-0.001	0.002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
R^2 / Pseudo R^2	0.035	0.038	0.029	0.040	0.015

Table 5: **Comparison of Sample and Model-implied Moments**

This table compares the values of selected moments in the data to those implied by the structural model of filing choice and abnormal announcement returns. The model-implied moments are calculated by simulating 10,000 samples of the filing types (13D v. 13G) and the abnormal annoucement returns of each of the 69,937 filings, taking as given the determinants of expected returns, $\mathbf{x}$ and using the estimated parameters $\boldsymbol{\beta}_D$, $\boldsymbol{\beta}_G$, σ_{Δ_D}, σ_{Δ_G},σ_{s_D}, σ_{s_G}, and C from specification (4) in Table 3. The table also shows the moments predicted by reduced-form estimation using the same derterminants ($\mathbf{x}$): OLS regressions for the conditional announcement returns and probit regressions for the filing choice.

Panel A: Filing type frequency

	13D filings			13G filings		
	Data	Predicted		Data	Predicted	
		Reduced form	Model		Reduced form	Model
Proportion of filings	0.12	0.02	0.12	0.88	0.98	0.88
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
corr(Data, Predicted)		0.26	0.54		0.26	0.54
		(0.00)	(0.00)		(0.00)	(0.00)

Panel B: Conditional distribution of announcement returns

	13D filings			13G filings		
	Data	Predicted		Data	Predicted	
		Reduced form	Model		Reduced form	Model
Average filing returns	6.34%	6.34%	6.34%	0.59%	0.59%	0.68%
	(0.00%)	(0.00%)	(0.24%)	(0.07%)	(0.00%)	(0.07%)
Standard deviation	22.15%	21.83%	21.93%	17.20%	16.86%	16.86%
	(0.42%)	(0.41%)	(0.00%)	(0.15%)	(0.15%)	(0.00%)
Q3 of filing returns	16.79%	8.49%	8.48%	8.40%	2.25%	2.34%
	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)
corr(Data, Predicted)		0.17	0.13		0.20	0.20
		(0.01)	(0.01)		(0.00)	(0.00)

Table 6: **Estimates of expected returns and the components of announcement returns**

This table summarizes the distributions of the estimates of the expected returns returns from filing a Schedule 13D, $\hat{\mu}_D$, or a Schedule 13G, $\hat{\mu}_G$, as well as the components of announcement returns. The total returns for each deal i, conditional on a 13D filing, include a price adjustment or mispricing effect, $\mu_{G,i} = \mathbf{x}_i'\hat{\boldsymbol{\beta}}_G$; a treatment effect, $\mu_{D,i} - \mu_{G,i} = \mathbf{x}_i'(\hat{\boldsymbol{\beta}}_D - \hat{\boldsymbol{\beta}}_G)$; and a selection effect, $\hat{\rho}_{D,i} \times \hat{\sigma}_D \times \hat{\lambda}_{i,D}$ (Panel A). For 13G filings, the returns are decomposed into a stock picking effect $\mu_{G,i} = \mathbf{x}_i'\hat{\boldsymbol{\beta}}_G$ and a selection effect, $-\hat{\rho}_{G,i} \times \hat{\sigma}_G \times \hat{\lambda}_{i,G}$. These effects are estimated for each of the observed 8,703 13D filings (Panel A) and 61,234 13G filings (Panel B), taking as given the target and activist characteristics, $\mathbf{x}_i$ and using the estimates of the structural model, $\hat{\boldsymbol{\beta}}_D$, $\hat{\boldsymbol{\beta}}_G$, $\hat{\sigma}_{\Delta_D}$, $\hat{\sigma}_{s_D}$, $\hat{\sigma}_{\Delta_G}$, and $\hat{\sigma}_{s_G}$ from specification (4) in Table 3.

