# Incentive Misalignment and Market Efficiency: Evidence from Portfolio Manager Ownership in the Mutual Fund Industry*

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July 2024

**Abstract**

This paper examines the impact of agency-issue-induced incentive misalignment on the risk-return relation in the stock market. Using hand-collected data on portfolio manager ownership of U.S. active mutual funds, I construct a stock-level measure of exposure to incentives-induced trading and show that this measure is associated with the abnormally low returns of high-risk stocks. Across a comprehensive set of strategies that buy high-risk stocks and sell low-risk stocks, negative alphas concentrate only among stocks subject to high incentives-induced trading. This finding is consistent with the conjecture that incentives-induced trading entails excessive risk taking that distorts the risk-return relation. This pattern is not driven by other firm characteristics and does not extend to other groups of anomaly strategies. Overall, the paper highlights the role of incentive alignment mechanisms in improving market efficiency.

*I am grateful to my advisor Michael O'Doherty for his invaluable support and guidance.

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# 1 Introduction

The conflict of interest between a mutual fund company and its clients is a classical agency problem that has drawn substantial attention from both academics and practitioners.[1] Fund investors want portfolio managers to make decisions that maximize risk-adjusted expected returns, whereas managers may act to maximize fund company profits and their compensation. Although there is a vast literature on the effects of this incentive misalignment on managers' behaviors (e.g., Brown et al., 1996, Chevalier and Ellison, 1997, Huang, Sialm, and Zhang, 2011, Bali, Brown, Murray, and Tang, 2017, Lee et al., 2019, and Ma and Tang, 2019), there is limited empirical evidence of its impact on the financial market. As active mutual funds manage half of all fund assets (ICI, 2023), it is reasonable to expect that managers' incentives-induced trading has some effects on asset prices.[2]

This paper provides direct evidence that agency-issue-induced incentive misalignment can have a pronounced impact on market efficiency and the risk-return relation. A simple conceptual framework helps guide the paper's analyses. Suppose that a representative manager makes investment decisions for her actively managed portfolio. In the absence of conflicts of interest, she would only deviate the portfolio weight from the equilibrium market weight if she has new fundamental information that can earn a positive alpha. Conventional theories (e.g., Grossman and Stiglitz, 1980) predict that by incorporating such information into asset prices through trading decisions, market efficiency improves. However, the manager may trade even when there is no new information if she responds to agency-problem-induced incentives. For instance, if her objective is to attract flow, which responds to performance, she may overweight stocks with higher risk as the higher variance increases the chance to outperform (e.g., Brown et al., 1996 and Chevalier and Ellison, 1997). This buying pressure for stocks with higher risk lowers their expected returns and leads to a weak or even inverted risk-return relation. This rationale builds a ground for the main conjecture in this paper: weak incentive alignment in the mutual fund industry contributes to the prominent high-risk low-return phenomena documented in the asset pricing literature.

I test this conjecture by constructing a stock-level measure that captures each stock's exposure to incentives-induced trading by active portfolio managers and showing that this measure is

[1]See Brown, Harlow, and Starks (1996), Chevalier and Ellison (1997), Sirri and Tufano (1998), Huang, Wei, and Yan (2007), Lee, Trzcinka, and Venkatesan (2019), and Ma, Tang, and Gomez (2019) for examples.

[2]There is also an emerging theoretical literature that analyze how contractual distortions or restrictions in the asset management industry can affect asset prices (e.g., Cuoco and Kaniel, 2011, Kaniel and Kondor, 2013, Basak and Pavlova, 2013, Vayanos and Woolley, 2013, Buffa, Vayanos, and Woolley, 2022, Buffa and Hodor, 2023).

associated with the abnormally low returns of high-risk stocks. I consider firm characteristics that have been featured in the prior literature on the high-risk low-return relation, including market beta (e.g., Black, Jensen, and Scholes, 1972, Fama and French, 1992, and Frazzini and Pedersen, 2014), idiosyncratic volatility (e.g., Ang, Hodrick, Xing, and Zhang, 2006), distress risk (Campbell, Hilscher, and Szilagyi, 2008), O-Score (Dichev, 1998), maximum returns (e.g., Bali, Cakici, and Whitelaw, 2011 and Asness, Frazzini, Gormsen, and Pedersen, 2020), skewness (e.g., Bali, Engle, and Murray, 2016), and coskewness (e.g., Harvey and Siddique, 2000 and Ang, Chen, and Xing, 2006).[3] Across this wide range of low-risk anomalies, I provide robust evidence that the high-risk low-return relations are only significant among stocks subject to high incentives-induced trading. This finding has implications for the role of incentive alignment mechanisms in improving market efficiency.

To capture each stock's exposure to incentives-induced trading arising from incentive misalignment, I use fund-level portfolio manager ownership information. I start by manually collecting data on portfolio manager ownership for a sample of 2,958 actively managed U.S. domestic equity mutual funds from 2006 to 2021. Since March 2005, the U.S. Securities and Exchange Commission (SEC) requires mutual funds to disclose their portfolio manager ownership using the following seven ranges: \$0, \$1-\$10,000, \$10,001-\$50,000, \$50,001-\$100,000, \$100,001-\$500,000, \$500,001-\$1,000,000, and above \$1,000,000.[4] Following Khorana, Servaes, and Wedge (2007) and Ma and Tang (2019), I convert the dollar ranges into dollar amounts by assuming managerial ownership to be at the midpoint of the reported intervals (e.g., a reported \$500,001-\$1,000,000 is converted to \$750,000). I sum the converted amounts for all reported fund managers of each fund, and convert the total amount back to the seven ranks (i.e., from 1 to 7) used by the SEC. Funds with higher rank have higher level of alignment with the interests of fund investors, and managers of these funds are less likely to trade in response to agency-issue-induced incentives.

Next, I compute a stock-level exposure to incentives-induced trading as the weighted average ownership rank, where the weight is the number of shares each fund owns for each stock. The

[3] Black et al. (1972) first document a positive (negative) abnormal return associated with stocks with low (high) market risk. A large number of studies continues to document the persistence of this beta anomaly and provides explanations for its existence (e.g., Baker, Bradley, and Wurgler, 2011, Frazzini and Pedersen, 2014, Cederburg and O'Doherty, 2016, Bali et al., 2017, Christoffersen and Simutin, 2017, Boguth and Simutin, 2018, Schneider, Wagner, and Zechner, 2020). Subsequent discovery of other low-risk high-return relations has lead the literature to refer to these phenomena as low-risk anomalies.

[4] The SEC suggests that these ranges provide sufficient information to judge the interest alignment between managers and investors (see SEC's final rule).

economic interpretation of this measure is that higher values imply lower exposure to incentives-induced trading by active portfolio managers. Another interpretation of this measure in dollar terms is that it captures the level of portfolio manager ownership in the stocks. I find that this measure exhibits significant variations both over time and in the cross section. For instance, Figure 1 shows that after the 2008 global financial crisis, the average managerial ownership increased to more than \$100,000 and became more volatile, but decreased substantially during the COVID-19 crisis before bouncing back. In the cross-section, the average managerial ownership is \$75,000 with a standard deviation of \$130,000.

To examine the impact of exposure to incentives-induced trading on the performance of low-risk anomalies, I use the broad set of seven firm characteristics above (i.e., market beta, idiosyncratic volatility, distress risk, O-Score, maximum returns, skewness, and coskewness) and also construct a composite risk score for each stock, defined as the arithmetic average of its percentile ranks across seven risk characteristics. I then adopt the conventional portfolio sorting approach, and assess the abnormal returns associated with strategies that buy high-risk stocks in the top quintile and sell low-risk stocks in the bottom quintile among different levels of incentives-induced trading.

First, I verify that all strategies earn a negative monthly CAPM alpha over the sample period from 2006 to 2021, ranging from $-0.16\%$ per month for the strategy based on skewness to $-0.69\%$ for the strategy based on distress risk. The CAPM alpha of the strategy based on the composite risk score is $-0.63\%$ ($t$-stat $= -2.25$). These findings are consistent with the prior literature that stocks with higher risk characteristics appear to earn lower abnormal returns on average. More important, the negative abnormal returns are monotonically increasing from the lowest tercile to the highest tercile of managerial ownership (or from the highest tercile to the lowest tercile of exposure to incentives-induced trading) across all seven characteristics and the composite risk score. Furthermore, the negative alphas associated with the strategies concentrate among stocks with the highest exposure to incentives-induced trading. For example, the CAPM alpha of the high-minus-low portfolio formed on the composiste risk score is $-0.96\%$ per month ($t$-stat $= -3.43$) among stocks in the top tercile of exposure to incentives-induced trading, whereas that among stocks in the bottom tercile is $-0.34\%$ ($t$-stat $= -1.17$).[5]

[5]This result is robust to a five-by-five portfolio sort, and other prominent asset pricing models that include the Fama-French three-factor model (Fama and French, 1993), the five-factor model that augments the three-factor model with Carhart's (1997) momentum factor and Pástor and Stambaugh's (2003) liquidity factor, and the Fama-French five-factor model augmented with the momentum factor (Fama and French, 2015).

A close examination reveals that the insignificant alphas among low-exposure stocks are mainly driven by the insignificant alphas associated with the high-risk portfolios. In particular, the CAPM alpha of the high-risk high-ownership portfolio is 0.11% ($t$-stat = 0.39), whereas that of the high-risk low-ownership portfolio is −0.67% ($t$-stat = −2.48). These results suggest that lowering exposure to incentives-induced trading via increasing managerial ownership attenuates the overpricing associated with high-risk stocks.

Because funds report portfolio manager ownership in dollar ranges, I follow Khorana et al. (2007) and Ma and Tang (2019) to construct two alternative measures of managerial ownership: the first one is an indicator of whether managers have ownership in the fund, and the second one uses the natural logarithm of the total dollar amount of ownership. Across portfolio sorts based on these alternative measures, I still find that the low-risk anomalies are systematically insignificant among stocks with high managerial ownership.

A concern to the main result is that this measure of exposure to incentives-induced trading masks other stock characteristics that have been found to explain some low-risk anomalies. For example, Stambaugh, Yu, and Yuan (2015) and Liu, Stambaugh, and Yuan (2018) show that the idiosyncratic risk and beta anomalies concentrate among overpriced stocks. To assess whether other firm characteristics can explain the effect of incentives-induced trading, I employ a series of robustness checks with a high-dimensional set of almost a hundred characteristics.

First, for each firm characteristic, I perform a triple portfolio sort based on the characteristic, composite risk score, and managerial ownership. In particular, I start by sorting all stocks in two portfolios based on the median value of the characteristic (e.g., firm size). Next, within each portfolio, I repeat the double sorting procedure based on the composite risk score and managerial ownership, construct the high-minus-low risk portfolio for each managerial ownership bucket and record the CAPM alpha. Across 18 portfolio groups constructed from a broad set of characteristics, including size, value, momentum, investment, profitability, mutual fund ownership, liquidity, mispricing and net anomaly, I find consistent evidence that the low-risk anomalies are only significant among stocks with high exposure to incentives-induced trading.[6]

A weakness of the triple portfolio sorting approach is that it does not control for multiple firm characteristics. To address this issue, I regress the managerial ownership measure on all charac-

[6] I construct the composite mispricing index based on Stambaugh et al. (2015) and the net anomaly score based on Engelberg, McLean, and Pontiff (2020).

teristics above to obtain a residual measure that is orthogonal to potential confounding factors. Repeating the portfolio sort based on the composite risk score and this orthogonalized measure, I continue to find that the low-risk high-return relation exists only among stocks with low managerial ownership.

Recently, Han, Roussanov, and Ruan (2022) show that the beta anomaly exists only among stocks held by underperforming funds. Based on the argument that funds who underperform other funds in the same category would take excessive risk in stocks that have higher exposure to the relevant category, Han et al. (2022) document the impact of risk taking by underperforming funds on the beta anomaly only before Morningstar changed their rating methodology in 2002. After the change, the paper documents the impact of fund performance on only style betas.

A concern to my main results is that the impact of portfolio manager ownership is driven by underperforming funds as portfolio manager ownership can be mechanically correlated with fund performance. However, portfolio manager ownership is used as a proxy for incentive alignment, whereas it is not clear whether the interests of underperforming managers are misaligned with that of their clients. For instance, portfolio managers may act in the interests of their investors but still underperform due to poor skill. Nevertheless, I employ two tests to differentitate between the impact of incentive misalignment and fund underperformance on the low-risk anomalies.

First, I remove any effect of fund performance on portfolio manager ownership by regressing the natural logarithm of ownership on different measures of fund performance and repeat the double port sort test. Across three different measures of fund performance featured in the literature, the conclusion remains that the high-risk low-return relation only exists among stocks with high exposure to incentives-induced trading. These results suggest that the effect of portfolio manager ownership on incentives-induced trading is not fully explained by fund performance.

Second, Han et al. (2022) show that fund performance does not explain the beta anomaly when beta is measured against the market index (e.g., S&P500) after 2002. The authors argue that after the Morningstar rating methodology change, underperforming funds would take excessive risk only when risk is measured against the relevant categories because these funds care about performing other funds in the same category. To provide evidence, Han et al. (2022) document the impact of fund performance on the beta anomaly when beta is measured against four category indices: Large Growth, Large Value, Small Growth, Small Value. To examine the impact of incentives-induced trading on these style-beta anomalies, I follow Han et al. (2022) to estimate stock betas against these categories and repeat the double port sort test.

In contrast to Han et al. (2022), I still find the effect of incentives-induced trading on high-beta stocks regardless of what indices beta is measured against. Specifically, the high-S&P500-beta stocks earn a negative alpha of $-0.79\%$ per month ($t$-stat $= -2.14$) among stocks with high exposure to incentives-induced trading, whereas they earn only $-0.33\%$ per month ($t$-stat $= -1.01$) among stocks with low exposure. This pattern repeats for all four style betas, providing further evidence that incentives-induced trading, as measured by portfolio manager ownership, captures a broader spectrum of fund risk taking than fund performance.

To provide further evidence that the impact of incentives-induced trading is unique to low-risk anomalies, I repeat the double portfolio sort for a set of 88 firm characteristics. Across this comprehensive sample of characteristics, I find no systematic evidence of a difference in the factor premium between stocks with high and low exposure to incentives-induced trading. These results imply that agency-issue-induced incentive misalignment contributes to the anomalous negative risk-return relations documented in the literature.

The results so far imply that increasing alignment of interests between fund managers and investors appears to attenuate the negative association between stock riskiness and future returns. Because the theory of leverage constraints suggests that mutual funds tilt toward high-risk stocks (e.g., Black, 1972, Frazzini and Pedersen, 2014), my results suggest that higher portfolio manager ownership should attenuate this tilting behavior. To provide formal evidence, I follow Dou, Kogan, and Wu (2024) and aggregate the portfolio of each group of funds based on their portfolio manager ownership. I start by aggregating the holdings of all funds whose managers do not have ownership, then of all funds whose manager ownership is in the range \$1-\$100,000, then in the range \$100,001-\$500,000, and finally greater than \$500,000, for a total of four groups. Using a stacked panel regression design, I examine the association between each portfolio holdings' deviation from market weight and its composite risk score. Consistent with prior evidence that active mutual funds take excessive risk, all portfolios exhibit a significant tilt toward stocks with high risk. However, this tilt is significantly lower in the portfolio of funds with the highest level of manager ownership (i.e., group 4), confirming the prior that these funds tend to take on less risk.

Recent studies show that institutional investors also tend to overweight overvalued stocks (e.g., Edelen, Ince, and Kadlec, 2016). Although the analyses so far show that exposure to incentives-induced trading does not appear to affect the abnormal returns associated with mispricing, I include the mispricing score as the characteristic of interest in the tilting test to provide further robustness. Consistent with prior studies, I find that all portfolios exhibit significant tilt toward overvalued stocks. However, there is no significant difference in this tilting behavior between the portfolio of high manager ownership and the others. This finding reinforces the conclusion that the attenuation effect of increasing incentive alignment is unique to the low-risk anomalies.

To gain more insights into the mechanism that drives the effect of incentives-induced trading on the low-risk anomalies, I examine the tilting behavior at the fund level. I first estimate the level of tilt toward high-risk stocks for each fund and confirm that funds with high manager ownership indeed have significantly lower tilt. I also find that this behavior is more pronounced following extreme market downturns and in high-volatility markets. The results are robust to alternative measures of ownership, suggesting that manager ownership is more likely to increase portfolio managers' risk aversion when their personal wealth is exposed to heightened uncertainty. This finding is consistent with the main objective of incentive alignment where portfolio managers have to share downside risks with fund investors.

My paper contributes to the emerging literature on the role of delegated portfolio management in asset pricing (e.g., Cuoco and Kaniel, 2011, Kaniel and Kondor, 2013, Basak and Pavlova, 2013, Vayanos and Woolley, 2013, Buffa et al., 2022, Buffa and Hodor, 2023). The theoretical frameworks in these studies analyze the asset pricing implications of contractual distortions or restrictions among fund managers, fund companies, and fund clients. Buffa et al. (2022) show that, for instance, constraints in how much portfolio managers can deviate from benchmarks contribute to low expected return and high volatility. This paper adds to the literature by showing that incentives-induced trading in the mutual fund industry has a strong impact on the risk-return relations in the market. This main finding highlights the connection between the agency-related incentives, the behavior they induce, and the consequences on market efficiency.

The paper also contributes to the literature on the impact of incentive alignment mechanisms in the mutual fund industry. Khorana et al. (2007) show that portfolio manager ownership is positively associated with fund risk-adjusted performance, suggesting that ownership is a useful information to investors for decision-making. Ma and Tang (2019) document the positive impact of portfolio manager ownership on mutual fund risk taking, implying that ownership mitigates agency-problem-induced risk-taking incentives. This paper complements these studies by showing that low incentive alignment appears to distort market efficiency. The paper also adds to our understanding of the dynamics of fund managers' risk-taking behavior by showing that portfolio managers with high ownership change their risk-shifting behavior during extreme market downturns and periods of high volatility. This mechanism is consistent with other evidence that negative wealth shocks to delegated agents can impact their risk-taking behavior (e.g., Pool, Stoffman, Yonker, and Zhang, 2019).

This paper also complements the vast literature that documents and provides explanations for the low-risk anomalies (e.g., Black et al., 1972, Ang, Hodrick, et al., 2006, Campbell et al., 2008, Baker et al., 2011, Frazzini and Pedersen, 2014, Cederburg and O'Doherty, 2016, Bali et al., 2017, Christoffersen and Simutin, 2017, Boguth and Simutin, 2018, Liu et al., 2018, Schneider et al., 2020, Chen, Hackbarth, and Strebulaev, 2022). Prior studies attempt to provide unified explanation for the low-risk anomalies (e.g., Liu et al., 2018, Schneider et al., 2020, Chen et al., 2022). This paper's results across a comprehensive set of low-risk anomalies provide direct evidence that the level of risk taking among constrained investors is a common source of the low-risk high-return phenomena.

## 2 Data, variables, and descriptive statistics

### 2.1 Mutual fund sample

I construct the mutual fund sample from the Center for Research in Security Prices Survivor-Bias-Free U.S. Mutual Fund Database (CRSP MFDB). Following the convention in the literature (e.g., Kacperczyk, Sialm, and Zheng, 2008, Huang et al., 2011), I restrict the sample to domestic actively managed U.S. equity funds. In particular, I eliminate index funds, balanced funds, sector funds, international funds, bond funds, money market funds, and exchange-traded funds.[7] I also exclude funds for which fund names are missing. To address concerns related to omission bias (Elton,

[7] To exclude index and exchange-traded funds, I use both CRSP index fund flag and check for funds' name with the following key words: 'index', 'inde', 'indx', 'inx', 'idx', 'dow jones', 'ishare', 's&p', 's &p', 's& p', 's & p', '500', 'wilshire', 'russell', 'msci', 'etf', 'exchange-traded', 'exchange traded'. I identify balanced, sector, international, bond, and money market funds by using the following CRSP policy code: 'C & I', 'Bal', 'Bonds', 'Pfd', 'B & P', 'GS', 'MM', 'TFM'. U.S. equity funds are further selected by using the following policy code: Lipper classes and objective codes 'EIEI', 'G', 'LCCE', 'LCGE', 'LCVE', 'MCCE', 'MCGE', 'MCVE', 'MLCE', 'MLGE', 'MLVE', 'SCCE', 'SCGE', 'SCVE', 'CA', 'EI', 'GI', 'MC', 'MR', 'SG'; Strategic Insight objective codes 'AGG', 'GMC', 'GRI', 'GRO', 'ING', 'SCG'; Wiesenberger objective codes 'G', 'GCI', 'IEQ', 'LTG', 'MCG', 'SCG'.

Gruber, and Blake, 2001) and incubation bias (Evans, 2010), I perform additional screens on the sample. In particular, I delete any observations prior to the first offer dates of funds, and exclude observations if the fund's total net assets (TNA) in the previous period is below $5 million. Finally, I include only funds that have more than 80% of their holdings on average in common stocks. I also identify the family associated with each fund following Dannhauser and Spilker III's (2023) procedure.[8]

I obtain quarterly fund equity holdings data from the Thomson Reuters Mutual Fund Holdings Database (S12) for the sample period before the third quarter of 2008, and the CRSP mutual fund holdings data for the rest of the sample. The use of CRSP data on portfolio holdings is to minimize concerns related to data quality of Thomson Reuters holdings data before 2008 (Zhu, 2020). I use the CRSP MFDB to collect information on fund characteristics such as expenses, fund portfolio turnovers, and percentage of portfolio invested in common stocks and other asset classes. Since a mutual fund can have multiple share classes, I use the MFLINKS database to identify such funds and combine different share classes into fund-level portfolios. For each period, I use the most recent TNA to construct fund-level TNA, returns, and characteristics. In particular, I take the sum of TNA across all share classes of a fund to construct the fund's TNA. The fund's returns and other characteristics are TNA-weighted averages.