Panel A: Subsample of Schedule 13D filings

	Observations	Mean	Standard Deviation	Q1	Median	Q3
$\hat{\mu}_D$	8,703	5.58%	4.12%	3.37%	5.35%	7.75%
$\hat{\mu}_G$ (Stock picking effect)	8,703	0.85%	3.92%	−1.04%	0.90%	2.99%
$\mathbf{x}(\beta_D - \beta_G)$ (Treatment effect)	8,703	4.74%	3.58%	3.85%	4.10%	4.42%
$\rho_D\sigma_D\lambda_D$ (Selection effect)	8,703	0.75%	0.35%	0.62%	0.78%	0.92%

Panel B: Subsample of Schedule 13G filings

	Observations	Mean	Standard Deviation	Q1	Median	Q3
$\hat{\mu}_D$	61,234	−4.62%	16.41%	−5.21%	1.42%	4.47%
$\hat{\mu}_G$ (Stock picking effect)	61,234	0.64%	3.36%	−1.18%	0.50%	2.29%
$-\rho_G\sigma_G\lambda_G$ (Selection effect)	61,234	0.04%	0.06%	0.00%	0.01%	0.08%

Table 7: **Informational content of expected returns.** This table reports estimate of the following regression: $y_i = \alpha_{t(i)} + \alpha_{CAR,i} + \beta_1 CAR_i + \beta_2 Treatment_i + \beta_3 Stockpicking_i + \beta_4 Selection_i + \varepsilon_i$, where y_i is a performance metric for Schedule 13D filing i, CAR_i is filing i announcement return, $Treatment_i$ is the predicted treatment effect, $Stockpicking_i$ is the predicted stock-picking effect, $Selection_i$ is the predicted sample selection bias, $\alpha_{t(i)}$ are calendar year fixed effects, and $\alpha_{CAR,i}$ are 500 dummy variables on announcement return groupings (each group captures 0.2% of the sample). Columns (1) and (3) include only CAR_i and column (4) includes only $\alpha_{CAR,i}$. For ease of interpretation of the coefficients, the variables have been normalized by their sample standard deviation. In panel A, the outcome variable is change in ROA, from one fiscal year prior to the filing year to one fiscal year after the filing year. In panel B, the outcome variable is change in sales turnover (equal to sales to assets). In panel C, the outcome variable is the indicator of a proxy contest. The indicator takes value 1 if the firm that experiences a Schedule 13D filing is targeted in a proxy contest during the fiscal year after Schedule 13D filing year, and zero otherwise. Heteroskedasticity-robust standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Panel A: ROA(t+1)-ROA(t-1)				
CAR	0.0054**		0.0039	
	(0.0027)		(0.0027)	
Treatment		0.0290**	0.0283**	0.0310***
		(0.0121)	(0.0121)	(0.0115)
Stockpicking		0.0139***	0.0133***	0.0141***
		(0.0028)	(0.0028)	(0.0028)
Selection		0.0056	0.0058	0.0057
		(0.0059)	(0.0059)	(0.0061)
R^2	0.017	0.023	0.024	0.112
N	5,362	5,362	5,362	5,362
Panel B: Sales Turnover(t+1)-Sales Turnover(t-1)				
CAR	0.0028		0.0002	
	(0.0054)		(0.0054)	
Treatment		0.0741**	0.0741**	0.0736**
		(0.0366)	(0.0366)	(0.0356)
Stockpicking		0.0256***	0.0256***	0.0270***
		(0.0066)	(0.0066)	(0.0067)
Selection		0.0201	0.0201	0.0241
		(0.0153)	(0.0153)	(0.0149)
R^2	0.010	0.015	0.015	0.112
N	5,362	5,362	5,362	5,362
Panel C: Proxy Contest Target (t+1)				
CAR	0.0025		0.0025	
	(0.0019)		(0.0019)	
Treatment		-0.0495***	-0.0499***	-0.0462***
		(0.0143)	(0.0144)	(0.0166)
Stockpicking		-0.0008	-0.0011	-0.0007
		(0.0020)	(0.0021)	(0.0023)
Selection		-0.0180**	-0.0179**	-0.0144*
		(0.0085)	(0.0085)	(0.0084)
R^2	0.012	0.014	0.014	0.111
N	5,038	5,038	5,038	5,038
Fixed effects:				
Year FE	Yes	Yes	Yes	Yes
CAR bins (500)	No	No	No	Yes

Table 8: **Counterfactual analysis: The effects of changes to the precision of the due diligence signal**