I supplement this sample with information on portfolio manager ownership hand collected from funds' Statement of Additional Information (SAI). Since March 2005, the U.S. Securities and Exchange Commission (SEC) requires mutual funds to disclose their portfolio manager ownership for each fiscal year using the following seven ranges: $0, $1-$10,000, $10,001-$50,000, $50,001-$100,000, $100,001-$500,000, $500,001-$1,000,000, and above $1,000,000. I retrieve these information from the SEC's Electronic Data Gathering, Analysis, and Retrieval (EDGAR) database for each year from 2006 to 2021. Following Khorana et al. (2007) and Ma and Tang (2019), I convert the dollar ranges into dollar amounts by assuming managerial ownership to be at the midpoint of the reported intervals (e.g., the range $50,001-$100,000 is converted to $75,000). Because the majority of funds in the sample is team-managed, and the ownership is reported at the individual level, I then aggregate the converted amounts for each fund, and transform the total value back to the seven ranks (i.e., from one to seven) used by the SEC (*Ownership rank*). I also use two alternative measures of

[8] I thank Caitlin Dannhauser for making the fund-family cleaning code available.

manager ownership, including an indicator of whether managers have ownership in the fund (*Ownership indicator*), and the natural logarithm of the total dollar amount of ownership (*LN(Ownership dollar)*).

The final mutual fund sample contains 2,958 unique funds from 2006 to 2021.[9] Panel A of Table 1 shows the summary statistics for my mutual funds sample. The mean of *Ownership rank* is 3.61 and the standard deviation is about 2 ranks. In economic terms, one standard deviation of ownership ranges from no ownership to more than $100,000. The mean of *Ownership indicator* is 0.61, suggesting that on average 60% of funds have their managers invested in the fund. These manager ownership statistics are close to those in Ma and Tang (2019). Moreover, the average fund manages $1.94 billion of assets. On average, a fund exists for almost 7 years during the sample period. The quarterly mean return is 2.71% and its distribution appears symmetric since the median is close to the mean. Consistent with prior studies, the average flow in recent decades is negative and fund flow is positively skewed as the mean of quarterly flow (−0.21%) is significantly higher than the median (−1.93%). The average annual expense ratio is 1.10% and the average turnover ratio is 72.12% annually.

## 2.2 Stock sample

### 2.2.1 Measures of incentives-induced trading

For the stock sample, I consider the universe of firms covered by the Center for Research in Security Prices (CRSP) and the Compustat Fundamentals Annual (Compustat). I include only U.S. common stocks that are listed on NYSE, AMEX, and NASDAQ, and exclude utility and financial firms. To mitigate the impact of micro- and small-cap stocks, I exclude firms with market capitalization below the first NYSE decile at the portfolio formation date.[10] For all portfolio sorts, I use the breakpoints from only NYSE firms.

[9] This sample is a substantial extension relative to Khorana et al. (2007) (1,406 funds in 2005) and Ma and Tang (2019) (1,610 funds between 2007 and 2014). Nevertheless, the focus of this paper on stock-level pricing ideally requires the entire population of active equity funds, and a concern is that the data collection process might inadvertently omit some funds. To mitigate this concern, I compare the number of funds and total assets under management (AUM) for funds covered in my final sample to that of the sample of active funds on CRSP MFDB. On average, my sample covers 89.53% of the domestic actively managed U.S. equity funds, and accounts for 90.74% of the industry's total AUM. These statistics suggest that the sample is representative of the active mutual fund industry.

[10] There is some empirical evidence that low-risk anomalies concentrate only among overpriced stocks (e.g., Liu et al., 2018). Recent evidence suggest high transaction cost associated with micro- and small-cap stocks contributes to mispricing (e.g., Novy-Marx and Velikov, 2016). I therefore exclude these stocks from the main analyses. The results remain robust if I include these stocks.

I combine the information from fund-level ownership and stock holdings to construct a proxy of stock-level portfolio manager ownership. In particular, the stock managerial ownership (*Ownership rank*) is measured as

$$\text{Ownership rank}_{i,t} = \frac{\sum_{j=1}^{J_t} \text{shares}_{i,j,t} \times \text{Rank}_{j,t-4}}{\sum_{j=1}^{J_t} \text{shares}_{i,j,t}}, \tag{1}$$

where Ownership $\text{rank}_{i,t}$ is the stock-level ownership rank of stock $i$ at the end of quarter $t$, $\text{Rank}_{j,t-4}$ is the portfolio manager ownership of fund $j$ in the quarter $t-4$, $\text{shares}_{i,j,t}$ is the number of shares that fund $j$ hold for stock $i$ at the end of quarter $t$, and $J_t$ is the total number of funds in quarter $t$.[11] Similarly, I also construct stock-level Ownership $\text{indicator}_{i,t}$ and $\text{LN(Ownership dollar)}_{i,t}$ using corresponding fund-level ownership measures. The economic interpretation of these measures is that stocks with higher values have lower exposure to incentives-induced trading by portfolio managers.

Panel B of Table 1 shows the summary statistics for stock ownership. The mean of *Ownership rank* is 4.52 and the standard deviation is 0.76. In economic terms, one standard deviation of ownership contains values between $10,000 to $500,000. The mean of *Ownership indicator* is 0.76, suggesting that on average 76% of stocks have certain ownership by active portfolio managers. These statistics suggest that there appears to be meaningful variation in stock managerial ownership across stocks that potentially impact their market risk pricing.

To gain a better understanding about potential economic sources that drive portfolio managers' stock ownership, Figure 1 plots the time-series of the average stock ownership from 2006 to 2021. The plot also shows the 95% interval of stock ownership across all stocks in each period. Mean ownership decreased during bad economic states, such as during the 2008-2009 financial crisis and in 2020 during the COVID-19 downturn. The variation in ownership across stocks also appears to be changing in which the distribution is relatively wide between 2013 and 2017 and tighter in other periods.

Another variation in ownership that is interesting to examine is the variation across stocks' size and value. Because active equity funds are generally categorized in the two dimensions of size and value (e.g., growth big-cap funds), portfolio manager ownership in their own fund can be considered as a proxy of style investment. Figure 2 plots the time-series of the average stock ownership across

[11] I use the fund-level ownership in the previous year to avoid look-ahead bias because most funds only disclose portfolio manager ownership at the end of funds' annual fiscal date.

the two dimensions from 2006 to 2021. In particular, each stock is classified as either small or large cap based on the median value of market cap of NYSE stocks for each period. Each stock is then independently sorted as either growth, neutral, or value, depending on their book-to-market ratio. This process forms six portfolios on the size and value dimension. The average stock ownership for each portfolio is the weighted average of individual stock ownership. The figure shows that there is significant variation over time across all portfolios. On average, small stocks have lower ownership, with the exception of stocks that are also growth. Growth stocks also appear to have higher ownership and their ownership are less volatile compared to value stocks during bad economic states.

### 2.2.2 Risk characteristics

I follow prior studies to construct seven firm risk characteristics, including market beta ($\beta_{\text{mkt}}$), idiosyncratic risk ($IVOL$), distress risk ($DISTRESS$), O-Score (*O-Score*), maximum return ($MAX$), skewness ($SKEW$) and coskewness ($COSKEW$).[12] Consistent with the prior literature, I find that portfolio strategies formed on the cross-section of these characteristics are highly correlated. In particular, Table A2 shows the correlation in the monthly returns among strategies that formed by buying stocks with the lowest risk characteristic and selling stocks with highest risk characteristics. The correlation ranges from 0.86 between $IVOL$ and $COSKEW$ to 0.97 between $MAX$ and $DISTRESS$.

To provide a comprehensive assessment of a firm's risk, I follow the approach in Stambaugh et al. (2015) to construct a composite risk score based the seven risk characteristics. The procedure is as follows. At the beginning of each period and for each characteristic, I sort all stocks in ascending order and assign a percentile rank to each stock (i.e., stocks with higher characteristic receive higher rank). I then calculate a stock's risk score by taking the arithmetic average of its ranks across seven characteristics. By construction, stocks with higher rank have higher risk score and lower returns.

Panel B of Table 1 shows the summary statistics of stock risk characteristics. The mean of $\beta_{\text{mkt}}$ is slightly greater than one, implying a higher level of riskiness relative to the market. This is perhaps not surprising given empirical evidence that active equity funds have a large tilt toward

[12]For market beta, I use the estimation approach similar to Fama and French (1992) and Liu et al. (2018), and employ four alternative measures in the literature for robustness check. Construction detail of these measures is in Table A1 in the Appendix.

large cap stocks, which generally have higher market beta (e.g., Lettau, Ludvigson, and Manoel, 2018). The mean of both *SKEW* and *COSKEW* is close to zero, suggesting that the average stock has a marginally higher chance of delivering extreme positive returns and is less likely to exhibit extreme returns when the market experiences large swings. On average, the risk score is about 50, implying the level of risk is moderate. However, the risk score exhibits high standard deviation of around 17.

# 3 Incentives-induced trading and low-risk anomalies

In this section, I analyze the performance of a strategy that buys high-risk stocks and sells low-risk stocks across different levels of incentives-induced trading, followed by a series of robustness checks.

## 3.1 Baseline results

### 3.1.1 Individual risk characteristics

The direct way to obtain the main results is to examine the performance of low-risk strategies from double portfolio sorts on seven risk characteristics and *Ownership rank*. Specifically, at the end of each quarter from 2006 to 2021, I form five-by-three portfolios by independently sorting stocks on each of risk characteristics and the ownership variable.[13] For each sort, the procedure produces 15 value-weighted portfolios, and they are rebalanced every quarter. Because low-risk anomalies are a direct violation of the capital asset pricing model (CAPM), I evaluate the performance of these portfolios using the CAPM alpha for the baseline analysis.

Panels A-G of Table 2 present the results for seven characteristics (i.e., $\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW), respectively. First, I examine the performance of low-risk anomalies that use all stocks for sorting in which the results are shown in the first row of each panel. Across seven characteristics, the strategies produce a negative monthly CAPM alpha on average, ranging from $-0.16\%$ per month for *SKEW* to $-0.69\%$ per month for *DISTRESS*. This finding is consistent with the prior literature that stocks with higher risk characteristics appear to earn lower abnormal returns on average. Four out of seven alphas are statistically significant, suggesting that most low-risk anomalies remains persistent and strong in the recent decades.[14]

[13] The main conclusion is robust to five-by-five portfolio sorts. Results for this robustness check are presented in Table A3 in the Appendix.

[14] The economic magnitude and statistical significance of these anomalies are lower than that documented in

Next, I investigate the performance of low-risk anomalies across three levels of managerial ownership reported in the last column of each panel. The negative abnormal returns are monotonically increasing from the low to high managerial ownership across all risk characteristics with the negative alphas concentrating among stocks with the lowest managerial ownership. For example, the CAPM alpha of the high-minus-low $\beta_{\text{mkt}}$ portfolio among stocks with the highest exposure to incentives-induced trading is $-1.08\%$ per month ($t$-stat $= -3.48$), whereas that among stocks with the lowest exposure is $-0.17\%$ ($t$-stat $= -0.46$).[15] This pattern repeats for the other characteristics with strong statistical evidence for four out of seven characteristics.

A close examination reveals that the insignificant alphas among high-ownership stocks are mainly driven by the insignificant abnormal returns associated with the high-risk portfolios. Examining the results in Column (5) of each panel, I find that the CAPM alpha of the high-risk portfolios is generally small and statistically insignificant among stocks with high managerial ownership. For example, the CAPM alpha of the high-*MAX* high-ownership portfolio is 0.13% ($t$-stat $= 0.65$), while that of the high-*MAX* low-ownership portfolio is $-0.58\%$ ($t$-stat $= -2.42$). The difference is 0.71% and is significantly different from zero. This pattern is similarly strong for other four characteristics that include $\beta_{\text{mkt}}$, *IVOL*, *O-Score*, *COSKEW*, and slightly lesser for *DISTRESS* and *SKEW*. On the other hand, there is much less systematic changes in the positive abnormal returns associated with the low-risk portfolios across different levels of managerial ownership. For example, the difference in the CAPM alpha between the high- and low-ownership portfolio among stocks with the lowest *IVOL* is 0.09% ($t$-stat $= 0.53$). The results imply that high exposure to incentives-induced trading (i.e., low managerial ownership) contributes to the negative abnormal returns associated with high-risk stocks.

### 3.1.2 Composite risk score

To provide a broad assessment on the attenuation effect of low exposure to incentives-induced trading on the negative abnormal returns associated with high-risk stocks, I examine the CAPM alpha of low-risk strategies from the five-by-three portfolio double sort on risk score and *Ownership*

previous papers. This is possibly due to a shorter evaluation period or increasing arbitrage activity in recent decades (e.g., McLean and Pontiff, 2016).

[15] The literature is not conclusive in the approach to estimate market beta. To mitigate the concern that beta estimation approaches can affect the conclusion, I provide robust evidence using four alternative estimates of market beta in Table A4 in the Appendix.

*rank*. Panel A of Table 3 presents the results from this portfolio sort. First, I examine the performance of the strategy that buys high-risk stocks and sells low-risk stocks, which is shown in the first row of Panel A. Over the sample period 2006-2021, the CAPM alpha of the bottom quintile portfolio (i.e., low-risk portfolio) is 0.35% per month, and statistically significant at the 1% level. On the other hand, the CAPM alpha of the top quintile portfolio is negative at −0.29% but not statistically significant. The difference in abnormal return between the long and short leg of the strategy is −0.63% per month, and statistically significant at the 5% level. This result reinforces the conclusion that high-risk stocks earn substantially lower future returns in general.[16]

Next, I examine the abnormal returns of low-risk strategies across three levels of stock managerial ownership. Column (6) shows that the CAPM alpha is monotonically increasing from the low to high managerial ownership. Specifically, the CAPM alpha of the high-low portfolio among stocks with low managerial ownership is −0.96% per month ($t$-stat = −3.43), while that among stocks with high managerial ownership is −0.34% ($t$-stat = −1.17). Similar to the pattern documented among individual risk characteristics, the attenuation effect of managerial ownership concentrates in the high-risk portfolio. Column (5) shows that the CAPM alpha of the high-risk high-ownership portfolio is 0.11% ($t$-stat = 0.39), while that of the high-beta low-ownership portfolio is −0.67% ($t$-stat = −2.48). The difference is 0.78% and is significantly different from zero. On the other hand, Column (1) shows that there is no difference in the performance of low-risk portfolios across different levels of ownership.

In Panel B of Table 3, I use a five-by-five sort and continue to find the same pattern. Specifically, the abnormal return associated with the low-risk strategy is monotonically increasing in managerial ownership and is not statistically significant different from zero among stocks with the highest managerial ownership. Collectively, these findings provide evidence that exposure to incentives-induced trading by portfolio managers can distort the risk-return relation in the stock market.

[16]Table A5 shows a similar pattern using more recent factor pricing models. In particular, the abnormal returns associated with the low-risk strategy concentrates only among stocks with high exposure to incentives-induced trading when alphas are measured with respect to either the Fama-French three-factor model, the three-factor model augmented with the momentum and liquidity factor or the Fama-French five-factor model augmented with the momentum factor.

## 3.2 Robustness checks

### 3.2.1 Alternative measures of ownership

Since SEC does not require funds to report exact portfolio ownership, I follow Khorana et al. (2007) and Ma and Tang (2019) to consider two other alternative measures. The first measure is *Ownership indicator*, which is equal to 1 if the ownership is different from 0, and 0 otherwise. The second measure is *Ownership dollar*, which is natural logarithm of the total ownership amount in dollar. Combining with fund holdings information, I construct the two corresponding measures for stock-level portfolio manager ownership and repeat the five-by-three portfolio sort from the baseline analysis with the risk score as the composite risk measure.

Table 4 reports the results. Using *Ownership indicator* in Panel A, the results imply that the low-risk anomaly does not exist among stocks with high managerial ownership, and the statistical significance only concentrates among high-risk stocks with low managerial ownership. The abnormal return difference of the strategy between low- and high-ownership stocks is 49 basis points per month and is statistically significant at the 10% level. The results using *Ownership dollar* from Panel B show similar pattern.[17]

## 3.3 Impact of other firm characteristics

A valid concern is that other firm characteristics can capture the impact of exposure to incentives-induced trading in explaining the low-risk anomalies. There are several other variables in the literature that have varying degrees of attenuating effects.

The first set of firm characteristics I consider is size, value, and momentum. Because active equity funds are generally categorized in the two dimensions of size and value (e.g., growth large-cap funds), portfolio manager ownership in their own fund may proxy for managers' preference for certain investment styles. Figure 2 also suggests that there seems to be a difference in ownership between large- and small-cap stocks and also between value and growth stocks. I also assess the role of momentum because prior studies in the mutual fund literature (e.g., Carhart, 1997) suggest

[17] I also use the percentage ownership measure defined as the aggregate dollar amount of managerial ownership divided by the TNA of the fund and obtain a similar conclusion. The CAPM alpha of the low-risk anomaly among the lowest and highest tercile of manager ownership is $-65$ basis points ($t$-stat $= -1.81$) and $-47$ basis points ($t$-stat $= -1.38$). However, Khorana et al. (2007) and Ma and Tang (2019) argue that this measure is not ideal to capture percentage ownership because a fund's total net asset is not a good proxy for its managers' personal wealth.

the momentum factor explains a large variation in mutual fund performance.[18] In the second set of firm characteristics, I add investment and profitability to the previous set for a total of five characteristics. Fama and French (2015) show that including these two characteristics increases the explanatory power for the cross-section of stock returns substantially.

For the third set of firm characteristics, I include mutual fund ownership, stock liquidity and mispricing to the previous set. Nagel (2005) show that many anomalies concentrate only among stocks with low institutional ownership because short-selling constraints are more likely to bind for these stocks. Because portfolio manager ownership is positively correlated with mutual fund ownership, which in turn is correlated with institutional ownership, it is possible that the impact of portfolio manager ownership on the low-risk anomalies is confounded by fund ownership. I therefore consider mutual fund ownership as a characteristic of interest. A stock's mutual fund ownership is measured as the total market value of the stock's holdings by all funds divided by the stock's market value.

Fund managers may prefer to hold liquid stocks for liquidity concerns (e.g., Coval and Stafford, 2007). Since higher liquidity make it easier for arbitrageurs to correct abnormal returns associated with high-risk stocks, I consider stock liquidity as a potential confounding characteristic. I measure a stock's liquidity using the liquidity beta following Pástor and Stambaugh (2003).

Liu et al. (2018) show that the beta anomaly concentrates among only overpriced stocks, arguing that limits to arbitrage (e.g., short-selling constraints) among overpriced stocks prevent investors to trade to correct the beta anomaly. This pattern is driven mainly by the positive relation between a stock's beta and its idiosyncratic risk. I thus include mispricing in this analysis. Following Stambaugh et al. (2015), I construct a mispricing score for each stock based on the composite ranking of nine mispricing characteristics (i.e., Momentum, Accruals, Asset growth, Composite equity issuance, Profitability, Investment, Net issuance, NOA and ROA).[19]

The final set of variables replaces the mispricing score from the previous set with Engelberg et al.'s (2020) anomaly net score. Similar to Engelberg et al. (2020), I construct a score that captures the anomalous characteristics associated with each stock based on a high-dimensional set of 88

[18] I follow Fama and French (1992) to construct size and book-to-market ratios for each stock and Jegadeesh and Titman (1993) to construct momentum.

[19] Stambaugh et al. (2015) consider 11 characteristics that also include *DISTRESS* and *O-Score*. However, these two characteristics are considered as risk characteristics in this paper. I therefore exclude them in the construction of the mispricing score in subsequent main analyses. The main conclusion is robust when I include these two characteristics.

stock characteristics.[20] For each characteristic, I sort all stocks in ascending order into quintile portfolios. Based on the documented signs from the original studies, I record whether each stock belongs to either the long or short leg of the anomaly. Then a stock's anomaly net score is the difference in the number of times the stock belongs to the long and short legs for 88 characteristics.

To assess the extent to which other characteristics might capture exposure to incentives-induced trading, I use two empirical testing approaches. The first approach uses a series of triple portfolio sorts that start by sorting stocks into two portfolios based on the characteristic of interest. For example, I use the median value of size in each period to sort all stocks into either small or large cap stocks. I then repeat the independent five-by-three double portfolio sort as in the baseline analysis within each of the two characteristic portfolios. This process produces 30 risk portfolios in total for each characteristic. Finally, I assess the performance of each risk portfolio. If the impact of managerial ownership is distinct from other characteristics, I expect that the low-risk anomalies are generally only significant among stocks with low managerial ownership regardless of the levels of these characteristics.

A weakness of the triple portfolio sorting approach is that it does not control for multiple firm characteristics. To address this issue, I regress the ownership measure on all characteristics to obtain a residual measure that is orthogonal to other characteristics. I then repeat the double portfolio sort based on the risk score and this orthogonalized measure to assess the impact of residual managerial ownership on the low-risk anomalies in general. To maintain brevity and space, I report the results from the triple portfolio sorts in Table A6 in the Appendix and discuss only the results from the second approach here for brevity.