This table shows the effects of changes in the standard deviation of the due diligence signal, σ_{s_D}, from its benchmark estimate of 5.916 (from specification (4) of Table 3), on the model's main quantities: the predicted 13D and 13G announcement returns, and the implied distributions of expected returns returns from filing a Schedule 13D, $\hat{\mu}_D$, a Schedule 13G, $\hat{\mu}_G$, and the components of announcement returns. The model-implied moments are calculated by simulating 10,000 samples of the filing types (13D v. 13G) and the abnormal annoucement returns of each of the 69,937 filings, Except for σ_{s_D}, all other estimates of parameters $\boldsymbol{\beta}_D$, $\boldsymbol{\beta}_G$, σ_{Δ_D}, σ_{Δ_G},σ_{s_G}, and C are kept fixed and taken from specification (4) in Table 3.

	Percentage change			Baseline	Percentage change		
	-75%	-50%	-25%	$\hat{\sigma}_{s_D} = 5.92$	+25%	+50%	+75%
Proportion of 13D filings	0.24	0.18	0.14	0.13	0.11	0.10	0.09
Average 13D returns	7.38%	6.71%	6.46%	6.34%	6.27%	6.23%	6.20%
Std. deviation of 13D returns	21.85%	21.92%	21.93%	21.93%	21.94%	21.94%	21.94%
μ_D	5.60%	5.59%	5.58%	5.58%	5.60%	5.61%	5.61%
μ_G (Stock picking)	0.13%	0.48%	0.72%	0.84%	0.92%	0.98%	1.02%
$\mu_D - \mu_G$ (Treatment effect)	5.47%	5.11%	4.85%	4.74%	4.68%	4.63%	4.59%
Average 13G returns	0.69%	0.68%	0.68%	0.68%	0.69%	0.69%	0.69%
Std. deviation of 13G returns	16.86%	16.86%	16.86%	16.86%	16.86%	16.86%	16.86%

Table 9: **Estimates of the Model's Structural Parameters in the Model with Heterogeneous Expected Returns and Activism Costs**

This table shows the estimates of the costs of activism parameters, $\boldsymbol{\kappa}$, where $C_i = \mathbf{w}_i'\boldsymbol{\kappa}$ is the expected costs of activism for filing i, the volatilties of returns, σ_{Δ_D} and σ_{Δ_G}, the volatilities of the due diligence signals, σ_{s_D} and σ_{s_G}, and the sensitivities of expected returns, $\boldsymbol{\beta}_D$ and $\boldsymbol{\beta}_G$ to their determinants, $\mathbf{x}$, for Schedule 13D and Schedule 13G filings (Panel A). For each filing i, the expected returns from filing a 13D or 13G schedule are given by

$$\mu_{i,D} = \mathbf{x}_i'\boldsymbol{\beta}_D \text{ and } \mu_{i,G} = \mathbf{x}_i'\boldsymbol{\beta}_G.$$

The parameters are estimated by maximum likelihood, targeting the model-implied joint distribution of filing choices (13D v. 13G) and conditional abnormal announcement returns. The data consists of 8,703 Schedule 13D and 61,234 Schedule 13G filings from 1996 to 2017. Standard errors are shown in brackets next to each estimate. Estimates followed by ***,**, and * are statistically different from zero at the 0.01, 0.05, and 0.1 significance levels, respectively. The Pseudo R2 statistic is the proportion of the total variation of abnormal returns from 13D or 13G filings that is explained by the model variation in expected returns, $\mu_{D,i}$ and $\mu_{G,i}$,. The LR statistic is the likelihood ratio for the current specifcation with respect to the specification with homogeneous activism costs. The p-value is for the null hypothesis that the parameters added to the current specification are zero. Other determinants included in the 13D and 13G expected returns specifications are: Market cap, Amihud illiquidity, Analyst coverage, Book-to-market, Firm age, Sales growth, HHI of SIC3, Idiosynchratic volatility, Leverage and Average stock returns. Panel B summarizes the distributions of the estimates of the expected returns returns, as well as the components of announcement returns and activism costs implied by the parameter estimates. Panel C compares the values of selected moments in the data to those implied by the parameter estimates. The model-implied moments are calculated by simulating 10,000 samples of the filing types (13D v. 13G) and the abnormal annoucement returns of each of the 8,703 Schedule 13D and 61,234 Schedule 13G filings. Panel C also shows the moments predicted by reduced-form estimation using the same derterminants ($\mathbf{x}$): OLS regressions for the conditional announcement returns and probit regressions for the filing choice.

(Table continues)

Table 9: continued

Panel A: Parameter estimates

	$\boldsymbol{\kappa}$		$\boldsymbol{\beta}_D$		$\boldsymbol{\beta}_G$		σ_{Δ_D}	
Constant	0.039^{***}	(0.005)	0.032^{***}	(0.005)	0.001	(0.003)	0.219^{***}	(0.001)
Activist HF	-0.021^{***}	(0.006)	-0.013^{**}	(0.006)	0.005^{*}	(0.003)	σ_{Δ_G}	
13D Experience	-0.013	(0.088)	0.167^{***}	(0.030)	-0.147^{*}	(0.081)	0.169^{***}	(0.000)
13G Experience	0.151^{***}	(0.024)	0.014	(0.024)	-0.000	(0.001)	σ_{s_D}	
Prior 13D filing	-0.002	(0.006)	0.005	(0.005)	0.004^{*}	(0.002)	7.364^{***}	(0.285)
Prior 13G filing	0.009^{*}	(0.005)	0.009^{*}	(0.005)	0.001	(0.002)	σ_{s_G}	
Inst. ownership	0.036^{***}	(0.008)	0.030^{***}	(0.008)	-0.004	(0.003)	5.538^{***}	(0.000)
ROA	-0.041^{***}	(0.011)	-0.041^{***}	(0.010)	0.000	(0.004)		
Other determinants		No		Yes		Yes		
LR statistic (p value)	4,042	(0.000)	Pseudo R2	0.032		0.038		

Panel B: Announcement returns decomposition

	13D filings 8,703 observations			13G filings 61,234 observations		
	Mean	Standard Deviation	Median	Mean	Standard Deviation	Median
$\hat{\mu}_D$	6.28%	3.98%	6.16%	6.78%	4.05%	6.65%
$\hat{\mu}_G$ (Stock picking effect)	0.98%	3.72%	0.94%	0.60%	3.35%	0.45%
$\mathbf{x}(\beta_D - \beta_G)$ (Treatment effect)	5.30%	2.98%	4.80%			
$\rho_D \sigma_D \lambda_D$ (Selection effect)	0.56%	0.26%	0.58%	0.05%	0.07%	0.01%
Cost of Activism	5.16%	2.32%	4.97%	15.06%	16.37%	8.14%

Panel C: Sample and model-implied moments

	13D filings			13G filings		
	Data	Predicted		Data	Predicted	
		Reduced form	Model		Reduced form	Model
Proportion of filings	0.12	0.02	0.12	0.88	0.98	0.88
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
corr(Data, Predicted)		0.26	0.54		0.26	0.54
		(0.00)	(0.00)		(0.00)	(0.00)
Average filing returns	6.34%	6.34%	6.84%	0.59%	0.59%	0.65%
	(0.00%)	(0.00%)	(0.23%)	(0.07%)	(0.00%)	(0.07%)
corr(Data, Predicted)		0.17	0.15		0.20	0.20
		(0.01)	(0.01)		(0.00)	(0.00)
Standard deviation	22.15%	21.83%	21.92%	17.20%	16.86%	16.86%
	(0.42%)	(0.41%)	(0.00%)	(0.15%)	(0.15%)	(0.00%)