Table 5 reports the results from the orthogonalization approach. Panel A shows the CAPM alphas when I regress *Ownership rank* on size, value, and momentum. The results show that the negative abnormal return associated with the high-risk stocks only exists among stocks with low managerial ownership. The high-risk high-ownership stocks have a CAPM alpha of only 3 basis points ($t$-stat $= 0.09$), and the difference relative to the high-risk low-ownership is 87 basis points per month ($t$-stat $= 3.00$). Removing the potential effects of investment and profitability on managerial ownership in Panel B does not alter the results significantly.

Panel C shows the results when excluding the potential effects of mutual fund ownership, stock

[20] The characteristics are constructed based on the descriptions provided in Hou, Xue, and Zhang (2015), McLean and Pontiff (2016) and Kelly, Pruitt, and Su (2019).

liquidity and mispricing. While the abnormal return difference between high and low ownership among high-risk stocks reduces, it is still robust that the abnormal return associated with the low-risk anomalies is only significant among stocks with low managerial ownership. The results are similar in Panel D when I replace the mispricing measure with the anomaly net score. The negative abnormal return associated with the low-risk strategy is monotonically increasing from the low-ownership portfolio (*alpha* $= -0.85\%$, $t$-stat $= -2.36$) to the high-ownership portfolio (*alpha* $= -0.28\%$, $t$-stat $= -0.73$).[21] Overall, these results suggest that even controlling for a broad and high-dimensional set of firm characteristics, high exposure to incentives-induced trading plays an important role in sustaining the high-risk low-return phenomenon.

### 3.3.1 Style betas

Recently, Han et al. (2022) show that the beta anomaly exists only among stocks held by underperforming funds. Based on the argument that funds who underperform other funds in the same category would take excessive risk in stocks that have higher exposure to the relevant category, Han et al. (2022) document the impact of risk taking by underperforming funds on the beta anomaly only before Morningstar changed their rating methodology in 2002. After the change, the paper documents the impact of fund performance on only style betas.

A concern to my main results is that the impact of portfolio manager ownership is driven by underperforming funds. This is a valid concern as it is potentially mechanical that managers of underperforming funds also have lower portfolio ownership. However, portfolio manager ownership is used as a proxy for incentive alignment, and it is not clear whether the interests of portfolio managers of underperforming funds are misaligned with that of their clients. For instance, portfolio managers may act in the interests of their investors but still underperform due to poor skill. Nevertheless, I employ two tests to differentitate between the impact of incentive misalignment and fund performance on the low-risk anomalies.

First, I remove any effect of fund performance on portfolio manager ownership by regressing the natural logarithm of ownership (i.e., LN(Ownership dollar)) on three different measures of fund performance. The first measure is the annual cumulative fund alpha measured with respect to the

[21] Table A7 in the Appendix presents the results for seven individual risk characteristics using the orthogonalization approach, and the conclusion remains. I also provide robust evidence using two alternative measures of ownership in Table A8 in the Appendix.

Fama-French five-factor model augmented with the momentum factor. The second measure is the annual cumulative fund excess returns over fund active benchmark where the active benchmark is identified following Cremers and Petajisto (2009).[22] The third measure uses S&P500 as the benchmark following Bessembinder, Cooper, and Zhang (2023). I then repeat the double port sort based on the composite risk score and these residual measures of ownership and assess the abnormal returns associated with high-risk stocks.

Table 6 reports the results from this test. Panels A, B, C report the result when the fund performance is captured by fund alpha, excess returns over active benchmark and excess returns over S&P500 returns, respectively. Across all panels, the conclusion remains that the high-risk low-return relation only exists among stocks with high exposure to incentives-induced trading. These results suggest that the effect of portfolio manager ownership on incentives-induced trading is not fully explained by fund performance.

Han et al. (2022) show that fund performance does not explain the beta anomaly when beta is measured with respect to the market index (e.g., S&P500) after 2002 due to the Morningstar rating methodology change. The authors argue that after the change, underperforming funds would take excessive risk only when risk is measured against the relevant categories because these funds care about performing other funds in the same category. To provide evidence, Han et al. (2022) document the impact of fund underperformance on the beta anomaly when beta is measured against four category indices: Large Growth, Large Value, Small Growth, Small Value. To examine whether the impact of incentives-induced trading, as proxied by portfolio manager ownership, on these style-beta anomalies, I follow Han et al. (2022) and estimate stock betas against these indices. Besides market beta estimated using the S&P500 index, I estimate style betas for Large Growth, Large Value, Small Growth and Small Value using the Russell 1000 Growth index, Russell 1000 Value index, Russell 2000 Growth index, and Russell 2000 Value index, respectively. I then repeat the double sort based on these measures of beta and stock managerial ownership and assess the abnormal returns associated with high-beta stocks. To further ensure that other firm characteristics does not affect stock managerial ownership, I use the residual ownership measure that is obtained as the residuals from the regression of ownership on firm size, value, and momentum, mutual fund ownership, stock liquidity, mispricing score and anomaly net score.

[22] The active share and benchmark data is collected from https://activeshare.nd.edu/. I thank Martijn Cremers and Tim Riley for maintaining the database.

Table 7 reports the results from these tests. Panel A presents the results when beta is measured against the S&P500 index. In contrast to Han et al. (2022), I still find the effect of incentives-induced trading on high-beta stocks. Specifically, the high-beta stocks earn a negative alpha of −0.79% per month ($t$-stat = −2.14) among stocks with high exposure to incentives-induced trading, whereas they earn only −0.33% per month ($t$-stat = −1.01) among stocks with low exposure.[23] This result suggests that the impact of incentives-induced trading is distinct from that of fund performance, which arises from the feature of relative performance assessment in the mutual fund industry.

Panels B to E report the results when beta is measured against four category indices. Across all four panels, I continue to find the impact of incentives-induced trading on the high-risk low-return relation. These results provide further evidence that incentives-induced trading, as measured by portfolio manager ownership, captures a broader spectrum of fund risk taking and contributes to the beta anomaly regardless of benchmark indices.

# 4 Incentives-induced trading and the factor zoo

In this section, I investigate whether the attenuation effect of managerial ownership extends to explaining anomalous returns associated with other firm characteristics. The objective is to highlight the uniqueness of incentive alignment mechanisms in the asset management industry on the low-risk anomalies.

## 4.1 Mispricing characteristics

The analysis starts with the mispricing characteristics proposed by Stambaugh et al. (2015). Liu et al. (2018) show that the beta anomaly concentrates among only overpriced stocks, arguing that limits to arbitrage (e.g., short-selling constraints) among overpriced stocks prevent investors to trade to correct the beta anomaly. This pattern is driven mainly by the positive relation between a stock's beta and its idiosyncratic risk. Furthermore, recent studies show that institutional investors tend to tilt toward overvalued stocks (e.g., Edelen et al., 2016). If agency-issue-induced incentives drive the portfolio choices of mutual fund managers, one might expect some consequences on the anomalous returns associated with other characteristics.

[23] The alphas are measured using the Fama-French three-factor model following Han et al. (2022) to take into account any effect of firm size and value on style betas.

I test this conjecture using the nine mispricing characteristics from Stambaugh et al. (2015) (i.e., Momentum, Accruals, Asset growth, Composite equity issuance, Profitability, Investment, Net issuance, NOA and ROA) and the composite mispricing score constructed based on these characteristics. The testing procedure is based on the five-by-three double portfolio sorts in which the first sorts use the characteristics. Panel A in Table 8 reports the CAPM alpha for nine characteristics. I do not find systematic evidence that anomalous returns only concentrates on one leg of the strategies. Specifically, the abnormal return difference in the high-minus-low characteristic portfolios is systematically indifferent from zero between the low- and high-ownership portfolios. Panel B reports the results when the mispricing score is used for sorting. The high-minus-low mispricing portfolio earns a CAPM alpha of $-0.57\%$ per month ($t$-stat $= -2.11$) among stocks with low ownership and $-0.45\%$ per month ($t$-stat $= -1.67$) among stocks with high ownership. While there appears to be a decrease in the abnormal returns, the difference remains statistically insignificant. The insignificant difference in the overpriced portfolio between the low- and high-ownership portfolios reaffirms the conclusion that incentives-induced trading by portfolio managers does not have a pronounced impact on stocks' overpricing, which has been shown to drive some low-risk anomalies (Liu et al., 2018).

### 4.2 Factor zoo

The literature on the cross-section of stock returns has documented hundreds of firm characteristics that appear to predict returns, leading to a broad set of tradable factors constructed from these characteristics that is widely known as the factor zoo (e.g., McLean and Pontiff, 2016, Hou, Xue, and Zhang, 2020).

To examine whether exposure to incentives-induced trading affects the factor premia, I start by constructing a high-dimensional set of 88 firm characteristics drawn from Hou et al. (2015), McLean and Pontiff (2016) and Kelly et al. (2019). I first use the anomaly net score constructed from Section 3.3 and repeat the double portfolio sort from the previous section. Panel C of Table 8 reports the results for this test. Column (6) shows that the difference of the high-low portfolio between the low and high ownership portfolios is only 6 basis point and statistically insignificant, implying that managerial ownership does not appear to impact anomalous returns.

To provide a broader assessment for individual characteristics, I repeat the double portfolio sort for each characteristic and record the CAPM alpha for the sorted portfolios. I also repeat this test using the orthogonalized characteristics which is obtained by regressing each characteristic on the risk score.

Table 9 reports the average CAPM alphas for the extreme portfolios across all 88 portfolio sorts. Panel A shows the results for 35 characteristics in which higher values are associated with lower future returns as documented in prior studies. Column (3) shows that while there appears to be a increase in the abnormal return of the high-low portfolio from the low ($alpha = -0.04\%$) to high ownership portfolio ($alpha = 0.10\%$), the difference is small and not statistically significant. The difference in the economic magnitude vanishes further when characteristics are orthogonalized to the risk score as shown in Column (6). Panel B shows the results for 53 characteristics in which higher values are associated with higher future returns as documented in prior studies. I also do not find systematic evidence that there is significant difference in the factor premia between low and high ownership stocks across the characteristics. Collectively, the results imply that exposure to incentives-induced trading does not appear to affect the anomalous returns associated with a high-dimensional set of firm characteristics, highlighting its unique impact on the low-risk anomalies.

# 5 Incentives-induced trading and portfolio tilt

In this section, I analyze the tilt toward high-risk stocks among portfolios of different levels of managerial ownership. I also provide evidence how the portfolio managers' risk-taking behavior responds to changes in market volatility at different levels of ownership.

## 5.1 Portfolio-level evidence of tilting toward high-risk stocks

The evidence so far show that exposure to incentives-induced trading captured by managerial ownership contributes to the anomalous low returns associated with high-risk stocks, suggesting that funds whose managers have lower ownership tilt more toward high-risk stocks. To formally test if this is the case, I examine the tilting behavior in the portfolios of these funds.

I start by using the fund-level *Ownership rank* variable and re-ranking these funds into four groups: the first group contains funds whose managers do not have any ownership (i.e., *Ownership rank* is 1), the second group contains funds whose *Ownership rank* is between 2 and 4, the third group contains funds whose *Ownership rank* is 5, and the last group contains funds whose *Ownership* *rank* is 6 and 7. For each group, I aggregate their portfolio holdings each period to construct stacked panel in which the unit of analysis is at group and stock level. Following Dou et al. (2024), I then estimate the deviation of each holding from its market weight as the difference between the fraction of the portfolio in the holdings and the market weight.[24] I then perform the stacked panel regression

$$\omega_{p,i,t} - \omega_{i,t}^{\text{mkt}} = \gamma_{j,t-1} \times \text{Char}_{i,t-1} + \delta_{j,t} \times \text{Char}_{i,t} \times \text{Ownership}_{p,t-1} + \text{Ownership}_{p,t-1} + \lambda_{k,t} + \varepsilon_{p,i,t-1},$$

where $\omega_{p,i,t} - \omega_{i,t}^{\text{mkt}}$ is the deviation of each stock $i$ in portfolio $p$ from its market weight, $Ownership_{p,t-1}$ is an indicator equal to 1 for the highest portfolio group $p$ and 0 otherwise, and $Char_{i,t-1}$ is stock $i$'s risk score. The regressions include $\lambda_{k,t}$ as the industry by time fixed effects to absorb any unobserved industry-specific shocks that might happen in each period. The main variable of interest is the interaction term between *Char* and *Ownership*, which captures the level of tilt toward high-risk stocks for high-ownership portfolio. If the attenuation effect on the high-risk stocks comes from funds with higher ownership tilting less toward high-risk stocks, I expect the interacted coefficients $\gamma$ to be negative.

Table 10 shows the results. Column (1) of Panel A present the results from the stacked panel regressions for the risk score as the firm characteristic. The coefficient estimate on *Risk score* is positive and statistically significant at the 1% level, suggesting that on average active mutual funds tilt toward risky stocks and consistent with the prior that mutual funds are generally taking excessive risk. Importantly, the interacted coefficient estimate with *Ownership* is negative and statistically significant, implying that portfolios of funds with high managerial ownership tilt significantly less toward high-risk stocks. The relative decrease in the tilt is almost 45%, suggesting that the economic magnitude on the pricing of high-risk stocks is potentially large. Column (1) of Panel B presents the test's results using Fama-MacBeth regressions and obtain a similar pattern.[25]

Since prior theoretical works provide particular predictions for this tilting behavior with respect to market beta (e.g., Karceski, 2002), I include $\beta_{\text{mkt}}$ as one of the characteristics in the regressions and report the results in Columns (2) in Table 10. Consistent with prior evidence (e.g., Dou et

[24] A concern with this construct is that a stock that is not held in the portfolio can be either excluded from the estimation or included with a zero weight. Because researchers do not observe the investment opportunity set of portfolio managers, I follow Dou et al. (2024) and assign a stock with zero weight at each period if the stock was held in the portfolio over the last two years, and missing otherwise.

[25] Table A9 in the Appendix provides robust evidence using two alternative measures of portfolio manager ownership and Table A10 shows robust evidence when I remove the impact of fund performance on portfolio manager ownership.

al., 2024), the coefficient estimate on $\beta_{\text{mkt}}$ is positive and statistically significant at the 1% level, suggesting that on average active mutual funds tilt toward stocks with high market beta. The interacted coefficient estimate is negative and statistically significant, reinforcing the conclusion that the portfolio of high-ownership funds takes substantially lower risk.

Recent studies show that institutional investors also tend to tilt toward overvalued stocks (e.g., Edelen et al., 2016). While the analyses in the prior sections show that incentives-induced trading does not appear to affect abnormal returns associated with mispricing, I include the mispricing score as the characteristic of interest in this analysis to provide further robustness. The results in Column (3) in both panels of Table 10 show that while active funds do indeed have a strong tilt toward overpriced stocks, the level of managerial ownership does not affect this tilt substantially. The interacted coefficient estimate is small and statistically insignificant in both panel and Fama-MacBeth regressions.

Overall, the results in this analysis suggest that the attenuation effect of managerial ownership on the low-risk anomalies stems from high ownership funds taking substantially less risk, and this effect appears to be unique to the low-risk anomalies.

## 5.2 Fund-level evidence of tilting toward high-risk stocks

This section employs the fund-level analyses to provide further evidence about the risk-taking behavior across different levels of managerial ownership and shed lights on the mechanisms that initiate risk shifting.

I repeat the analysis from the previous section but at the fund level. For each period, I first estimate the portfolio tilt toward risky stocks for each fund using the funds' quarterly holdings from the following regression:

$$\omega_{j,i,t+1} - \omega_{i,t+1}^{\text{mkt}} = \gamma_{j,t} \times \text{Risk score}_{i,t} + \lambda_{t+1} + \varepsilon_{j,i,t+1}, \tag{2}$$

where $\omega_{j,i,t+1} - \omega_{\text{mkt},i,t+1}$ is the deviation of fund $j$ for stock $i$ from its market weight, and $\lambda_{t+1}$ is the quarter fixed effects. I then use the estimated tilting coefficient $\gamma_{j,t}$ as the dependent variable in a panel regression in which the independent variables are measures of ownership. Fund-level control variables include fund size, past performance, past flow, fund age, expense ratio, turnover ratio, family size, fund activeness, and funds' stock characteristics that include size, value, and momentum. The regressions include style by year fixed effects to absorb unobserved factors that affect portfolio choices based on fund style in each period. I also include family fixed effects to absorb time-invariant factors associated with each fund family.

Table 11 presents the results using three measures of portfolio manager ownership: *Ownership rank* (Columns (1)-(2)), *Ownership indicator* (Columns (3)-(4)) and *Ownership dollar* (Columns (5)-(6)). Across different specifications, the results show that funds with higher managerial ownership have significantly lower tilt, providing fund-level evidence that moderating risk-taking behavior at the fund level is a mechanism that alleviates the anomalous returns associated with high-risk stocks.

### 5.3 Tilting behavior in bad times

In this section, I examine the conditions in which managerial ownership alters the tilt toward high-risk stocks across funds. If managerial ownership changes the risk aversion of portfolio managers, one would expect that the effect to be concentrated during times that portfolio managers are more likely to be experiencing wealth shocks, which are partially captured by their ownership.

To test this hypothesis, I repeat the analysis from the previous section but include indicators that capture the bad economic times. The first indicator is *Pessimistic market*, which is an indicator equal to 1 for years that the cumulative 12-month market return is in the lowest tercile of the sample period and 0 otherwise. Another indicator, *Volatile market*, is equal to 1 for years that the annualized weekly market volatility is in the highest tercile of the sample period and 0 otherwise. Panels A and B of Table 12 present the results for the two variables, respectively.

Consistent with the prior hypothesis, Panel A shows that the effect of managerial ownership on tilting behavior concentrates among periods in which the market is bearish. Column (1) shows that the difference in tilting between funds with high and low managerial ownership is $-0.023$, and the low $p$-value from the $F$-test suggests that this difference is statistically significant. Similar results are obtained for other measures of ownership. In Panel B where the bad market conditions are captured by the volatility, I obtain a similar pattern. Overall, these results imply that the tilting behavior toward high-risk stocks is significantly mitigated during bad times via the exposure of ownership to bad market conditions.

# 6 Conclusion

The mutual fund literature shows that agency-issue-induced incentives drive managers' risk-taking behavior. In this paper, I provide direct evidence that this incentive misalignment also has a pronounced impact on the risk-return relations in the stock market.

Based on hand-collected data on portfolio manager ownership, I construct a measure that captures each stock's exposure to incentives-induced trading and show that this measure is associated with the abnormally low returns of high-risk stocks. Across a broad set of low-risk anomalies, I find that the negative abnormal returns concentrate only among stocks with high exposure to incentives-induced trading. This pattern appears to be unique to the low-risk anomalies and does not extend to the factor zoo in the asset pricing literature. Further analyses show that portfolio managers who have more "skin in the game" reduce risk exposure following extreme downturns and volatile markets, implying that a stronger interest alignment alters managers' risk aversion. The paper re-emphasizes the negative impact of agency-issue-induced risk-taking incentives and highlights the role of incentive alignment mechanisms in improving market efficiency.

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**Figure 1. Aggregate time-series distribution of stock managerial ownership**
The figure shows the time-series distribution of stock managerial ownership from January 2006 to December 2021. The dashed line shows the mean of portfolio managerial ownership across all stocks, and the solid lines show the 95% confidence interval. A stock's portfolio managerial ownership is estimated as the weighted average of portfolio manager ownership, where the weight is the number of shares held by each fund. Data on fund-level portfolio manager ownership (in dollars) is collected from the Statement of Additional Information that funds file with the SEC. The shaded areas represent NBER recessions.