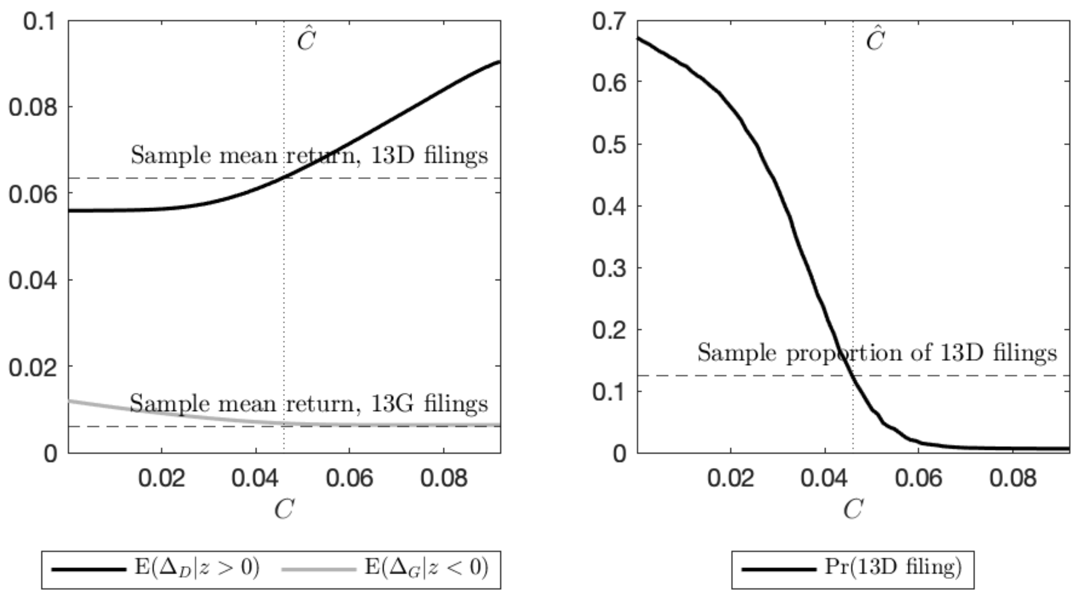

Figure 1: **Sensitivity of Model-implied Moments to Activism Costs.** This figure shows the sensitivity of the conditional announcement returns for 13D and 13G filings (left panel) and the proportion of 13D filings (right panel) to the model's activism costs parameters. The left panel plots the 13D filings' conditional announcement returns, $E(\Delta_D|z > 0)$ (blue line), and the 13G filings' conditional announcement returns, $E(\Delta_G|z < 0)$ (red line), as a function of C and fixing all other structural parameters at their maximum likelihood estimates. The horizontal blue and red dashed lines shows the sample mean announcement returns for 13D and 13G filings, respectively. The vertical dotted line shows maximum likelihood estimate of activism costs, $\hat{C}$. The right panel plots the model-simulated average proportion of 13D filings as a function of C, fixing all other structural parameters at their maximum likelihood estimates. The average propotion is calculated over 1,000 simulated date sets. The horizontal dashed line shows the actual proportion of 13D filings in the sample an dthe vertical dotted line shows the maximum likelihood estimate of the of activism costs, $\hat{C}$.

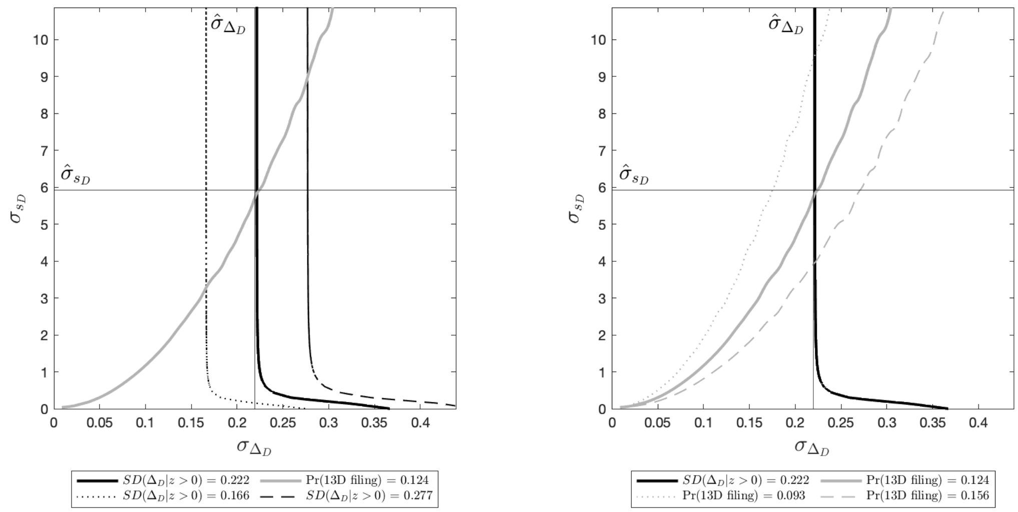

Figure 2: **Sensitivity of Model-Implied Moments to Volatility Parameters.** This figure shows the sensitivity of the conditional announcement returns volatility and the filing-type probability for 13D filings (left panel) and 13G filings (right panel) to the model's volatility parameters. Both panels show the pairs (σ_D, σ_{s_D}) for which the model-implied standard deviation of 13D announcement returns equals its sample analog (solid black line), or for which the model-implied proportion of 13D filings equals its sample counterpart (solid grey line). The horizontal line shows the actual maximum likelihood estimate of the due diligence volatility for 13D filings, $\hat{\sigma}_{s_D}$ and the vertical line shows the actual maximum likelihood estimate of the volatility for activist returns, $\hat{\sigma}_{\Delta_D}$. The left panel represents shifts to the iso-conditional volatility curve: the dotted (dashed) line plots all the (σ_D, σ_{s_D}) combinations for which the model-implied standard deviation of 13D announcement returns equals a counterfactual 13D sample standard deviation that is 25% smaller (larger) that the true sample analog. The right panel represents shifts to the iso-proportion of 13D filings: the dotted (dashed) line plots all the (σ_D, σ_{s_D}) combinations for which the model-implied proportion of 13D equals a counterfactual 13D sample proportion that is 25% smaller (larger) that the true sample analog.

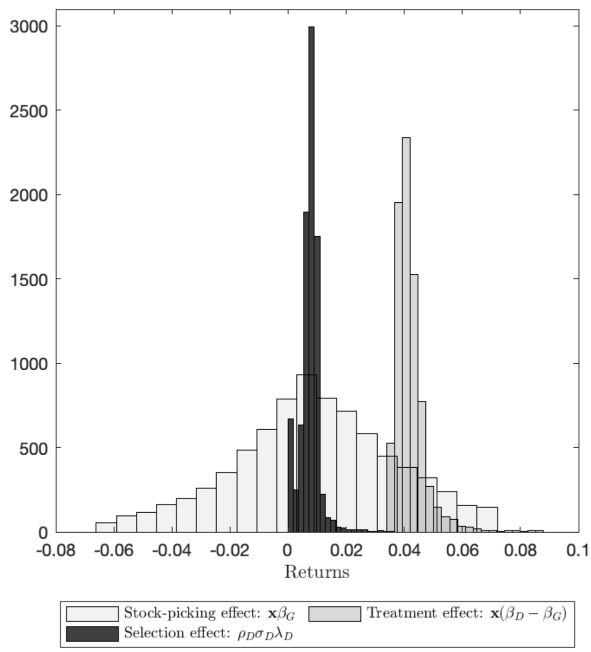

Figure 3: **Estimated decomposition of the expected announcement returns conditional on 13D filings.** This figure shows the distributions of the theoretical components of the 13D announcement returns. The total returns for each deal i, conditional on a 13D filing, include a stock-picking effect, $\mu_{G,i} = \mathbf{x}_i\hat{\boldsymbol{\beta}}_G$; a treatment effect, $\mu_{D,i} - \mu_{G,i} = \mathbf{x}_i(\hat{\boldsymbol{\beta}}_D - \hat{\boldsymbol{\beta}}_G)$; and a selection effect, $\hat{\rho}_{D,i} \times \hat{\sigma}_D \times \hat{\lambda}_{i,D}$. These effects are estimated for each of the observed 8,703 13D filings, taking as given the target and activist characteristics, $\mathbf{x}_i$ and using the estimates of the structural model, $\hat{\boldsymbol{\beta}}_D$, $\hat{\boldsymbol{\beta}}_G$, and $\hat{\sigma}_D$.