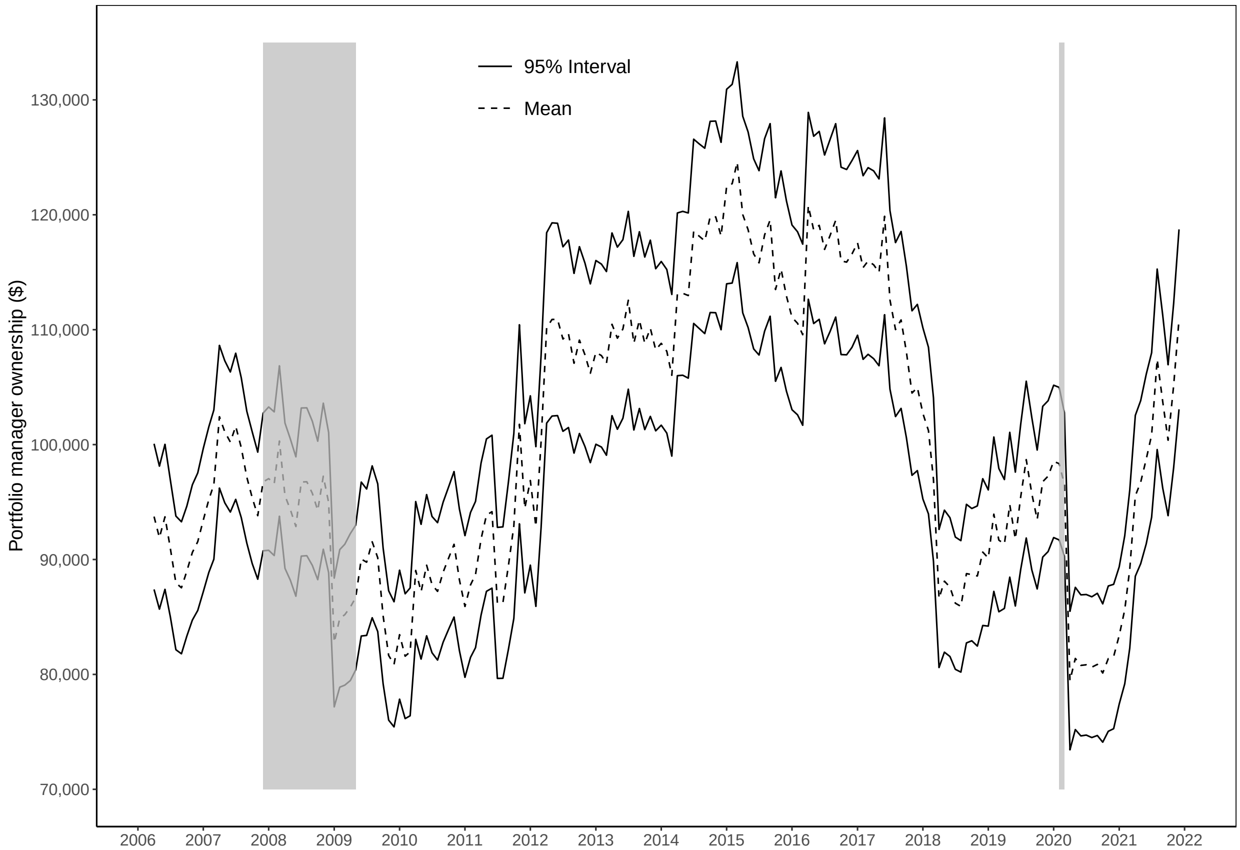

**Figure 2. Time-series distribution of stock managerial ownership across styles**
The figure shows the mean of stock managerial ownership across six stock categories from January 2006 to December 2021. The stocks are independently sorted on two size (small and big) and three value portfolios (growth, neutral and value), based on their market value and book-to-market ratio, respectively. A stock's portfolio managerial ownership is estimated as the weighted average of portfolio manager ownership, where the weight is the number of shares held by each fund. Data on fund-level portfolio manager ownership (in dollars) is collected from the Statement of Additional Information that funds file with the SEC. The shaded areas represent NBER recessions.

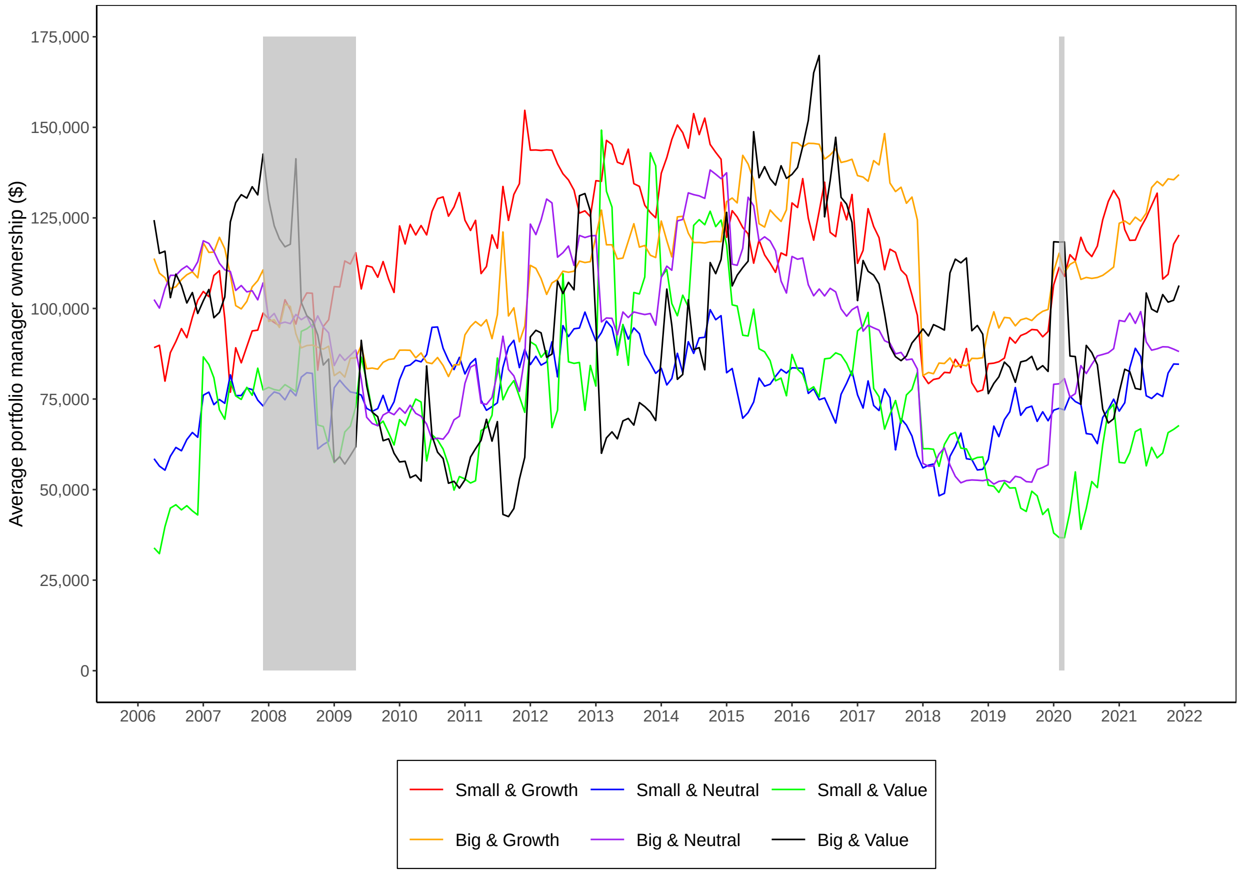

**Table 1. Summary statistics**

The table presents the summary statistics for the main variables used in the paper from January 2006 to December 2021. Panel A shows the statistics for the variables in the mutual fund sample. I retrieve portfolio manager ownership information from the SEC's Electronic Data Gathering, Analysis, and Retrieval (EDGAR) database, which requires disclosure in seven ranges: \$0, \$1-\$10,000, \$10,001-\$50,000, \$50,001-\$100,000, \$100,001-\$500,000, \$500,001-\$1,000,000, and above \$1,000,000. I convert the dollar ranges into dollar amounts by assuming managerial ownership to be at the midpoint of the reported intervals and aggregate the converted amounts for each fund. *Ownership rank* is the value obtained by transforming the total value back to the seven ranks (i.e., from one to seven) used by the SEC. *Ownership indicator* is an indicator equal to 1 if managers have ownership in the fund and 0 otherwise. *LN(Ownership dollar)* is the natural logarithm of the total dollar amount of ownership. Panel B shows the statistics for the variables in the stock sample. Managerial ownership variables are the weighted average of portfolio managerial ownership variables, where the weight is the number of shares held by each fund. Table A1 in the Appendix provides construction detail for risk characteristics.

| | Mean | SD | p10 | p25 | Median | p75 | p90 |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Panel A: Mutual fund sample | | | | | | | |
| *Managerial ownership* | | | | | | | |
| Ownership rank | 3.611 | 2.279 | 1.000 | 1.000 | 4.344 | 5.938 | 6.000 |
| Ownership indicator | 0.610 | 0.487 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 |
| LN(Ownership dollar) | 7.814 | 6.326 | 0.000 | 0.000 | 11.693 | 13.572 | 13.816 |
| *Fund characteristics* | | | | | | | |
| LN(TNA) | 7.576 | 2.013 | 5.010 | 6.225 | 7.555 | 8.909 | 10.188 |
| LN(Age) (years) | 1.935 | 0.776 | 1.099 | 1.386 | 1.946 | 2.773 | 2.773 |
| Quarterly return (%) | 2.712 | 3.335 | −1.218 | 0.607 | 2.650 | 4.822 | 6.838 |
| Quarterly flow (%) | −0.214 | 18.780 | −8.526 | −4.528 | −1.933 | 1.324 | 8.560 |
| Expense ratio (%) | 1.105 | 0.387 | 0.709 | 0.900 | 1.088 | 1.288 | 1.492 |
| Turnover ratio (%) | 72.120 | 76.523 | 17.203 | 31.182 | 54.496 | 89.056 | 137.152 |
| Panel B: Stock sample | | | | | | | |
| *Managerial ownership* | | | | | | | |
| Ownership rank | 4.516 | 0.756 | 3.610 | 4.168 | 4.625 | 4.999 | 5.313 |
| Ownership indicator | 0.761 | 0.142 | 0.599 | 0.704 | 0.786 | 0.851 | 0.902 |
| LN(Ownership dollar) | 10.076 | 1.969 | 7.793 | 9.242 | 10.397 | 11.338 | 12.092 |
| *Risk characteristics* | | | | | | | |
| $\beta_{\text{mkt}}$ | 1.100 | 0.695 | 0.363 | 0.638 | 0.995 | 1.436 | 1.958 |
| Idiosyncratic risk (IVOL) | 0.021 | 0.017 | 0.008 | 0.011 | 0.017 | 0.025 | 0.038 |
| Distress risk (Distress) | −4.097 | 18.268 | −6.537 | −5.844 | −4.858 | −3.406 | −1.374 |
| O-Score | −1.522 | 2.839 | −4.282 | −2.919 | −1.628 | −0.368 | 1.115 |
| Maximum return (MAX) | 0.061 | 0.063 | 0.023 | 0.032 | 0.046 | 0.070 | 0.109 |
| Skewness (SKEW) | 0.128 | 0.877 | −0.830 | −0.332 | 0.106 | 0.567 | 1.138 |
| Coskewness (COSKEW) | −0.196 | 0.157 | −0.394 | −0.302 | −0.198 | −0.093 | 0.002 |
| Risk score | 50.047 | 17.081 | 27.626 | 36.940 | 49.530 | 62.627 | 73.209 |

**Table 2. Stock managerial ownership and low-risk anomalies**

The table shows the monthly CAPM alphas (in percent) of portfolios constructed from independent double portfolio sorts based on *Ownership rank* and each of seven risk characteristics ($\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW) from January 2006 to December 2021. For each characteristic, at the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios based on the characteristic. All stocks are then independently sorted in ascending order into three portfolios based on *Ownership rank*. Portfolios are value weighted and rebalanced every three months. Panels A-G report the results for $\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW, respectively. The first row in each panel reports the results for the quintile risk portfolios for all stocks, and the subsequent rows report the results for the risk portfolios at three levels of managerial ownership. The last column in each panel shows the results for the strategies that buy the high-risk stocks and sell the low-risk stocks. Newey-West adjusted standard errors are shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | Panel A: $\beta_{\text{mkt}}$ | | | |
| | All | 0.36*** | 0.09 | −0.05 | 0.04 | −0.31 | −0.67** |
| | | (0.10) | (0.09) | (0.11) | (0.15) | (0.26) | (0.33) |
| Ownership | Low | 0.37*** | −0.06 | −0.39** | −0.36* | −0.71** | −1.08*** |
| | | (0.12) | (0.12) | (0.20) | (0.20) | (0.29) | (0.31) |
| | 2 | 0.35*** | −0.04 | −0.08 | 0.11 | −0.59** | −0.94*** |
| | | (0.13) | (0.15) | (0.15) | (0.19) | (0.29) | (0.35) |
| | High | 0.33*** | 0.18 | 0.00 | 0.01 | 0.16 | −0.17 |
| | | (0.12) | (0.11) | (0.16) | (0.21) | (0.32) | (0.37) |
| | High−Low | −0.04 | 0.24 | 0.40 | 0.37 | 0.87*** | 0.92*** |
| | | (0.16) | (0.18) | (0.27) | (0.24) | (0.29) | (0.32) |
| | | | | Panel B: IVOL | | | |
| | All | 0.35*** | 0.21** | −0.24** | −0.14 | −0.18 | −0.52* |
| | | (0.08) | (0.10) | (0.12) | (0.12) | (0.25) | (0.29) |
| Ownership | Low | 0.29** | 0.10 | −0.29* | −0.40** | −0.61** | −0.90*** |
| | | (0.12) | (0.13) | (0.17) | (0.19) | (0.25) | (0.27) |
| | 2 | 0.25** | 0.27** | −0.28* | −0.07 | −0.19 | −0.44 |
| | | (0.11) | (0.13) | (0.16) | (0.20) | (0.28) | (0.34) |
| | High | 0.39*** | 0.09 | −0.10 | −0.24 | 0.01 | −0.37 |
| | | (0.10) | (0.12) | (0.16) | (0.15) | (0.31) | (0.30) |
| | High−Low | 0.09 | −0.01 | 0.19 | 0.16 | 0.62** | 0.53* |
| | | (0.17) | (0.19) | (0.23) | (0.23) | (0.31) | (0.30) |

*(Continued on next page)*

**Table 2** (*continued*)

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | Panel C: Distress | | | |
| Ownership | All | 0.29*** | 0.10 | −0.10 | −0.34* | −0.40 | −0.69** |
| | | (0.08) | (0.10) | (0.12) | (0.20) | (0.25) | (0.30) |
| | Low | 0.23** | −0.04 | −0.29 | −0.40 | −0.50* | −0.73** |
| | | (0.10) | (0.14) | (0.20) | (0.25) | (0.27) | (0.31) |
| | 2 | 0.25** | 0.02 | −0.13 | −0.23 | −0.49* | −0.73** |
| | | (0.12) | (0.14) | (0.18) | (0.21) | (0.27) | (0.34) |
| | High | 0.29*** | 0.16 | −0.02 | −0.28 | −0.18 | −0.47 |
| | | (0.10) | (0.16) | (0.16) | (0.24) | (0.29) | (0.32) |
| | High−Low | 0.07 | 0.20 | 0.27 | 0.11 | 0.32 | 0.26 |
| | | (0.14) | (0.20) | (0.22) | (0.30) | (0.27) | (0.31) |
| | | | | Panel D: O-Score | | | |
| Ownership | All | 0.24** | 0.03 | 0.12 | 0.18* | −0.02 | −0.26 |
| | | (0.10) | (0.08) | (0.08) | (0.10) | (0.11) | (0.17) |
| | Low | 0.08 | −0.18 | −0.07 | 0.27 | −0.39** | −0.48* |
| | | (0.16) | (0.14) | (0.18) | (0.17) | (0.20) | (0.28) |
| | 2 | 0.27** | 0.16 | 0.26** | 0.07 | 0.12 | −0.15 |
| | | (0.11) | (0.12) | (0.10) | (0.11) | (0.15) | (0.21) |
| | High | 0.20** | −0.21 | 0.01 | 0.23 | 0.08 | −0.12 |
| | | (0.09) | (0.14) | (0.11) | (0.19) | (0.14) | (0.15) |
| | High−Low | 0.11 | −0.04 | 0.08 | −0.04 | 0.47** | 0.36 |
| | | (0.17) | (0.22) | (0.19) | (0.22) | (0.23) | (0.30) |
| | | | | Panel E: MAX | | | |
| Ownership | All | 0.38*** | 0.15* | −0.07 | −0.18 | −0.06 | −0.44** |
| | | (0.08) | (0.08) | (0.09) | (0.14) | (0.18) | (0.22) |
| | Low | 0.14 | 0.10 | −0.35** | −0.39* | −0.58** | −0.72*** |
| | | (0.12) | (0.16) | (0.17) | (0.20) | (0.24) | (0.25) |
| | 2 | 0.33*** | 0.05 | −0.04 | −0.17 | −0.16 | −0.50* |
| | | (0.12) | (0.14) | (0.14) | (0.20) | (0.24) | (0.29) |
| | High | 0.40*** | 0.14 | −0.07 | −0.10 | 0.13 | −0.27 |
| | | (0.10) | (0.12) | (0.12) | (0.19) | (0.20) | (0.21) |
| | High−Low | 0.26 | 0.04 | 0.29 | 0.29 | 0.71*** | 0.45* |
| | | (0.17) | (0.23) | (0.20) | (0.26) | (0.25) | (0.24) |

*(Continued on next page)*

**Table 2** (*continued*)

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | Panel F: SKEW | | | |
| Ownership | All | 0.31*** | 0.16 | −0.02 | 0.08 | 0.14 | −0.16 |
| | | (0.11) | (0.10) | (0.06) | (0.15) | (0.09) | (0.11) |
| | Low | 0.31* | −0.06 | −0.20 | −0.06 | −0.02 | −0.34** |
| | | (0.16) | (0.19) | (0.19) | (0.22) | (0.22) | (0.16) |
| | 2 | 0.34** | 0.33*** | 0.01 | 0.12 | 0.12 | −0.22 |
| | | (0.15) | (0.11) | (0.10) | (0.17) | (0.12) | (0.16) |
| | High | 0.06 | −0.11 | 0.07 | 0.07 | 0.23* | 0.17 |
| | | (0.12) | (0.12) | (0.15) | (0.15) | (0.13) | (0.18) |
| | High−Low | −0.25 | −0.05 | 0.28 | 0.12 | 0.25 | 0.50** |
| | | (0.19) | (0.23) | (0.27) | (0.16) | (0.25) | (0.20) |
| | | | | Panel G: COSKEW | | | |
| Ownership | All | 0.25 | 0.11 | 0.16 | 0.14 | −0.05 | −0.30 |
| | | (0.19) | (0.10) | (0.12) | (0.09) | (0.09) | (0.23) |
| | Low | 0.17 | −0.12 | 0.24 | −0.32 | −0.30* | −0.47* |
| | | (0.17) | (0.16) | (0.19) | (0.21) | (0.18) | (0.28) |
| | 2 | 0.27 | 0.24* | 0.16 | 0.28** | 0.03 | −0.25 |
| | | (0.19) | (0.13) | (0.15) | (0.13) | (0.10) | (0.21) |
| | High | 0.13 | 0.03 | 0.09 | 0.20 | 0.15 | 0.03 |
| | | (0.23) | (0.14) | (0.10) | (0.12) | (0.16) | (0.32) |
| | High−Low | −0.04 | 0.16 | −0.15 | 0.51** | 0.46** | 0.50** |
| | | (0.18) | (0.22) | (0.21) | (0.23) | (0.20) | (0.25) |

**Table 3. Stock managerial ownership and low-risk anomalies: Composite risk score**
The table shows the monthly CAPM alphas (in percent) of portfolios constructed from an independent double portfolio sort based on *Ownership rank* and the composite risk score from January 2006 to December 2021. A stock's composite risk score is the arithmetic average of its ranking percentile for each of seven risk characteristics (i.e., $\beta_{\mathrm{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW). At the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios based on the risk score. All stocks are then independently sorted in ascending order into three (Panel A) or five (Panel B) portfolios based on *Ownership rank*. Portfolios are value weighted and rebalanced every three months. The first row in Panel A reports the results for the quintile risk portfolios for all stocks. The last column in each panel shows the results for the strategies that buy the high-risk stocks and sell the low-risk stocks. Newey-West adjusted standard errors are shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) |
| Panel A: Five-by-three sort | | | | | | | |
| | All | 0.35*** | −0.05 | −0.05 | −0.14 | −0.29 | −0.63** |
| | | (0.08) | (0.09) | (0.13) | (0.19) | (0.24) | (0.28) |
| Ownership | Low | 0.28** | −0.19 | −0.27 | −0.33 | −0.67** | −0.96*** |
| | | (0.11) | (0.17) | (0.18) | (0.23) | (0.27) | (0.28) |
| | 2 | 0.20* | 0.12 | −0.02 | −0.26 | −0.36 | −0.56* |
| | | (0.11) | (0.15) | (0.18) | (0.21) | (0.28) | (0.32) |
| | High | 0.44*** | −0.18 | −0.06 | −0.07 | 0.11 | −0.34 |
| | | (0.10) | (0.12) | (0.15) | (0.27) | (0.28) | (0.29) |
| | High−Low | 0.16 | 0.02 | 0.21 | 0.25 | 0.78*** | 0.62** |
| | | (0.16) | (0.25) | (0.23) | (0.30) | (0.27) | (0.26) |
| Panel B: Five-by-five sort | | | | | | | |
| Ownership | Low | 0.41*** | 0.18 | −0.43** | −0.30 | −0.79*** | −1.21*** |
| | | (0.14) | (0.15) | (0.18) | (0.26) | (0.25) | (0.27) |
| | 2 | 0.12 | −0.12 | −0.07 | −0.38** | −0.69** | −0.81** |
| | | (0.14) | (0.18) | (0.21) | (0.19) | (0.30) | (0.36) |
| | 3 | 0.25** | −0.01 | −0.08 | 0.26 | −0.51* | −0.76** |
| | | (0.12) | (0.17) | (0.11) | (0.27) | (0.29) | (0.35) |
| | 4 | 0.47*** | 0.16 | −0.12 | −0.03 | −0.27 | −0.74** |
| | | (0.14) | (0.17) | (0.16) | (0.28) | (0.32) | (0.37) |
| | High | 0.34*** | 0.26** | 0.06 | −0.11 | −0.09 | −0.42 |
| | | (0.13) | (0.13) | (0.15) | (0.25) | (0.34) | (0.41) |
| | High−Low | −0.08 | 0.08 | 0.49** | 0.19 | 0.71** | 0.78** |
| | | (0.20) | (0.20) | (0.22) | (0.34) | (0.35) | (0.39) |

**Table 4. Alternative stock managerial ownership measures and low-risk anomalies**
The table shows the monthly CAPM alphas (in percent) of portfolios constructed from independent double portfolio sorts based on two alternative measures of managerial ownership and the composite risk score from January 2006 to December 2021. A stock's composite risk score is the arithmetic average of its ranking percentile for each of seven risk characteristics (i.e., $\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW). At the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios based on the risk score. All stocks are then independently sorted in ascending order into three portfolios based on either *Ownership indicator* (Panel A) and *LN(Ownership dollar)* (Panel B). Portfolios are value weighted and rebalanced every three months. The rows in each panel report the results for the risk portfolios at different levels of managerial ownership. The last column in each panel shows the results for the strategies that buy the high-risk stocks and sell the low-risk stocks. Newey-West adjusted standard errors are shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: Ownership indicator** | | | | | | | |
| Ownership | Low | 0.37*** | −0.03 | −0.20 | −0.32 | −0.68** | −1.05*** |
| | | (0.10) | (0.17) | (0.19) | (0.24) | (0.28) | (0.26) |
| | 2 | 0.23** | 0.00 | −0.01 | −0.23 | −0.20 | −0.43 |
| | | (0.10) | (0.14) | (0.15) | (0.20) | (0.29) | (0.32) |
| | High | 0.41*** | −0.13 | −0.03 | 0.00 | −0.15 | −0.56 |
| | | (0.12) | (0.14) | (0.17) | (0.28) | (0.33) | (0.34) |
| | High−Low | 0.04 | −0.10 | 0.17 | 0.32 | 0.53 | 0.49* |
| | | (0.15) | (0.25) | (0.22) | (0.35) | (0.33) | (0.29) |
| **Panel B: LN(Ownership dollar)** | | | | | | | |
| Ownership | Low | 0.29*** | −0.21 | −0.12 | −0.28 | −0.73*** | −1.02*** |
| | | (0.11) | (0.17) | (0.17) | (0.23) | (0.28) | (0.28) |
| | 2 | 0.22** | 0.02 | −0.09 | −0.31 | −0.27 | −0.48 |
| | | (0.11) | (0.15) | (0.17) | (0.19) | (0.29) | (0.32) |
| | High | 0.41*** | −0.07 | −0.05 | 0.02 | −0.04 | −0.45 |
| | | (0.11) | (0.13) | (0.14) | (0.29) | (0.30) | (0.30) |
| | High−Low | 0.12 | 0.15 | 0.07 | 0.29 | 0.69** | 0.57** |
| | | (0.15) | (0.24) | (0.22) | (0.33) | (0.29) | (0.26) |

**Table 5. Orthogonalized stock managerial ownership measures and low-risk anomalies**
The table shows the monthly CAPM alphas (in percent) of portfolios constructed from independent double portfolio sorts based on orthogonalized managerial ownership measures and the composite risk score from January 2006 to December 2021. A stock's composite risk score is the arithmetic average of its ranking percentile for each of seven risk characteristics (i.e., $\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW). Residual ownership measures are obtained by regressing *Ownership rank* on sets of stock characteristics. At the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios based on the risk score. All stocks are then independently sorted in ascending order into three portfolios based on orthogonalized managerial ownership measures. Panel A uses firm size, value, and momentum as the set of characteristics. Panel B adds asset growth and profitability to the previous set. Panel C adds mutual fund ownership, stock liquidity and mispricing score to the set in Panel B. Panel D adds mutual fund ownership, stock liquidity and anomaly net score to the set in Panel B. A stock's mispricing score is the arithmetic average of its ranking percentile for each of nine mispricing characteristics (i.e., including Momentum, Accruals, Asset growth, Composite equity issuance, Profitability, Investment, Net issuance, NOA and ROA, and excluding Distress and O-Score). A stock's anomaly net score is the difference in the number of times the stock belongs to the long and short legs based on 88 firm characteristics. Portfolios are value weighted and rebalanced every three months. The rows in each panel report the results for the risk portfolios at different levels of managerial ownership. The last column in each panel shows the results for the strategies that buy the high-risk stocks and sell the low-risk stocks. Newey-West adjusted standard errors are shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|
| | | | Panel A: Three characteristics | | | |
| Low | 0.22 | −0.47** | 0.22 | −0.25 | −0.84*** | −1.06*** |
| | (0.13) | (0.18) | (0.24) | (0.26) | (0.31) | (0.36) |
| 2 | 0.49*** | 0.15 | −0.18 | 0.03 | −0.05 | −0.55* |
| | (0.09) | (0.11) | (0.15) | (0.23) | (0.26) | (0.30) |
| High | 0.26** | 0.09 | −0.07 | −0.23 | 0.03 | −0.22 |
| | (0.12) | (0.12) | (0.17) | (0.24) | (0.32) | (0.33) |
| High−Low | 0.04 | 0.56** | −0.29 | 0.03 | 0.87*** | 0.83*** |
| | (0.16) | (0.23) | (0.21) | (0.31) | (0.29) | (0.31) |

*(Continued on next page)*

**Table** 5 (*continued*)

| | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|
| | | | Panel B: Five characteristics | | | |
| Low | 0.28** | −0.46** | 0.12 | −0.27 | −0.77** | −1.05*** |
| | (0.14) | (0.19) | (0.26) | (0.26) | (0.31) | (0.36) |
| 2 | 0.45*** | 0.17 | −0.09 | 0.08 | −0.03 | −0.48 |
| | (0.09) | (0.12) | (0.13) | (0.23) | (0.28) | (0.32) |
| High | 0.30*** | 0.02 | −0.12 | −0.25 | −0.02 | −0.32 |
| | (0.10) | (0.11) | (0.17) | (0.25) | (0.32) | (0.32) |
| High−Low | 0.02 | 0.48** | −0.25 | 0.03 | 0.75*** | 0.72** |
| | (0.16) | (0.23) | (0.22) | (0.31) | (0.26) | (0.30) |
| | | | Panel C: Seven characteristics + Mispricing score | | | |
| Low | 0.41*** | −0.42** | 0.01 | −0.30 | −0.47 | −0.88** |
| | (0.15) | (0.20) | (0.19) | (0.24) | (0.31) | (0.37) |
| 2 | 0.43*** | 0.06 | −0.06 | −0.05 | −0.26 | −0.68*** |
| | (0.10) | (0.13) | (0.15) | (0.21) | (0.22) | (0.26) |
| High | 0.23** | −0.01 | −0.03 | −0.02 | −0.05 | −0.27 |
| | (0.10) | (0.10) | (0.17) | (0.31) | (0.35) | (0.37) |
| High−Low | −0.18 | 0.41* | −0.04 | 0.28 | 0.43 | 0.60* |
| | (0.15) | (0.25) | (0.16) | (0.31) | (0.31) | (0.33) |
| | | | Panel D: Seven characteristics + Net score | | | |
| Low | 0.31** | −0.31* | 0.04 | −0.39 | −0.55* | −0.85** |
| | (0.14) | (0.18) | (0.20) | (0.25) | (0.31) | (0.36) |
| 2 | 0.44*** | 0.08 | −0.05 | −0.02 | −0.21 | −0.65** |
| | (0.10) | (0.13) | (0.14) | (0.21) | (0.23) | (0.26) |
| High | 0.26** | −0.07 | −0.04 | −0.05 | −0.02 | −0.28 |
| | (0.11) | (0.10) | (0.17) | (0.30) | (0.35) | (0.38) |
| High−Low | −0.05 | 0.24 | −0.08 | 0.34 | 0.52* | 0.57* |
| | (0.16) | (0.22) | (0.18) | (0.32) | (0.31) | (0.32) |

**Table 6. Stock managerial ownership, fund performance and low-risk anomalies**
The table shows the monthly CAPM alphas (in percent) of portfolios constructed from independent double portfolio sorts based on orthogonalized measures of managerial ownership to fund performance and the composite risk score from January 2006 to December 2021. A stock's composite risk score is the arithmetic average of its ranking percentile for each of seven risk characteristics (i.e., $\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW). Residual portfolio manager ownership is obtained by regressing *LN(Ownership dollar)* on funds' annual cumulative alpha with respect to the Fama-French five-factor model augmented with the momentum factor (Panel A), annual cumulative excess returns over fund's active benchmark (Panel B), annual cumulative excess returns over S&P500 index returns (Panel C), respectively. Stock-level orthogonalized ownership is then constructed based on the residual portfolio manager ownership. At the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios based on the risk score. All stocks are then independently sorted in ascending order into three portfolios based on orthogonalized managerial ownership measures. Portfolios are value weighted and rebalanced every three months. The rows in each panel report the results for the risk portfolios at different levels of managerial ownership. The last column in each panel shows the results for the strategies that buy the high-risk stocks and sell the low-risk stocks. Newey-West adjusted standard errors are shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: Six-factor alpha** | | | | | | | |
| Ownership | Low | 0.38*** | −0.17 | −0.25 | −0.29 | −0.67** | −1.05*** |
| | | (0.11) | (0.16) | (0.19) | (0.24) | (0.27) | (0.28) |
| | High | 0.45*** | −0.17 | 0.00 | 0.00 | −0.09 | −0.53 |
| | | (0.11) | (0.12) | (0.15) | (0.27) | (0.31) | (0.33) |
| | High−Low | 0.07 | 0.00 | 0.25 | 0.29 | 0.59** | 0.52** |
| | | (0.15) | (0.22) | (0.23) | (0.34) | (0.29) | (0.25) |
| **Panel B: Excess returns over active benchmark** | | | | | | | |
| Ownership | Low | 0.27** | −0.22 | −0.21 | −0.41* | −0.64** | −0.91*** |
| | | (0.12) | (0.17) | (0.17) | (0.23) | (0.27) | (0.28) |
| | High | 0.45*** | −0.08 | −0.03 | −0.05 | −0.04 | −0.49 |
| | | (0.10) | (0.12) | (0.16) | (0.26) | (0.31) | (0.33) |
| | High - Low | 0.18 | 0.14 | 0.18 | 0.36 | 0.60** | 0.42 |
| | | (0.18) | (0.23) | (0.23) | (0.33) | (0.28) | (0.27) |
| **Panel C: Excess returns over S&P500** | | | | | | | |
| Ownership | Low | 0.26** | −0.18 | −0.19 | −0.43* | −0.65** | −0.91*** |
| | | (0.11) | (0.16) | (0.17) | (0.23) | (0.27) | (0.27) |
| | High | 0.44*** | −0.09 | −0.02 | −0.05 | −0.06 | −0.50 |
| | | (0.10) | (0.12) | (0.16) | (0.26) | (0.31) | (0.32) |
| | High−Low | 0.18 | 0.10 | 0.17 | 0.39 | 0.59** | 0.42* |
| | | (0.16) | (0.23) | (0.21) | (0.33) | (0.28) | (0.25) |

**Table 7. Stock managerial ownership and style-beta anomalies**

The table shows the monthly Fama-French three-factor alphas (in percent) of portfolios constructed from independent double portfolio sorts based on orthogonalized *Ownership rank* and five beta measures from January 2006 to December 2021. The residual ownership measure is obtained by regressing *Ownership rank* on firm size, value, and momentum, mutual fund ownership, stock liquidity, mispricing score and anomaly net score. The benchmark to estimate stock beta is S&P500 (Panel A), Large Growth with Russell 1000 Growth (Panel B), Large Value with Russell 1000 Value (Panel C), Small Growth with Russell 2000 Growth (Panel D), and Small Value with Russell 2000 Value (Panel E). For each beta measure, at the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios. All stocks are then independently sorted in ascending order into three portfolios based on orthogonalized *Ownership rank*. Portfolios are value weighted and rebalanced every three months. The first row in each panel reports the results for the quintile risk portfolios for all stocks, and the subsequent rows report the results for the risk portfolios at the lowest and highest levels of managerial ownership. The last column in each panel shows the results for the strategies that buy the high-risk stocks and sell the low-risk stocks. Newey-West adjusted standard errors are shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | Panel A: $\beta_{\text{S\&P500}}$ | | | |
| | All | 0.33*** | 0.00 | 0.00 | −0.32 | −0.45 | −0.78* |
| | | (0.11) | (0.09) | (0.11) | (0.20) | (0.34) | (0.42) |
| Ownership | Low | 0.21 | 0.05 | −0.28 | −0.39 | −0.79** | −1.00** |
| | | (0.18) | (0.12) | (0.18) | (0.26) | (0.37) | (0.47) |
| | High | 0.36*** | 0.14 | −0.15 | −0.23 | −0.33 | −0.69* |
| | | (0.12) | (0.12) | (0.19) | (0.24) | (0.33) | (0.38) |
| | High−Low | 0.15 | 0.09 | 0.13 | 0.16 | 0.46* | 0.31 |
| | | (0.18) | (0.17) | (0.23) | (0.24) | (0.28) | (0.34) |
| | | | | Panel B: $\beta_{\text{Large Growth}}$ | | | |
| | All | 0.28*** | 0.00 | 0.00 | −0.46** | −0.34 | −0.62 |
| | | (0.11) | (0.10) | (0.07) | (0.19) | (0.33) | (0.40) |
| Ownership | Low | 0.19 | 0.21 | −0.19 | −0.49** | −0.62* | −0.80** |
| | | (0.13) | (0.15) | (0.13) | (0.20) | (0.34) | (0.39) |
| | High | 0.30*** | 0.14 | −0.05 | −0.44*** | −0.11 | −0.41 |
| | | (0.11) | (0.16) | (0.12) | (0.17) | (0.31) | (0.36) |
| | High−Low | 0.11 | −0.07 | 0.15 | 0.05 | 0.50** | 0.39 |
| | | (0.13) | (0.22) | (0.19) | (0.18) | (0.24) | (0.28) |

*(Continued on next page)*

**Table 7** (*continued*)

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | Panel C: $\beta_{\text{Large Value}}$ | | | |
| Ownership | All | 0.33*** | 0.08 | −0.03 | −0.35** | −0.61** | −0.94*** |
| | | (0.11) | (0.10) | (0.12) | (0.14) | (0.28) | (0.35) |
| | Low | 0.25 | 0.07 | −0.18 | −0.45*** | −0.80** | −1.04** |
| | | (0.16) | (0.15) | (0.14) | (0.16) | (0.34) | (0.42) |
| | High | 0.31*** | 0.05 | −0.07 | −0.22 | −0.58* | −0.88** |
| | | (0.11) | (0.13) | (0.16) | (0.17) | (0.31) | (0.34) |
| | High−Low | 0.06 | −0.02 | 0.11 | 0.23 | 0.22 | 0.16 |
| | | (0.19) | (0.22) | (0.18) | (0.23) | (0.33) | (0.34) |
| | | | | Panel D: $\beta_{\text{Small Growth}}$ | | | |
| Ownership | All | 0.26 | 0.35*** | −0.09 | −0.22 | −0.69** | −0.95** |
| | | (0.16) | (0.12) | (0.14) | (0.14) | (0.31) | (0.42) |
| | Low | 0.09 | 0.37 | −0.39 | −0.15 | −1.04** | −1.13** |
| | | (0.22) | (0.23) | (0.31) | (0.27) | (0.43) | (0.56) |
| | High | 0.19 | 0.34 | 0.19 | −0.46 | −0.32 | −0.51 |
| | | (0.25) | (0.21) | (0.35) | (0.32) | (0.55) | (0.56) |
| | High−Low | 0.10 | −0.03 | 0.58 | −0.31 | 0.72 | 0.62 |
| | | (0.32) | (0.34) | (0.49) | (0.44) | (0.52) | (0.62) |
| | | | | Panel E: $\beta_{\text{Small Value}}$ | | | |
| Ownership | All | 0.45*** | 0.10 | −0.11 | −0.47** | −0.71* | −1.16** |
| | | (0.17) | (0.11) | (0.16) | (0.20) | (0.37) | (0.47) |
| | Low | 0.37 | −0.34 | −0.60** | −0.68** | −0.84** | −1.21** |
| | | (0.25) | (0.22) | (0.28) | (0.30) | (0.43) | (0.56) |
| | High | 0.23 | 0.17 | 0.21 | −0.30 | −0.45 | −0.69 |
| | | (0.20) | (0.23) | (0.31) | (0.36) | (0.45) | (0.54) |
| | High - Low | −0.13 | 0.52 | 0.81** | 0.38 | 0.39 | 0.52 |
| | | (0.26) | (0.35) | (0.40) | (0.40) | (0.47) | (0.52) |

**Table 8. Stock managerial ownership and mispricing anomalies**

The table shows the monthly CAPM alphas (in percent) of portfolios constructed from independent double portfolio sorts based on *Ownership rank* and firm characteristics from January 2006 to December 2021. The characteristics include nine mispricing characteristics, the composite mispricing score and the anomaly net score. A stock's mispricing score is the arithmetic average of its ranking percentile for each of nine mispricing characteristics (i.e., including Momentum, Accruals, Asset growth, Composite equity issuance, Profitability, Investment, Net issuance, NOA and ROA, and excluding Distress and O-Score). A stock's anomaly net score is the difference in the number of times the stock belongs to the long and short legs based on 88 firm characteristics. For each characteristic, at the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios based on the characteristic. All stocks are then independently sorted in ascending order into three portfolios based on *Ownership rank*. Portfolios are value weighted and rebalanced every three months. Panel A, B, and C report the results for nine mispricing characteristics, the mispricing score and the anomaly net score, respectively. The first row in each panel reports the results for the quintile portfolios for all stocks, and the subsequent rows report the results for the portfolios at the two extreme levels of managerial ownership for brevity. The last column in each panel shows the results for the strategies that buy the stocks in the highest quintile portfolio and sell the stocks in the lowest quintile portfolio. Newey-West adjusted standard errors are shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | Panel A: Individual mispricing anomaly | | | |
| | | | | *12-month momentum* | | | |
| | All | −0.14 | 0.20 | 0.26** | 0.21** | 0.07 | 0.21 |
| | | (0.28) | (0.19) | (0.11) | (0.10) | (0.18) | (0.39) |
| Ownership | Low | −0.14 | 0.01 | 0.28 | 0.26* | −0.10 | 0.04 |
| | | (0.35) | (0.26) | (0.19) | (0.16) | (0.19) | (0.42) |
| | High | −0.41 | 0.18 | 0.11 | 0.21 | 0.06 | 0.47 |
| | | (0.33) | (0.15) | (0.14) | (0.14) | (0.27) | (0.53) |
| | High−Low | −0.27 | 0.17 | −0.17 | −0.05 | 0.16 | 0.43 |
| | | (0.24) | (0.25) | (0.21) | (0.19) | (0.30) | (0.43) |
| | | | | *Accruals* | | | |
| | All | 0.08 | 0.25** | 0.22*** | 0.01 | 0.07 | −0.01 |
| | | (0.13) | (0.11) | (0.08) | (0.10) | (0.11) | (0.13) |
| Ownership | Low | −0.13 | −0.04 | 0.25 | 0.06 | −0.26 | −0.13 |
| | | (0.22) | (0.16) | (0.18) | (0.16) | (0.19) | (0.22) |
| | High | −0.21 | 0.21 | 0.17 | 0.10 | 0.05 | 0.26 |
| | | (0.22) | (0.16) | (0.13) | (0.19) | (0.15) | (0.23) |
| | High−Low | −0.08 | 0.24 | −0.08 | 0.04 | 0.31 | 0.40 |
| | | (0.31) | (0.25) | (0.22) | (0.23) | (0.26) | (0.30) |

*(Continued on next page)*

**Table 8** (*continued*)

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | *Asset growth* | | | |
| | All | 0.16 | 0.02 | 0.16* | 0.07 | 0.26* | 0.10 |
| | | (0.10) | (0.09) | (0.10) | (0.10) | (0.15) | (0.17) |
| Ownership | Low | 0.11 | −0.18 | 0.18 | −0.12 | 0.07 | −0.04 |
| | | (0.14) | (0.22) | (0.20) | (0.17) | (0.19) | (0.20) |
| | High | −0.07 | 0.15 | 0.06 | 0.16 | 0.13 | 0.20 |
| | | (0.21) | (0.15) | (0.12) | (0.15) | (0.18) | (0.30) |
| | High−Low | −0.18 | 0.33 | −0.12 | 0.28 | 0.06 | 0.24 |
| | | (0.20) | (0.29) | (0.23) | (0.19) | (0.27) | (0.33) |
| | | | | *Composite equity issuance* | | | |
| | All | 0.11 | 0.15 | 0.19* | 0.10 | 0.16 | 0.04 |
| | | (0.20) | (0.12) | (0.11) | (0.11) | (0.14) | (0.23) |
| Ownership | Low | 0.30 | 0.00 | 0.00 | −0.10 | −0.06 | −0.36 |
| | | (0.27) | (0.16) | (0.20) | (0.15) | (0.18) | (0.29) |
| | High | 0.06 | 0.31* | 0.12 | −0.11 | 0.03 | −0.03 |
| | | (0.27) | (0.16) | (0.10) | (0.11) | (0.21) | (0.30) |
| | High−Low | −0.24 | 0.31 | 0.13 | −0.01 | 0.10 | 0.33 |
| | | (0.29) | (0.23) | (0.19) | (0.18) | (0.27) | (0.38) |
| | | | | *Gross profitability* | | | |
| | All | −0.43** | −0.03 | 0.20** | 0.32*** | 0.35** | 0.78*** |
| | | (0.18) | (0.12) | (0.08) | (0.10) | (0.14) | (0.28) |
| Ownership | Low | −0.52** | −0.22 | 0.20 | 0.24* | 0.30* | 0.82*** |
| | | (0.23) | (0.18) | (0.16) | (0.13) | (0.17) | (0.29) |
| | High | −0.50* | 0.15 | −0.18 | 0.32*** | 0.40** | 0.90** |
| | | (0.26) | (0.18) | (0.20) | (0.12) | (0.16) | (0.35) |
| | High−Low | 0.03 | 0.37 | −0.38 | 0.07 | 0.10 | 0.08 |
| | | (0.26) | (0.26) | (0.30) | (0.18) | (0.21) | (0.34) |