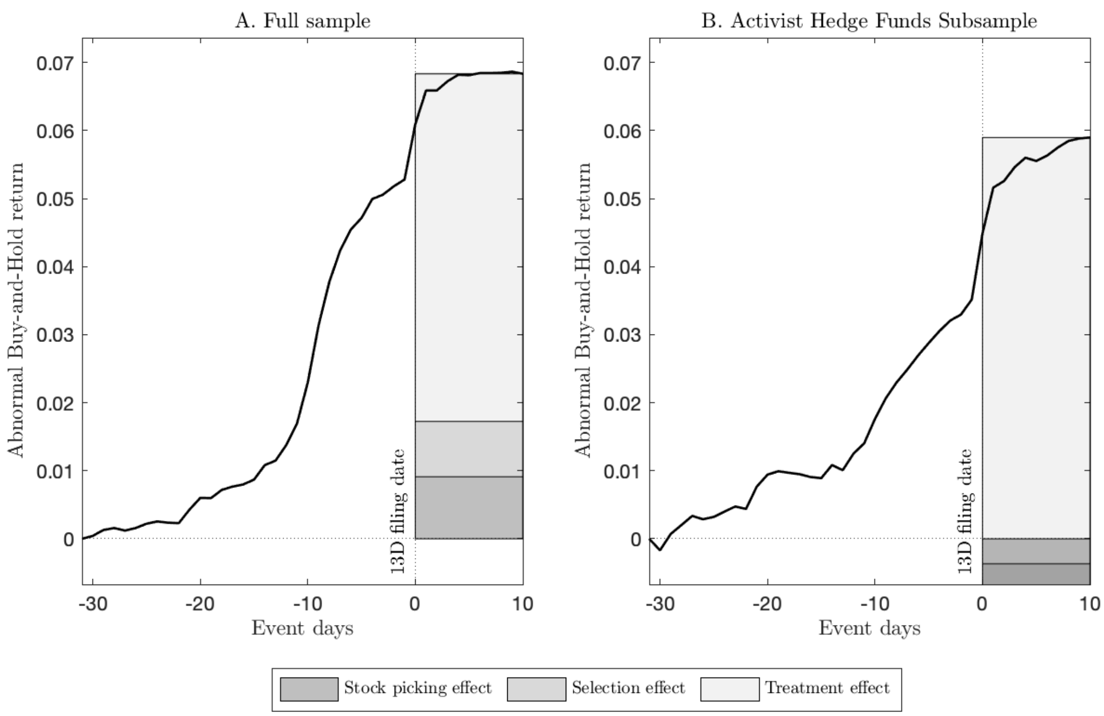

Figure 4: **Decomposition of 13D filings Returns.** This figure shows the decomposition of announcement returns to 13D filings into the stock picking component, the treatment effect, and the selection effect. The decomposition in Panel A is for the average filing under Schedule 13D, using the parameter estimates obtained with the full sample of 69,937 filings. The decomposition in Panel B is for the average filing under Schedule 13D, using the parameter estimates obtained with the subsample of 6,742 filings by activist hedge funds only. The the solid line plots the average buy-and-hold stock return around the filing date in excess of Fama-French three-factor model, which is estimated from 360 days through 60 days before the filing date. The abnormal return is plotted from 30 days prior to the filing date to 10 days afterwards.