*(Continued on next page)*

**Table 8** (*continued*)

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | *Investment* | | | |
| Ownership | All | −0.06 | 0.13 | 0.02 | 0.48*** | −0.05 | 0.01 |
| | | (0.11) | (0.09) | (0.08) | (0.13) | (0.16) | (0.21) |
| | Low | −0.14 | 0.11 | 0.05 | −0.02 | −0.60*** | −0.46** |
| | | (0.15) | (0.18) | (0.16) | (0.15) | (0.22) | (0.23) |
| | High | 0.12 | 0.14 | 0.08 | 0.31* | −0.17 | −0.29 |
| | | (0.16) | (0.14) | (0.16) | (0.18) | (0.30) | (0.34) |
| | High−Low | 0.26 | 0.03 | 0.03 | 0.32 | 0.43 | 0.18 |
| | | (0.19) | (0.20) | (0.24) | (0.22) | (0.29) | (0.37) |
| | | | | *Net issuance* | | | |
| Ownership | All | 0.24*** | 0.19** | 0.00 | 0.14 | 0.05 | −0.19 |
| | | (0.08) | (0.09) | (0.11) | (0.15) | (0.20) | (0.23) |
| | Low | 0.02 | 0.25* | −0.25 | 0.05 | 0.06 | 0.04 |
| | | (0.15) | (0.14) | (0.26) | (0.20) | (0.22) | (0.29) |
| | High | 0.19 | 0.10 | −0.14 | 0.07 | 0.19 | −0.01 |
| | | (0.15) | (0.13) | (0.15) | (0.19) | (0.27) | (0.34) |
| | High−Low | 0.17 | −0.15 | 0.11 | 0.02 | 0.12 | −0.05 |
| | | (0.21) | (0.19) | (0.31) | (0.26) | (0.31) | (0.42) |
| | | | | *Net operating assets* | | | |
| Ownership | All | 0.34*** | 0.21** | 0.00 | 0.02 | −0.22* | −0.56*** |
| | | (0.11) | (0.09) | (0.10) | (0.11) | (0.12) | (0.17) |
| | Low | 0.16 | 0.15 | −0.15 | −0.07 | −0.22 | −0.38 |
| | | (0.16) | (0.13) | (0.24) | (0.20) | (0.18) | (0.23) |
| | High | 0.27 | 0.25 | 0.12 | −0.10 | −0.20 | −0.48** |
| | | (0.17) | (0.20) | (0.20) | (0.16) | (0.18) | (0.23) |
| | High−Low | 0.11 | 0.10 | 0.27 | −0.03 | 0.02 | −0.09 |
| | | (0.23) | (0.23) | (0.38) | (0.20) | (0.22) | (0.29) |

*(Continued on next page)*

**Table 8** (*continued*)

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | *Return on assets* | | | | | |
| Ownership | All | −0.35** | 0.03 | 0.17 | 0.10 | 0.30*** | 0.65*** |
| | | (0.17) | (0.12) | (0.10) | (0.08) | (0.11) | (0.24) |
| | Low | −0.23 | −0.17 | 0.13 | −0.03 | 0.22 | 0.45 |
| | | (0.24) | (0.26) | (0.13) | (0.17) | (0.13) | (0.30) |
| | High | −0.45* | 0.14 | −0.07 | 0.21 | 0.35** | 0.80*** |
| | | (0.24) | (0.21) | (0.14) | (0.14) | (0.15) | (0.30) |
| | High−Low | −0.21 | 0.31 | −0.20 | 0.24 | 0.13 | 0.35 |
| | | (0.29) | (0.37) | (0.18) | (0.21) | (0.20) | (0.37) |
| | | Panel B: Mispricing score | | | | | |
| Ownership | All | 0.31*** | 0.20** | 0.14 | 0.05 | −0.19 | −0.50** |
| | | (0.11) | (0.09) | (0.11) | (0.11) | (0.15) | (0.21) |
| | Low | 0.31* | 0.07 | −0.29 | 0.08 | −0.26 | −0.57** |
| | | (0.16) | (0.15) | (0.24) | (0.22) | (0.21) | (0.27) |
| | High | 0.16 | 0.20 | 0.19 | 0.15 | −0.28 | −0.45* |
| | | (0.14) | (0.13) | (0.15) | (0.17) | (0.21) | (0.27) |
| | High−Low | −0.15 | 0.13 | 0.48 | 0.07 | −0.02 | 0.12 |
| | | (0.22) | (0.20) | (0.31) | (0.26) | (0.23) | (0.34) |
| | | Panel C: Net score | | | | | |
| Ownership | All | −0.09 | 0.21** | 0.27*** | 0.22** | 0.31** | 0.40* |
| | | (0.14) | (0.10) | (0.07) | (0.09) | (0.12) | (0.23) |
| | Low | −0.36 | 0.04 | 0.12 | 0.15 | 0.13 | 0.49 |
| | | (0.23) | (0.19) | (0.14) | (0.15) | (0.17) | (0.30) |
| | High | −0.22 | 0.06 | 0.14 | 0.13 | 0.20 | 0.43 |
| | | (0.21) | (0.19) | (0.13) | (0.16) | (0.16) | (0.26) |
| | High−Low | 0.13 | 0.02 | 0.02 | −0.02 | 0.07 | −0.06 |
| | | (0.29) | (0.29) | (0.18) | (0.19) | (0.21) | (0.36) |

**Table 9. Stock managerial ownership and the factor zoo**

The table summarizes the monthly CAPM alphas (in percent) of portfolios constructed from independent double portfolio sorts based on *Ownership rank* and 88 firm (orthogonalized) characteristics from January 2006 to December 2021. For each characteristic, at the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios based on the characteristic. All stocks are then independently sorted in ascending order into three portfolios based on *Ownership rank*. Portfolios are value weighted and rebalanced every three months. The panel reports the average CAPM alpha across all portfolios. Panel A (B) report the results for 35 (53) anomaly portfolios in which the the long leg is the lowest (highest) quintile portfolio. For brevity, the results are only shown for the extreme portfolios. Columns (1)-(3) show the results for the original characteristics. Columns (4)-(5) show the results for the orthogonalized characteristics, which are obtained each period as residuals from the regressions of each characteristic on the risk score. The first row in each panel reports the results for the extreme portfolios for all stocks, and the subsequent rows report the results for the portfolios at the two extreme levels of managerial ownership. Columns (3) and (6) in each panel shows the results for the strategies that buy the stocks in the highest quintile portfolio and sell the stocks in the lowest quintile portfolio. Newey-West adjusted $t$-statistics are shown in square brackets.

| | | Low | High | High−Low | Low | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: Short-Long anomalies** | | | | | | | |
| | | Original | | | Orthogonalized | | |
| Ownership | All | −0.01 | 0.08 | 0.09 | 0.05 | 0.11 | 0.07 |
| | | [0.32] | [0.80] | [0.25] | [0.44] | [0.99] | [0.23] |
| | Low | −0.22 | −0.26 | −0.04 | −0.17 | −0.11 | 0.07 |
| | | [−1.04] | [−1.32] | [−0.17] | [−0.83] | [−0.54] | [0.32] |
| | High | 0.05 | 0.15 | 0.10 | 0.10 | 0.16 | 0.06 |
| | | [0.52] | [0.93] | [0.29] | [0.69] | [0.92] | [0.15] |
| | High−Low | 0.27 | 0.41 | 0.14 | 0.27 | 0.27 | 0.00 |
| | | [1.26] | [1.60] | [0.37] | [1.34] | [0.96] | [−0.06] |
| **Panel B: Long-Short anomalies** | | | | | | | |
| | | Original | | | Orthogonalized | | |
| Ownership | All | −0.05 | 0.11 | 0.16 | 0.02 | 0.08 | 0.05 |
| | | [−0.11] | [1.18] | [0.78] | [0.48] | [0.79] | [0.26] |
| | Low | −0.31 | −0.16 | 0.15 | −0.13 | −0.08 | 0.05 |
| | | [−1.48] | [−0.82] | [0.56] | [−0.44] | [−0.31] | [0.13] |
| | High | 0.00 | 0.18 | 0.17 | 0.04 | 0.11 | 0.07 |
| | | [0.19] | [1.22] | [0.68] | [0.42] | [0.76] | [0.32] |
| | High−Low | 0.32 | 0.34 | 0.02 | 0.18 | 0.19 | 0.02 |
| | | [1.40] | [1.52] | [0.06] | [0.62] | [0.73] | [0.12] |

**Table 10. Stock managerial ownership and portfolio tilt**

The table presents the results from the tests of portfolio tilt toward high-risk stocks. Each active mutual fund is classified into four groups based on fund-level *Ownership rank*, in which the last group contains funds whose *Ownership rank* is 6 and 7 (i.e., ownership is greater than \$500,000). Portfolio holdings are then aggregated to the group level to construct a stacked panel at the group-stock level. The dependent variable is the deviation of each holding from its market weight and the stacked panel regression is

$$\omega_{p,i,t} - \omega_{i,t}^{\text{mkt}} = \gamma_{j,t-1} \times \text{Char}_{i,t-1} + \delta_{j,t} \times \text{Char}_{i,t} \times \text{Ownership}_{p,t-1} + \text{Ownership}_{p,t-1} + \lambda_{k,t} + \varepsilon_{p,i,t-1},$$

where $\text{Ownership}_{p,t-1}$ is an indicator equal to 1 for the highest portfolio group $p$ and 0 otherwise. $\lambda_{k,t}$ is the industry by time fixed effects. $Char$ is the risk score (Columns (1) and (4)), $\beta_{\text{mkt}}$ (Columns (2) and (5)) and the mispricing score (Columns (3) and (6)), respectively. A stock's composite risk score is the arithmetic average of its ranking percentile for each of seven risk characteristics (i.e., $\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW). A stock's mispricing score is the arithmetic average of its ranking percentile for each of nine mispricing characteristics (i.e., including Momentum, Accruals, Asset growth, Composite equity issuance, Profitability, Investment, Net issuance, NOA and ROA, and excluding Distress and O-Score). Panel A reports the results using panel regressions that include industry by time fixed effects, and standard errors are double clustered at the stock and time level and shown in brackets. Panel B reports the results using Fama-MacBeth regressions, and standard errors are Newey-West adjusted and shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively. The sample period is from 2006Q1 to 2021Q4.

| | Dependent variable: $\omega_{p,i,t} - \omega_{i,t}^{\text{mkt}}$ | | | | | |
|---|---|---|---|---|---|---|
| | Panel A: Panel regressions | | | Panel B: Fama-MacBeth regressions | | |
| | (1) | (2) | (3) | (1) | (2) | (3) |
| Risk score$_{i,t-1}$ | 0.117$^{***}$ | | | 0.114$^{***}$ | | |
| | (0.026) | | | (0.009) | | |
| Risk score$_{i,t-1}$ × Ownership$_{p,t-1}$ | −0.065$^{***}$ | | | −0.066$^{***}$ | | |
| | (0.016) | | | (0.008) | | |
| $\beta_{i,t-1}^{mkt}$ | | 0.091$^{***}$ | | | 0.094$^{***}$ | |
| | | (0.022) | | | (0.006) | |
| $\beta_{i,t-1}^{mkt}$ × Ownership$_{p,t-1}$ | | −0.049$^{***}$ | | | −0.052$^{***}$ | |
| | | (0.012) | | | (0.007) | |
| Mispricing score$_{i,t-1}$ | | | 0.045$^{***}$ | | | 0.039$^{***}$ |
| | | | (0.012) | | | (0.004) |
| Mispricing score$_{i,t-1}$ × Ownership$_{p,t-1}$ | | | −0.003 | | | −0.003 |
| | | | (0.011) | | | (0.004) |
| Ownership$_{p,t-1}$ | 0.001 | 0.001 | 0.001 | −0.001 | −0.001 | 0.001 |
| | (0.016) | (0.016) | (0.016) | (0.003) | (0.003) | (0.003) |
| Industry × Time FE | ✓ | ✓ | ✓ | | | |
| # obs. (Avg. # obs./quarter) | 297,968 | 297,968 | 297,968 | 4,729 | 4,729 | 4,729 |
| R-squared (Avg. R-squared) | 0.05 | 0.05 | 0.06 | 0.01 | 0.01 | 0.01 |

**Table 11. Fund-level managerial ownership and portfolio tilt**

The table presents the results from the tests of fund-level portfolio tilt toward high-risk stocks. For each year, I estimate each fund's tilt toward high-risk stocks using the regression

$$\omega_{j,i,t+1} - \omega_{i,t+1}^{\text{mkt}} = \gamma_{j,t} \times \text{Risk score}_{i,t} + \lambda_{t+1} + \varepsilon_{j,i,t+1}, \tag{3}$$

where $\omega_{j,i,t+1} - \omega_{\text{mkt},i,t+1}$ is the deviation of fund $j$ for stock $i$ from its market weight, and $\lambda_{t+1}$ is the quarter fixed effects. A stock's composite risk score is the arithmetic average of its ranking percentile for each of seven risk characteristics (i.e., $\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW). I then regress the estimated $\gamma_{j,t}$ on three measures of portfolio manager ownership: *Ownership rank* is the ownership rank from one to seven used by the SEC (Columns (1) and (2)), *Ownership indicator* is an indicator equal to 1 if managers have ownership in the fund and 0 otherwise (Columns (3) and (4)), and *LN(Ownership dollar)* is the natural logarithm of the total dollar amount of ownership (Columns (5) and (6)). Control variables include fund size, past performance, past flow, fund age, expense ratio, turnover ratio, family size, fund activeness, and funds' stock characteristics that include size, value, and momentum. The regressions include style by year fixed effects and family fixed effects. Standard errors are clustered at the fund level and shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively. The sample period is from 2006 to 2021.

| | Dependent variable: $\hat{\gamma}_{j,t}$ | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Ownership rank$_{j,t-1}$ | −0.019*** | −0.012* | | | | |
| | (0.007) | (0.007) | | | | |
| Ownership indicator$_{j,t-1}$ | | | −0.086*** | −0.063** | | |
| | | | (0.030) | (0.031) | | |
| LN(Ownership dollar)$_{j,t-1}$ | | | | | −0.042*** | −0.029** |
| | | | | | (0.014) | (0.015) |
| Controls | | ✓ | | ✓ | | ✓ |
| Style x Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Family FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| # obs. | 17,960 | 17,960 | 17,960 | 17,960 | 17,960 | 17,960 |
| Adjusted R-squared | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 |

**Table 12. Fund-level managerial ownership and portfolio tilt in bad times**
The table tests the mechanism of portfolio manager ownership on the tilt toward high-risk stocks. For each year, I estimate each fund's tilt toward high-risk stocks using the regression

$$\omega_{j,i,t+1} - \omega^{\text{mkt}}_{i,t+1} = \gamma_{j,t} \times \text{Risk score}_{i,t} + \lambda_{t+1} + \varepsilon_{j,i,t+1}, \tag{4}$$

where $\omega_{j,i,t+1} - \omega_{\text{mkt},i,t+1}$ is the deviation of fund $j$ for stock $i$ from its market weight, and $\lambda_{t+1}$ is the year fixed effects. A stock's composite risk score is the arithmetic average of its ranking percentile for each of seven risk characteristics (i.e., $\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW). I then regress the estimated $\gamma_{j,t}$ on three measures of portfolio manager ownership: *Ownership rank* is the ownership rank from one to seven used by the SEC (Columns (1) and (4)), *Ownership indicator* is an indicator equal to 1 if managers have ownership in the fund and 0 otherwise (Columns (2) and (5)), and *LN(Ownership dollar)* is the natural logarithm of the total dollar amount of ownership (Columns (3) and (6)). The regressions include variables that indicate bad economic times and their interaction with the ownership variables. Panel A reports the results in which the bad times are *Pessimistic market*, which is an indicator equal to 1 for years that the cumulative 12-month market return is in the lowest tercile of the sample period. Panel B uses *Volatile market*, which is equal to 1 for years that the annualized market volatility is in the highest tercile of the sample period. The table also reports the difference between the interacted coefficient estimates in the bad times and other times and $p$-value associated with the $F$-test of the difference. Control variables include fund size, past performance, past flow, fund age, expense ratio, turnover ratio, family size, fund activeness, and funds' stock characteristics that include size, value, and momentum. The regressions include style by year fixed effects and family fixed effects. Standard errors are clustered at the fund level and shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively. The sample period is from 2006 to 2021.

| | Dependent variable: $\hat{\gamma}_{j,t}$ | | | | | |
|---|---|---|---|---|---|---|
| | Panel A: Pessimistic market | | | Panel B: Volatile market | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Ownership rank × Bad times | −0.027*** | | | −0.020** | | |
| | (0.008) | | | (0.008) | | |
| Ownership rank × Other times | −0.004 | | | −0.006 | | |
| | (0.007) | | | (0.007) | | |
| Ownership indicator × Bad times | | −0.112*** | | | −0.093** | |
| | | (0.035) | | | (0.036) | |
| Ownership indicator × Other times | | −0.036 | | | −0.042 | |
| | | (0.031) | | | (0.033) | |
| LN(Ownership dollar) × Bad times | | | −0.057*** | | | −0.045*** |
| | | | (0.017) | | | (0.017) |
| LN(Ownership dollar) × Other times | | | −0.015 | | | −0.019 |
| | | | (0.015) | | | (0.016) |
| Difference | −0.023 | −0.077 | −0.042 | −0.014 | −0.051 | −0.027 |
| $p$-value ($F$-test) | 0.000 | 0.002 | 0.000 | 0.063 | 0.129 | 0.091 |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Style x Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Family FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| # obs. | 17,960 | 17,960 | 17,960 | 17,960 | 17,960 | 17,960 |
| Adjusted R-squared | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |

# Appendix

**Table A1. Construction of low-risk characteristics**
The table describes the construction of seven firm low-risk characteristics (i.e., $\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW) and the composite risk score.

| No. | Characteristic | Construction detail |
|---|---|---|
| 1 | Market beta ($\beta$) | Similar to Fama and French (1992) and Liu et al. (2018), I estimate a stock's beta each month by regressing the stock's monthly excess return on the contemporaneous and the lagged market excess return over the most recent 60-month moving window, requiring at least 36 months of non-missing data. $\beta_{\text{mkt}}$ is the sum of the two slope coefficients from the regression (Dimson, 1979).<br><br>I also estimate a stock's beta using four alternative estimation approaches. The first approach uses the prior estimate but adopts the shrinking procedure following Liu et al. (2018) (Monthly 5-year shrunk). The second approach follows Hong and Sraer (2016) and uses a one-year window with daily returns that include five lags of the daily market return, applying the Dimson summed-coefficients method (Daily 1-year). The third approach uses the previous estimate but follows Cederburg and O'Doherty (2016) to add the constraint that coefficients on the three least recent lagged market returns are equal (Daily 1-year constrained). The last approach follows Frazzini and Pedersen (2014) and estimates beta by separately estimating correlation and volatilities (Frazzini and Pedersen). |
| 2 | Idiosyncratic risk ($IVOL$) | Following Ang, Hodrick, et al. (2006), I estimate a stock's idiosyncratic risk each month as the standard deviation of residuals from Fama-French three-factor regressions using the past month of daily data. |
| 3 | Distress risk ($DISTRESS$) | Following Campbell et al. (2008), I estimate a stock's bankruptcy probability using the equation<br><br>$-9.16 - .058 \times \text{PRICE} + .075 \times \text{MB} - 2.13 \times \text{CASHMTA} - .045 \times \text{RSIZE}$<br>$+1.41 \times \text{SIGMA} - 7.13 \times \text{EXRETAVG} + 1.42 \times \text{TLMTA} - 20.26 \times \text{NIMTAAVG},$<br><br>where PRICE is the stock price, MB is the stock's market-to-book ratio, CASHMTA is the stock's cash equivalents to market value of total assets, RSIZE is the relative size of each firm measured as the log ratio of its market capitalization to that of the S&P 500 index, SIGMA is the firm's idiosyncratic risk, EXRETAVG is the geometric mean of the monthly log excess return relative to the S&P 500 index, TLMTA is the total liabilities over market value of total assets, and NIMTAAVG is the geometric mean of net income over market value of total assets. All variables are winsorized at the 5th and 95th percentile. |