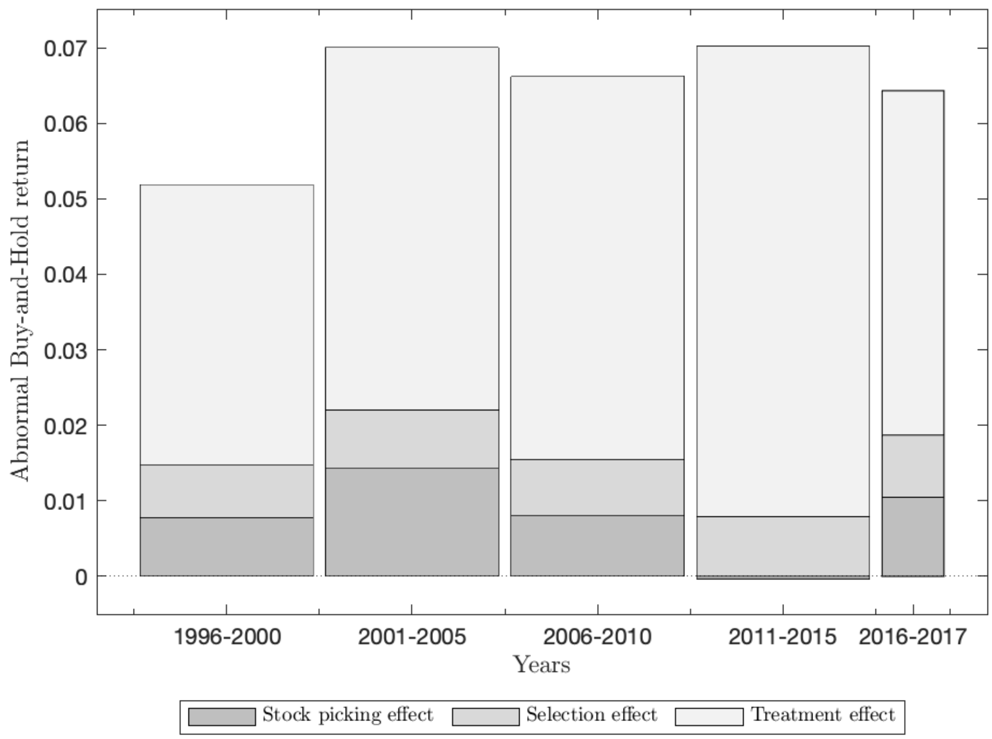

Figure 5: **Decomposition of 13D filings Returns over Time.** This figure shows the decomposition of announcement returns to 13D filings into the stock picking component, the treatment effect, and the selection effect for the average filing under Schedule 13D for each five-year period in the data. The decompositions are calculated using the parameter estimates obtained with the full sample of 69,937 filings..

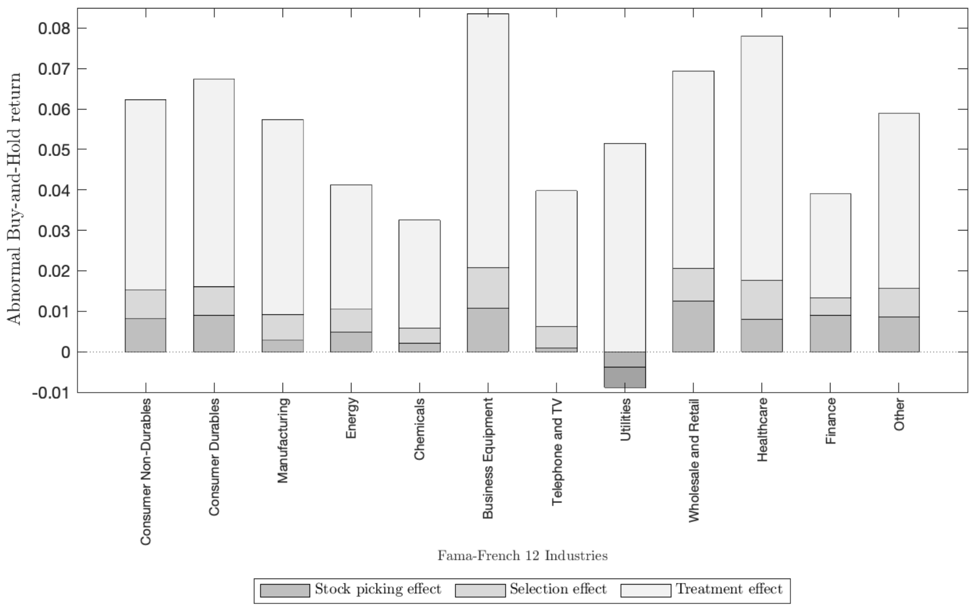

Figure 6: **Decomposition of 13D filings Returns by Industries.** This figure shows the decomposition of announcement returns to 13D filings into the stock picking component, the treatment effect, and the selection effect for the average filing under Schedule 13D for target firms belonging to each of the 12 Fama-French industries. The decompositions are calculated using the parameter estimates obtained with the full sample of 69,937 filings..

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