*(Continued on next page)*

**Table A1** (*continued*)

| No. | Characteristic | Construction detail |
|---|---|---|
| 4 | O-Score (*OSCORE*) | Following Dichev (1998), I estimate a stock's O-Score using the equation $$-1.32 - .407 \times \text{LN(AT/GNP)} + 6.03 \times \text{(LT/AT)} - 1.43 \times \text{((ACT - LCT)/AT)}$$ $$+.076 \times \text{(LCT/ACT)} - 1.72 \times \text{I(LT} > \text{AT)} - 2.37 \times \text{(IB/AT)} - 1.83 \times \text{(FFO/LT)}$$ $$+.285 \times \text{I}(\text{IB} + \text{IB}_{t-1} + \text{IB}_{t-2} < 0) - .521 \times ((\text{IB} - \text{IB}_{t-1})/(\lvert\text{IB}\rvert + \lvert\text{IB}_{t-1}\rvert)).$$ where I(AT/GNP) is natural logarithm of total assets adjusted for GNP, LT/AT is the total liabilities over total assets, (ACT - LCT)/AT is the working capital over total assets, LCT/ACT is current liabilities over current assets, I(LT $>$ AT) is an indicator equal to 1 if total liabilities are greater than total assets, IB/AT is the net income over total assets, FFO/LT is the funds from operations over total liabilities, $\text{I}(\text{IB} + \text{IB}_{t-12} + \text{IB}_{t-24} < 0)$ is an indicator equal to 1 if past two-year net income is negative, and $(\text{IB} - \text{IB}_{t-1})/(\lvert\text{IB}\rvert + \lvert\text{IB}_{t-1}\rvert)$ is change in net income over the average of absolute net income over the past two years. |
| 5 | Maximum return (*MAX*) | I follow Bali et al. (2011) and estimate $MAX$ as the maximum of daily returns over the previous month. |
| 6 | Skewness (*SKEW*) | I follow Bali et al. (2016) and estimate skewness as the third moment of the residuals obtained from regression of daily excess returns on Fama-French three factors over the previous month. |
| 7 | Coskewness (*COSKEW*) | Similar to Harvey and Siddique (2000) and Ang, Chen, and Xing (2006), I estimate a stock's coskewness using the sample counterpart to $E[\epsilon_{it}\epsilon^2_{\text{mkt}}]/(\sqrt{E[\epsilon^2_{it}]}E[\epsilon^2_{\text{mkt}}])$, where $\epsilon_{it}$ the residual from the regression of the excess return on the contemporaneous monthly market excess return and $\epsilon_{\text{mkt}}$ is the deviation of the excess market return from its mean. I use the returns in the recent 60 months, requiring at least 36 months of non-missing data. |
| 8 | Risk score (*RISK SCORE*) | For each of the seven characteristics above, I sort all the stocks in ascending order and assign a percentile rank to each stock (i.e., stocks with higher characteristic receive higher rank). A stock's composite risk score is the arithmetic average of its ranks across seven risk characteristics. |

**Table A2. Correlations among low-risk strategies**

The table reports the correlations among low-risk strategies from January 2006 to December 2021. For each of seven low-risk characteristics (i.e., $\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW), at the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios based on the characteristic. Portfolios are then value weighted and rebalanced every three months. A low-risk strategy buys the stocks in the lowest quintile portfolio and sell the stocks in the highest quintile portfolio.

| | $\beta_{\text{mkt}}$ | IVOL | Distress | O-Score | MAX | COSKEW | SKEW |
|---|---|---|---|---|---|---|---|
| $\beta_{\text{mkt}}$ | 1.00 | | | | | | |
| IVOL | 0.93 | 1.00 | | | | | |
| Distress | 0.94 | 0.97 | 1.00 | | | | |
| O-Score | 0.93 | 0.93 | 0.93 | 1.00 | | | |
| MAX | 0.94 | 0.97 | 0.97 | 0.93 | 1.00 | | |
| COSKEW | 0.88 | 0.86 | 0.88 | 0.89 | 0.88 | 1.00 | |
| SKEW | 0.90 | 0.88 | 0.88 | 0.93 | 0.90 | 0.90 | 1.00 |

**Table A3. Stock managerial ownership and low-risk anomalies: Five-by-five portfolio sorts**

The table repeats the baseline tests from Table 2 but adopts five-by-five portfolio sorts for *Ownership rank* and each of seven risk characteristics ($\beta_{\mathrm{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW) from January 2006 to December 2021. For each characteristic, at the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios based on the characteristic. All stocks are then independently sorted in ascending order into quintile portfolios based on *Ownership rank*. Portfolios are value weighted and rebalanced every three months. The first two rows in each panel report the results for the risk portfolios at the lowest and highest managerial ownership for brevity. The last column in each panel shows the results for the strategies that buy the high-risk stocks and sell the low-risk stocks. Newey-West adjusted standard errors are shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | $\beta_{\mathrm{mkt}}$ | | | |
| Ownership | Low | 0.42*** | 0.05 | −0.48** | −0.33 | −0.66** | −1.09*** |
| | | (0.15) | (0.16) | (0.22) | (0.22) | (0.29) | (0.30) |
| | High | 0.33** | 0.15 | 0.13 | 0.05 | 0.08 | −0.24 |
| | | (0.13) | (0.13) | (0.14) | (0.23) | (0.33) | (0.39) |
| | High−Low | −0.09 | 0.09 | 0.61** | 0.38 | 0.75** | 0.84** |
| | | (0.20) | (0.20) | (0.27) | (0.27) | (0.30) | (0.33) |
| | | | | *IVOL* | | | |
| Ownership | Low | 0.41** | 0.23 | −0.17 | −0.55** | −0.80*** | −1.22*** |
| | | (0.18) | (0.15) | (0.18) | (0.21) | (0.31) | (0.29) |
| | High | 0.34*** | 0.12 | −0.15 | −0.05 | 0.01 | −0.33 |
| | | (0.11) | (0.12) | (0.15) | (0.17) | (0.35) | (0.36) |
| | High−Low | −0.07 | −0.11 | 0.01 | 0.50** | 0.82** | 0.89** |
| | | (0.23) | (0.18) | (0.23) | (0.24) | (0.35) | (0.35) |
| | | | | *Distress* | | | |
| Ownership | Low | 0.39** | 0.06 | −0.24 | −0.60** | −0.63** | −1.02*** |
| | | (0.16) | (0.16) | (0.19) | (0.24) | (0.30) | (0.33) |
| | High | 0.29*** | 0.13 | 0.06 | −0.05 | −0.23 | −0.53 |
| | | (0.10) | (0.16) | (0.19) | (0.30) | (0.31) | (0.33) |
| | High−Low | −0.10 | 0.07 | 0.30 | 0.55 | 0.40 | 0.50 |
| | | (0.20) | (0.21) | (0.24) | (0.34) | (0.32) | (0.38) |

*(Continued on next page)*

**Table A3** (*continued*)

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | *O-Score* | | | |
| Ownership | Low | −0.04 | −0.13 | −0.22 | 0.02 | −0.28 | −0.24 |
| | | (0.21) | (0.21) | (0.22) | (0.18) | (0.23) | (0.26) |
| | High | 0.25* | −0.02 | 0.28** | 0.33 | −0.04 | −0.29 |
| | | (0.13) | (0.17) | (0.12) | (0.20) | (0.21) | (0.27) |
| | High−Low | 0.28 | 0.11 | 0.50** | 0.31 | 0.24 | −0.04 |
| | | (0.24) | (0.29) | (0.20) | (0.28) | (0.29) | (0.34) |
| | | | | *MAX* | | | |
| Ownership | Low | 0.35** | 0.14 | −0.36** | −0.25 | −0.80*** | −1.15*** |
| | | (0.15) | (0.17) | (0.18) | (0.22) | (0.27) | (0.27) |
| | High | 0.41*** | 0.18 | 0.00 | −0.13 | 0.15 | −0.26 |
| | | (0.11) | (0.14) | (0.17) | (0.18) | (0.25) | (0.26) |
| | High−Low | 0.06 | 0.04 | 0.37 | 0.13 | 0.96*** | 0.90*** |
| | | (0.20) | (0.25) | (0.25) | (0.27) | (0.30) | (0.26) |
| | | | | *SKEW* | | | |
| Ownership | Low | −0.11 | −0.14 | −0.06 | −0.24 | −0.31 | −0.20 |
| | | (0.20) | (0.17) | (0.19) | (0.20) | (0.21) | (0.22) |
| | High | 0.03 | 0.12 | 0.06 | 0.21 | 0.15 | 0.12 |
| | | (0.15) | (0.15) | (0.13) | (0.18) | (0.17) | (0.21) |
| | High−Low | 0.14 | 0.26 | 0.12 | 0.45* | 0.46 | 0.32 |
| | | (0.24) | (0.25) | (0.22) | (0.27) | (0.29) | (0.33) |
| | | | | *COSKEW* | | | |
| Ownership | Low | −0.10 | −0.10 | 0.10 | −0.19 | −0.53** | −0.43 |
| | | (0.25) | (0.18) | (0.21) | (0.26) | (0.21) | (0.35) |
| | High | 0.16 | 0.03 | 0.11 | 0.28** | −0.04 | −0.20 |
| | | (0.23) | (0.16) | (0.14) | (0.13) | (0.16) | (0.34) |
| | High−Low | 0.26 | 0.14 | 0.01 | 0.47 | 0.49*** | 0.23 |
| | | (0.21) | (0.24) | (0.25) | (0.30) | (0.18) | (0.25) |

**Table A4. Stock managerial ownership and alternative beta measures**

The table shows the monthly CAPM alphas (in percent) of portfolios constructed from independent double portfolio sorts based on *Ownership rank* and four alternative beta estimates from January 2006 to December 2021. For each characteristic, at the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios based on market beta. All stocks are then independently sorted in ascending order into three portfolios based on *Ownership rank*. Portfolios are value weighted and rebalanced every three months. Panel A reports the results in which betas are estimated using a one-year window with daily returns that include five lags of the daily market return, applying the Dimson summed-coefficients method (Daily 1-year). Panel B reports the results using the previous estimate but follows Cederburg and O'Doherty (2016) to add the constraint that coefficients on the three least recent lagged market returns are equal (Daily 1-year constrained). Panel C reports the results in which betas are estimated based on $\beta_{\text{mkt}}$, applying the shrinking procedure following Liu et al. (2018) (Monthly 5-year shrunk). Panel D reports the results in which betas are estimated by separately estimating correlation and volatilities (Frazzini and Pedersen). The first row in each panel reports the results for the quintile beta portfolios for all stocks, and the subsequent rows report the results for the beta portfolios at three levels of managerial ownership. The last column in each panel shows the results for the strategies that buy the high-beta stocks and sell the low-beta stocks. Newey-West adjusted standard errors are shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | Panel A: Daily 1-year | | | |
| Ownership | All | 0.32*** | 0.20** | 0.11 | 0.04 | 0.04 | −0.28 |
| | | (0.10) | (0.10) | (0.13) | (0.15) | (0.30) | (0.36) |
| | Low | 0.19 | 0.03 | −0.15 | −0.22 | −0.58** | −0.77** |
| | | (0.14) | (0.12) | (0.19) | (0.21) | (0.27) | (0.30) |
| | 2 | 0.28** | 0.19 | 0.09 | 0.10 | −0.25 | −0.53 |
| | | (0.13) | (0.16) | (0.15) | (0.20) | (0.30) | (0.37) |
| | High | 0.26* | 0.23* | 0.08 | −0.03 | 0.42 | 0.16 |
| | | (0.14) | (0.12) | (0.19) | (0.19) | (0.41) | (0.46) |
| | High−Low | 0.08 | 0.20 | 0.23 | 0.20 | 1.00*** | 0.92*** |
| | | (0.18) | (0.18) | (0.23) | (0.26) | (0.36) | (0.34) |

*(Continued on next page)*

**Table** A4 (*continued*)

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | Panel B: Daily 1-year constrained | | | | | |
| Ownership | All | 0.32*** | 0.21** | 0.07 | 0.03 | 0.07 | −0.24 |
| | | (0.10) | (0.10) | (0.13) | (0.15) | (0.31) | (0.36) |
| | Low | 0.25* | −0.06 | −0.13 | −0.28 | −0.55** | −0.80*** |
| | | (0.13) | (0.13) | (0.17) | (0.21) | (0.28) | (0.30) |
| | 2 | 0.26** | 0.22 | 0.05 | 0.08 | −0.24 | −0.50 |
| | | (0.12) | (0.16) | (0.16) | (0.20) | (0.30) | (0.36) |
| | High | 0.27* | 0.23* | 0.08 | −0.04 | 0.46 | 0.20 |
| | | (0.14) | (0.12) | (0.18) | (0.19) | (0.40) | (0.46) |
| | High−Low | 0.02 | 0.29 | 0.21 | 0.24 | 1.02*** | 1.00*** |
| | | (0.18) | (0.18) | (0.22) | (0.26) | (0.35) | (0.35) |
| | | Panel C: Monthly 5-year shrunk | | | | | |
| Ownership | All | 0.29** | 0.19* | −0.09 | −0.39** | −0.37 | −0.66* |
| | | (0.12) | (0.11) | (0.12) | (0.18) | (0.31) | (0.39) |
| | Low | 0.31** | −0.06 | −0.39** | −0.74*** | −0.73** | −1.04*** |
| | | (0.13) | (0.15) | (0.19) | (0.24) | (0.34) | (0.38) |
| | 2 | 0.25 | 0.05 | −0.09 | −0.55** | −0.41 | −0.66 |
| | | (0.16) | (0.13) | (0.15) | (0.23) | (0.36) | (0.47) |
| | High | 0.31** | 0.25 | 0.00 | −0.19 | −0.31 | −0.62 |
| | | (0.14) | (0.17) | (0.16) | (0.19) | (0.32) | (0.38) |
| | High−Low | 0.00 | 0.30 | 0.38* | 0.56** | 0.42 | 0.42 |
| | | (0.15) | (0.26) | (0.22) | (0.25) | (0.36) | (0.34) |
| | | Panel D: Frazzini-Pedersen | | | | | |
| Ownership | All | 0.28** | 0.21** | −0.09 | −0.26 | −0.71** | −0.99** |
| | | (0.12) | (0.10) | (0.12) | (0.21) | (0.32) | (0.41) |
| | Low | 0.24* | 0.02 | −0.32* | −0.66*** | −1.01*** | −1.25*** |
| | | (0.14) | (0.15) | (0.18) | (0.24) | (0.36) | (0.40) |
| | 2 | 0.28* | 0.06 | −0.10 | −0.18 | −1.02*** | −1.30*** |
| | | (0.16) | (0.12) | (0.14) | (0.27) | (0.31) | (0.41) |
| | High | 0.29** | 0.28* | 0.02 | −0.29 | −0.37 | −0.66 |
| | | (0.13) | (0.16) | (0.14) | (0.20) | (0.39) | (0.44) |
| | High−Low | 0.05 | 0.26 | 0.33 | 0.37 | 0.65* | 0.60 |
| | | (0.15) | (0.27) | (0.21) | (0.26) | (0.39) | (0.36) |

**Table A5. Stock managerial ownership and low-risk anomalies: Alternative alpha measures**

The table shows the alphas (in percent) from different factor models for portfolios constructed from an independent double portfolio sort based on *Ownership rank* and the composite risk score from January 2006 to December 2021. A stock's composite risk score is the arithmetic average of its ranking percentile for each of seven risk characteristics (i.e., $\beta_{\mathrm{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW). At the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios based on the risk score. All stocks are then independently sorted in ascending order into three portfolios based on *Ownership rank*. Portfolios are value weighted and rebalanced every three months. Panel A, B and C uses the Fama-French three-factor model, the three-factor model augmented with the momentum and liquidity factor and the Fama-French five-factor model augmented with the momentum factor, respectively. The first row in each panel reports the results for the quintile risk portfolios for all stocks, and the subsequent rows report the results for the risk portfolios at the lowest and highest managerial ownership for brevity. The last column in each panel shows the results for the strategies that buy the high-risk stocks and sell the low-risk stocks. Newey-West adjusted standard errors are shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) |
| Panel A: Three-factor alpha | | | | | | | |
| | All | 0.26*** | −0.08 | −0.05 | −0.10 | −0.20 | −0.45* |
| | | (0.08) | (0.09) | (0.13) | (0.17) | (0.20) | (0.24) |
| Ownership | Low | 0.31*** | −0.13 | −0.15 | −0.12 | −0.43* | −0.74*** |
| | | (0.11) | (0.15) | (0.18) | (0.22) | (0.26) | (0.26) |
| | High | 0.34*** | −0.24** | −0.07 | −0.05 | 0.13 | −0.21 |
| | | (0.10) | (0.10) | (0.17) | (0.23) | (0.25) | (0.26) |
| | High−Low | 0.03 | −0.11 | 0.08 | 0.08 | 0.56** | 0.53* |
| | | (0.16) | (0.19) | (0.22) | (0.29) | (0.28) | (0.27) |
| Panel B: Five-factor alpha | | | | | | | |
| | All | 0.24*** | −0.07 | −0.03 | −0.06 | −0.14 | −0.38** |
| | | (0.07) | (0.09) | (0.12) | (0.14) | (0.16) | (0.19) |
| Ownership | Low | 0.30*** | −0.12 | −0.13 | −0.09 | −0.38* | −0.67*** |
| | | (0.11) | (0.15) | (0.16) | (0.21) | (0.20) | (0.20) |
| | High | 0.33*** | −0.23** | −0.07 | −0.01 | 0.17 | −0.16 |
| | | (0.10) | (0.10) | (0.17) | (0.23) | (0.22) | (0.22) |
| | High−Low | 0.03 | −0.11 | 0.06 | 0.07 | 0.54** | 0.51* |
| | | (0.16) | (0.20) | (0.22) | (0.30) | (0.27) | (0.27) |
| Panel C: Six-factor alpha | | | | | | | |
| | All | 0.15** | −0.13 | −0.09 | −0.06 | −0.05 | −0.20 |
| | | (0.07) | (0.08) | (0.13) | (0.16) | (0.16) | (0.18) |
| Ownership | Low | 0.24** | −0.08 | −0.18 | −0.08 | −0.34* | −0.58*** |
| | | (0.11) | (0.15) | (0.17) | (0.22) | (0.19) | (0.20) |
| | High | 0.25*** | −0.23** | −0.09 | −0.03 | 0.30 | 0.05 |
| | | (0.10) | (0.10) | (0.16) | (0.20) | (0.23) | (0.24) |
| | High−Low | 0.01 | −0.16 | 0.09 | 0.05 | 0.65** | 0.64** |
| | | (0.17) | (0.19) | (0.23) | (0.27) | (0.28) | (0.28) |

**Table A6. Stock managerial ownership and low-risk anomalies: Triple portfolio sorts**
The table repeats the baseline tests from Table 3 but employs another portfolio sort based on firm characteristics before the main double portfolio sort. Using the median value of a firm characteristic, all stocks are sorted in ascending order into two portfolios. Then within each portfolio, all stocks are independently sorted based on stock managerial ownership (*Ownership rank*) and the risk score. The panel headings show the name of the characteristic used for the first sort, and the six characteristics are size, value, momentum, mutual fund ownership, mispricing score and anomaly net score. The rows in each panel report the monthly CAPM alphas (in percent) for the risk portfolios at the lowest and highest managerial ownership for brevity. The last column in each panel shows the results for the strategies that buy the high-risk stocks and sell the low-risk stocks. Newey-West adjusted standard errors are shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|
| | | | Panel A: Size | | | |
| *Small* | | | | | | |
| Low | 0.06 | −0.04 | −0.30 | −0.42* | −1.02*** | −1.08*** |
| | (0.17) | (0.15) | (0.25) | (0.22) | (0.34) | (0.28) |
| High | 0.06 | 0.07 | 0.13 | −0.33 | −0.23 | −0.29 |
| | (0.16) | (0.19) | (0.21) | (0.29) | (0.39) | (0.32) |
| High−Low | 0.00 | 0.11 | 0.43* | 0.09 | 0.79** | 0.79** |
| | (0.14) | (0.17) | (0.25) | (0.28) | (0.37) | (0.34) |
| *Big* | | | | | | |
| Low | 0.23 | 0.06 | −0.41** | −0.04 | −0.55* | −0.78** |
| | (0.14) | (0.15) | (0.20) | (0.20) | (0.30) | (0.36) |
| High | 0.42*** | 0.28** | −0.08 | 0.08 | 0.25 | −0.17 |
| | (0.13) | (0.13) | (0.14) | (0.18) | (0.27) | (0.29) |
| High−Low | 0.19 | 0.22 | 0.33 | 0.12 | 0.80** | 0.60** |
| | (0.18) | (0.20) | (0.26) | (0.26) | (0.32) | (0.30) |

*(Continued on next page)*

**Table A6** *(continued)*

| | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|
| | | | Panel B: Value | | | |
| *Growth* | | | | | | |
| Low | 0.52*** | 0.44*** | −0.02 | −0.37 | −0.54* | −1.06*** |
| | (0.13) | (0.15) | (0.21) | (0.26) | (0.29) | (0.36) |
| High | 0.32** | 0.21 | 0.27* | 0.27 | 0.01 | −0.31 |
| | (0.15) | (0.17) | (0.14) | (0.24) | (0.32) | (0.37) |
| High−Low | −0.19 | −0.23 | 0.30 | 0.64** | 0.55* | 0.74** |
| | (0.17) | (0.23) | (0.25) | (0.30) | (0.28) | (0.30) |
| *Value* | | | | | | |
| Low | 0.30* | −0.53** | −0.32 | −0.40 | −0.63 | −0.92** |
| | (0.17) | (0.22) | (0.31) | (0.35) | (0.45) | (0.44) |
| High | 0.11 | −0.29 | −0.18 | −0.92** | −0.14 | −0.25 |
| | (0.23) | (0.21) | (0.23) | (0.39) | (0.49) | (0.53) |
| High−Low | −0.18 | 0.24 | 0.14 | −0.52 | 0.49 | 0.67 |
| | (0.25) | (0.27) | (0.30) | (0.44) | (0.34) | (0.42) |
| | | | Panel C: Momentum | | | |
| *Low* | | | | | | |
| Low | 0.38* | −0.30 | −0.31 | −0.23 | −0.77* | −1.16*** |
| | (0.23) | (0.25) | (0.26) | (0.32) | (0.39) | (0.39) |
| High | 0.49*** | −0.11 | 0.16 | 0.16 | −0.10 | −0.59 |
| | (0.19) | (0.24) | (0.29) | (0.28) | (0.43) | (0.40) |
| High−Low | 0.10 | 0.19 | 0.47 | 0.39 | 0.67 | 0.56 |
| | (0.22) | (0.21) | (0.35) | (0.30) | (0.44) | (0.47) |
| *High* | | | | | | |
| Low | 0.23 | −0.17 | 0.03 | −0.54** | −0.53** | −0.76*** |
| | (0.16) | (0.18) | (0.25) | (0.24) | (0.27) | (0.27) |
| High | 0.30** | 0.37** | −0.11 | 0.18 | 0.06 | −0.24 |
| | (0.13) | (0.18) | (0.20) | (0.22) | (0.40) | (0.41) |
| High−Low | 0.07 | 0.54** | −0.14 | 0.72** | 0.59 | 0.52 |
| | (0.19) | (0.25) | (0.31) | (0.28) | (0.38) | (0.35) |

*(Continued on next page)*

**Table A6** (*continued*)

| | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|
| | | | Panel D: Mutual fund ownership | | | |
| *Low* | | | | | | |
| Low | 0.34** | −0.01 | −0.22 | −0.40 | −0.83** | −1.17*** |
| | (0.16) | (0.23) | (0.22) | (0.27) | (0.33) | (0.36) |
| High | 0.54*** | 0.10 | −0.02 | 0.17 | 0.21 | −0.33 |
| | (0.13) | (0.13) | (0.20) | (0.32) | (0.43) | (0.45) |
| High−Low | 0.21 | 0.11 | 0.20 | 0.57 | 1.04** | 0.84** |
| | (0.19) | (0.28) | (0.30) | (0.36) | (0.44) | (0.40) |
| *High* | | | | | | |
| Low | 0.38** | 0.06 | −0.09 | 0.11 | −0.37 | −0.76*** |
| | (0.16) | (0.20) | (0.20) | (0.27) | (0.27) | (0.25) |
| High | 0.24* | −0.08 | −0.20 | 0.12 | −0.03 | −0.27 |
| | (0.14) | (0.20) | (0.22) | (0.24) | (0.31) | (0.30) |
| High−Low | −0.14 | −0.15 | −0.12 | 0.01 | 0.34 | 0.49* |
| | (0.22) | (0.24) | (0.29) | (0.35) | (0.34) | (0.29) |
| | | | Panel E: Mispricing score | | | |
| *Low* | | | | | | |
| Low | 0.37** | −0.05 | −0.07 | −0.58** | −0.43 | −0.80** |
| | (0.17) | (0.17) | (0.21) | (0.23) | (0.27) | (0.35) |
| High | 0.40*** | 0.23 | −0.03 | 0.13 | 0.28 | −0.12 |
| | (0.13) | (0.15) | (0.22) | (0.15) | (0.32) | (0.32) |
| High−Low | 0.03 | 0.29 | 0.04 | 0.71*** | 0.70* | 0.67* |
| | (0.20) | (0.22) | (0.28) | (0.25) | (0.37) | (0.37) |
| *High* | | | | | | |
| Low | 0.24 | −0.16 | −0.32 | −0.38 | −0.74* | −0.99*** |
| | (0.20) | (0.26) | (0.26) | (0.24) | (0.38) | (0.37) |
| High | 0.35** | −0.04 | 0.18 | −0.36 | 0.11 | −0.24 |
| | (0.16) | (0.25) | (0.36) | (0.26) | (0.40) | (0.43) |
| High−Low | 0.11 | 0.11 | 0.50 | 0.02 | 0.85* | 0.74 |
| | (0.29) | (0.29) | (0.40) | (0.30) | (0.45) | (0.47) |

*(Continued on next page)*

**Table A6** (*continued*)

| | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|
| | | | Panel F: Net score | | | |
| *Low* | | | | | | |
| Low | −0.01 | −0.29 | −0.11 | −0.53** | −0.74** | −0.73** |
| | (0.18) | (0.20) | (0.20) | (0.26) | (0.31) | (0.36) |
| High | 0.45*** | −0.03 | −0.22 | 0.56 | 0.00 | −0.46 |
| | (0.12) | (0.15) | (0.17) | (0.41) | (0.36) | (0.35) |
| High−Low | 0.47** | 0.25 | −0.11 | 1.09** | 0.74* | 0.27 |
| | (0.23) | (0.24) | (0.23) | (0.48) | (0.39) | (0.42) |
| *High* | | | | | | |
| Low | 0.51*** | −0.29 | −0.08 | −0.22 | −0.41 | −0.92*** |
| | (0.16) | (0.26) | (0.21) | (0.28) | (0.34) | (0.34) |
| High | 0.39*** | 0.20 | 0.14 | 0.09 | 0.26 | −0.14 |
| | (0.13) | (0.15) | (0.26) | (0.27) | (0.36) | (0.37) |
| High−Low | −0.11 | 0.49* | 0.22 | 0.31 | 0.67** | 0.79** |
| | (0.23) | (0.26) | (0.33) | (0.25) | (0.33) | (0.34) |

**Table A7. Stock managerial ownership and low-risk anomalies: Orthogonalization**
The table shows the monthly CAPM alphas (in percent) of portfolios constructed from independent double portfolio sorts based on orthogonalized managerial ownership measures and each of seven risk characteristics (i.e., $\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW) from January 2006 to December 2021. Residual ownership measures are obtained by regressing *Ownership rank* on eight characteristics that include firm size, value, momentum, asset growth, profitability, mutual fund ownership, stock liquidity and mispricing score. A stock's mispricing score is the arithmetic average of its ranking percentile for each of nine mispricing characteristics (i.e., including Momentum, Accruals, Asset growth, Composite equity issuance, Profitability, Investment, Net issuance, NOA and ROA, and excluding Distress and O-Score). At the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios based on each of seven risk characteristic. All stocks are then independently sorted in ascending order into three portfolios based on the orthogonalized managerial ownership measure. Portfolios are value weighted and rebalanced every three months. The rows in each panel report the results for the risk portfolios at the lowest and highest managerial ownership for brevity. The last column in each panel shows the results for the strategies that buy the high-risk stocks and sell the low-risk stocks. Newey-West adjusted standard errors are shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | $\beta_{\text{mkt}}$ | | | |
| Ownership | Low | 0.28** | 0.00 | −0.25 | −0.27 | −0.52* | −0.79** |
| | | (0.11) | (0.13) | (0.16) | (0.19) | (0.30) | (0.33) |
| | High | 0.33** | −0.02 | −0.07 | −0.10 | 0.15 | −0.18 |
| | | (0.13) | (0.09) | (0.13) | (0.27) | (0.33) | (0.41) |
| | High−Low | 0.05 | −0.02 | 0.19 | 0.17 | 0.66** | 0.61* |
| | | (0.16) | (0.16) | (0.20) | (0.21) | (0.31) | (0.34) |
| | | | | *IVOL* | | | |
| Ownership | Low | 0.27** | 0.16 | −0.16 | −0.34* | −0.43* | −0.70** |
| | | (0.11) | (0.18) | (0.17) | (0.20) | (0.22) | (0.28) |
| | High | 0.33*** | 0.13 | −0.26* | −0.15 | −0.13 | −0.47 |
| | | (0.08) | (0.11) | (0.14) | (0.16) | (0.33) | (0.34) |
| | High−Low | 0.07 | −0.02 | −0.10 | 0.20 | 0.30 | 0.23 |
| | | (0.14) | (0.18) | (0.22) | (0.20) | (0.29) | (0.31) |

*(Continued on next page)*

**Table A7** (*continued*)

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | *Distress* | | | |
| Ownership | Low | 0.23 | −0.21 | −0.12 | −0.45 | −0.61** | −0.84** |
| | | (0.15) | (0.18) | (0.21) | (0.28) | (0.30) | (0.36) |
| | High | 0.37*** | −0.14 | −0.01 | −0.25 | −0.20 | −0.57* |
| | | (0.12) | (0.15) | (0.20) | (0.22) | (0.30) | (0.31) |
| | High−Low | 0.14 | 0.07 | 0.11 | 0.21 | 0.41* | 0.27 |
| | | (0.19) | (0.23) | (0.21) | (0.28) | (0.24) | (0.26) |
| | | | | *O-Score* | | | |
| Ownership | Low | −0.16 | −0.31* | −0.09 | 0.11 | −0.39** | −0.23 |
| | | (0.15) | (0.17) | (0.19) | (0.16) | (0.19) | (0.18) |
| | High | 0.27** | 0.19 | 0.09 | 0.32* | 0.11 | −0.17 |
| | | (0.13) | (0.14) | (0.12) | (0.18) | (0.17) | (0.23) |
| | High−Low | 0.43** | 0.50** | 0.18 | 0.21 | 0.49** | 0.06 |
| | | (0.20) | (0.24) | (0.18) | (0.24) | (0.20) | (0.23) |
| | | | | *MAX* | | | |
| Ownership | Low | 0.26** | 0.09 | −0.34** | −0.01 | −0.37* | −0.64** |
| | | (0.10) | (0.21) | (0.15) | (0.26) | (0.22) | (0.27) |
| | High | 0.20*** | 0.09 | −0.05 | 0.01 | −0.06 | −0.26 |
| | | (0.07) | (0.13) | (0.16) | (0.17) | (0.24) | (0.25) |
| | High−Low | −0.07 | 0.00 | 0.29* | 0.02 | 0.31 | 0.38 |
| | | (0.12) | (0.31) | (0.16) | (0.19) | (0.21) | (0.23) |

*(Continued on next page)*

**Table A7** (*continued*)

| | | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|---|
| | | | | *SKEW* | | | |
| Ownership | Low | −0.07 | −0.11 | −0.24 | −0.15 | −0.23 | −0.16 |
| | | (0.17) | (0.16) | (0.20) | (0.17) | (0.17) | (0.18) |
| | High | 0.07 | 0.20* | −0.06 | 0.32** | 0.16 | 0.09 |
| | | (0.14) | (0.12) | (0.11) | (0.16) | (0.13) | (0.15) |
| | High−Low | 0.14 | 0.31 | 0.18 | 0.47* | 0.39* | 0.26 |
| | | (0.22) | (0.20) | (0.21) | (0.26) | (0.23) | (0.23) |
| | | | | *COSKEW* | | | |
| Ownership | Low | −0.02 | −0.23 | 0.09 | −0.23 | −0.36* | −0.34 |
| | | (0.25) | (0.16) | (0.22) | (0.20) | (0.19) | (0.33) |
| | High | 0.12 | 0.16 | 0.12 | 0.17 | 0.00 | −0.12 |
| | | (0.29) | (0.14) | (0.14) | (0.13) | (0.15) | (0.34) |
| | High−Low | 0.14 | 0.39* | 0.03 | 0.39 | 0.36** | 0.22 |
| | | (0.21) | (0.22) | (0.24) | (0.27) | (0.17) | (0.24) |

**Table A8. Orthogonalized stock managerial ownership and low-risk anomalies: Alternative ownership measures**

The table repeats the tests from Table 5 but uses two alternative residual measures of stock managerial ownership. Residual ownership measures are obtained by regressing *Ownership indicator* (Panel A) and *LN(Ownership dollar)* (Panel B) on eight characteristics that include firm size, value, momentum, asset growth, profitability, mutual fund ownership, stock liquidity and mispricing score. A stock's mispricing score is the arithmetic average of its ranking percentile for each of nine mispricing characteristics (i.e., including Momentum, Accruals, Asset growth, Composite equity issuance, Profitability, Investment, Net issuance, NOA and ROA, and excluding Distress and O-Score). At the beginning of each quarter, all stocks are sorted in ascending order into quintile portfolios based on the risk score. All stocks are then independently sorted in ascending order into three portfolios based on the orthogonalized managerial ownership measure. Portfolios are value weighted and rebalanced every three months. The first two rows in each panel report the CAPM alphas for the risk portfolios at the lowest and highest managerial ownership for brevity. The last column in each panel shows the CAPM alphas for the strategies that buy the high-risk stocks and sell the low-risk stocks. Newey-West adjusted standard errors are shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | Low | 2 | 3 | 4 | High | High−Low |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Panel A: Ownership indicator | | | | | | |
| Low | 0.34*** | −0.11 | −0.23 | −0.27 | −0.51* | −0.85*** |
| | (0.13) | (0.13) | (0.19) | (0.21) | (0.27) | (0.31) |
| High | 0.31** | 0.03 | −0.08 | −0.23 | 0.05 | −0.27 |
| | (0.13) | (0.11) | (0.12) | (0.25) | (0.34) | (0.41) |
| High - Low | −0.02 | 0.14 | 0.14 | 0.05 | 0.55* | 0.58 |
| | (0.17) | (0.17) | (0.21) | (0.24) | (0.31) | (0.36) |
| Panel B: LN(Ownership dollar) | | | | | | |
| Low | 0.31*** | −0.08 | −0.28 | −0.34 | −0.48 | −0.79** |
| | (0.12) | (0.13) | (0.18) | (0.21) | (0.29) | (0.33) |
| High | 0.36*** | 0.06 | −0.06 | −0.13 | 0.06 | −0.30 |
| | (0.13) | (0.11) | (0.13) | (0.26) | (0.32) | (0.40) |
| High - Low | 0.05 | 0.14 | 0.21 | 0.21 | 0.53* | 0.49 |
| | (0.17) | (0.15) | (0.20) | (0.23) | (0.32) | (0.34) |

**Table A9. Alternative managerial ownership measures and portfolio tilt**

The table repeats the tests from Table 10 but uses two alternative measures of portfolio manager ownership for fund classification. Each active mutual fund is classified into groups based on either *Ownership indicator* (Panel A) or *LN(Ownership dollar)* (Panel B). For *Ownership indicator*, funds are classified into two groups in which the last group contains funds whose *Ownership indicator* is 1 (i.e., ownership is greater than \$0). For *LN(Ownership dollar)*, funds are classified into four groups in which the last group contains funds whose *LN(Ownership dollar)* belongs to the quantile group sorted by *LN(Ownership dollar)*. Portfolio holdings are then aggregated to the group level to construct a stacked panel at the group-stock level. The dependent variable is the deviation of each holding from its market weight and the stacked panel regression is

$$\omega_{p,i,t} - \omega_{i,t}^{\text{mkt}} = \gamma_{j,t-1} \times \text{Char}_{i,t-1} + \delta_{j,t} \times \text{Char}_{i,t} \times \text{Ownership}_{p,t-1} + \text{Ownership}_{p,t-1} + \lambda_{k,t} + \varepsilon_{p,i,t-1},$$

where $\text{Ownership}_{p,t-1}$ is an indicator equal to 1 for the highest portfolio group $p$ and 0 otherwise. $\lambda_{k,t}$ is the industry by time fixed effects. *Char* is the risk score (Columns (1) and (4)), $\beta_{\text{mkt}}$ (Columns (2) and (5)) and the mispricing score (Columns (3) and (6)), respectively. A stock's composite risk score is the arithmetic average of its ranking percentile for each of seven risk characteristics (i.e., $\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW). A stock's mispricing score is the arithmetic average of its ranking percentile for each of nine mispricing characteristics (i.e., including Momentum, Accruals, Asset growth, Composite equity issuance, Profitability, Investment, Net issuance, NOA and ROA, and excluding Distress and O-Score). The regressions include industry by time fixed effects, and standard errors are double clustered at the stock and time level and shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively. The sample period is from 2006Q1 to 2021Q4.

| | Dependent variable: $\omega_{p,i,t} - \omega_{i,t}^{\text{mkt}}$ | | | | | |
|---|---|---|---|---|---|---|
| | Panel A: Ownership indicator | | | Panel B: LN(Ownership dollar) | | |
| | (1) | (2) | (3) | (1) | (2) | (3) |
| Risk $\text{score}_{i,t-1}$ | $0.118^{***}$ | | | $0.124^{***}$ | | |
| | (0.030) | | | (0.027) | | |
| Risk $\text{score}_{i,t-1}$ × $\text{Ownership}_{p,t-1}$ | $-0.047^{***}$ | | | $-0.075^{***}$ | | |
| | (0.014) | | | (0.016) | | |
| $\beta_{i,t-1}^{mkt}$ | | $0.093^{***}$ | | | $0.097^{***}$ | |
| | | (0.026) | | | (0.023) | |
| $\beta_{i,t-1}^{mkt}$ × $\text{Ownership}_{p,t-1}$ | | $-0.037^{***}$ | | | $-0.056^{***}$ | |
| | | (0.011) | | | (0.012) | |
| Mispricing $\text{score}_{i,t-1}$ | | | $0.056^{***}$ | | | $0.051^{***}$ |
| | | | (0.014) | | | (0.013) |
| Mispricing $\text{score}_{i,t-1}$ × $\text{Ownership}_{p,t-1}$ | | | −0.005 | | | −0.009 |
| | | | (0.010) | | | (0.012) |
| $\text{Ownership}_{p,t-1}$ | −0.001 | −0.001 | −0.001 | −0.001 | −0.001 | −0.001 |
| | (0.014) | (0.014) | (0.015) | (0.016) | (0.016) | (0.016) |
| Industry × Time FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| # obs. (Avg. # obs./quarter) | 149,454 | 149,454 | 149,454 | 257,385 | 257,385 | 257,385 |
| R-squared (Avg. R-squared) | 0.06 | 0.06 | 0.06 | 0.05 | 0.05 | 0.05 |

**Table A10. Managerial ownership measures, fund performance, and portfolio tilt**
The table repeats the tests from Table 10 but uses three measures of portfolio manager ownership that are orthogonalized to fund performance. Residual *LN(Ownership dollar)* is obtained by regressing *LN(Ownership dollar)* on funds' annual cumulative alpha with respect to the Fama-French five-factor model augmented with the momentum factor (Rows (1) and (2)), annual cumulative excess returns over fund's active benchmark (Rows (3) and (4)), annual cumulative excess returns over S&P500 index returns (Rows (5) and (6)). Each active mutual fund is classified into four groups based on fund-level residual *LN(Ownership dollar)*, in which the last group contains funds whose residual *LN(Ownership dollar)* belongs to the quantile group sorted by residual *LN(Ownership dollar)*. Portfolio holdings are then aggregated to the group level to construct a stacked panel at the group-stock level. The dependent variable is the deviation of each holding from its market weight and the stacked panel regression is

$$\omega_{p,i,t}-\omega_{i,t}^{\text{mkt}} = \gamma_{j,t-1}\times\text{Risk score}_{i,t-1}+\delta_{j,t}\times\text{Risk score}_{i,t}\times\text{Ownership}_{p,t-1}+\text{Ownership}_{p,t-1}+\lambda_{k,t}+\varepsilon_{p,i,t-1},$$

where $\text{Ownership}_{p,t-1}$ is an indicator equal to 1 for the highest portfolio group $p$ and 0 otherwise. $\lambda_{k,t}$ is the industry by time fixed effects. A stock's composite risk score is the arithmetic average of its ranking percentile for each of seven risk characteristics (i.e., $\beta_{\text{mkt}}$, IVOL, Distress, O-Score, MAX, SKEW, COSKEW). Panel A reports the results using panel regressions that include industry by time fixed effects, and standard errors are double clustered at the stock and time level and shown in brackets. Panel B reports the results using Fama-MacBeth regressions, and standard errors are Newey-West adjusted and shown in brackets. $***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively. The sample period is from 2006Q1 to 2021Q4.

| | Dependent variable: $\omega_{p,i,t}-\omega_{i,t}^{\text{mkt}}$ | | | | | |
|---|---|---|---|---|---|---|
| | Panel A: Panel regressions | | | Panel B: Fama-MacBeth regressions | | |
| | (1) | (2) | (3) | (1) | (2) | (3) |
| Risk score$_{i,t-1}$ | 0.119*** | | | 0.118*** | | |
| | (0.028) | | | (0.008) | | |
| Risk score$_{i,t-1}$ × Ownership$^{\text{Alpha}}{}_{p,t-1}$ | −0.087*** | | | −0.087*** | | |
| | (0.018) | | | (0.008) | | |
| Risk score$_{i,t-1}$ | | 0.100*** | | | 0.101*** | |
| | | (0.026) | | | (0.008) | |
| Risk score$_{i,t-1}$ × Ownership$^{\text{AB}}{}_{p,t-1}$ | | −0.080*** | | | −0.080*** | |
| | | (0.018) | | | (0.009) | |
| Risk score$_{i,t-1}$ | | | 0.102*** | | | 0.103*** |
| | | | (0.026) | | | (0.009) |
| Risk score$_{i,t-1}$ × Ownership$^{\text{S\&P500}}{}_{p,t-1}$ | | | −0.082*** | | | −0.082*** |
| | | | (0.018) | | | (0.010) |
| Ownership$_{p,t-1}$ | −0.001 | −0.001 | −0.001 | −0.001 | −0.001 | −0.001 |
| | (0.018) | (0.017) | (0.017) | (0.004) | (0.004) | (0.005) |
| Industry × Time FE | ✓ | ✓ | ✓ | | | |
| # obs. (Avg. # obs./quarter) | 297,968 | 297,968 | 297,968 | 4,729 | 4,729 | 4,729 |
| R-squared (Avg. R-squared) | 0.05 | 0.05 | 0.06 | 0.01 | 0.01 | 0.01 |

## Appendix References


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