# The Impact of Mandatory Managerial Co-Investment on Mutual Fund Performance: Evidence from India

Mathijs Cosemans* Vaibhav Grewal† Marno Verbeek‡

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**Abstract**

This paper provides causal evidence on the impact of managerial co-investment on mutual fund performance. Specifically, we exploit a regulatory reform in India that mandates co-investment for managers of active funds. The exogenous nature of this requirement mitigates the endogeneity concerns in prior studies based on voluntary co-investment data. We find that mandatory co-investment results in higher returns for funds without any prior voluntary co-investment. However, fund alphas decline as managers reduce active bets and align their portfolios more closely with passive benchmarks. Consistent with a reduction in agency conflicts, we show that co-investment curbs managers' incentives to take risk.

**JEL classifications:** G11, G23, G28, J33

**Keywords:** managerial ownership, mutual funds, fund governance, agency problems, risk taking

*Rotterdam School of Management, Erasmus University, E-mail: mcosemans@rsm.nl.
†Rotterdam School of Management, Erasmus University, E-mail: grewal@rsm.nl.
‡Rotterdam School of Management, Erasmus University, E-mail: mverbeek@rsm.nl.

# 1 Introduction

In recent years, several leading asset managers have proactively advertised their personal investments into the funds they manage. Bill Ackman, the manager of the US-based hedge fund Pershing Square, stated in an interview that "*we do view it as our personal investment vehicle in the sense that we have a very large stake individually.*"[1] Similarly, Terry Smith, the CEO of the UK-based asset manager Fundsmith, said "*who would trust a chef who wouldn't eat their own cooking?*".[2] Theory predicts that such co-ownership can help mitigate agency conflicts between principals and agents (Jensen and Meckling (1976)). In the context of mutual funds, this 'skin in the game' aligns the interests of fund managers and investors by exposing managers' own wealth to the same risks as those faced by their investors.[3] However, testing this prediction empirically is challenging because managers are more likely to voluntarily co-invest in those funds that they expect to perform better. As a result, it is impossible to determine if a positive relation between managerial co-investment and fund performance observed in the data is caused by a reduction in agency conflicts and greater managerial effort or due to endogenous self selection.

In this paper, we address this problem by exploiting a recent regulatory change in the Indian mutual fund market to determine the causal impact of managerial co-investment (CI) on fund performance and managerial risk taking. Specifically, in October 2021, the Securities and Exchange Board of India (SEBI) implemented a new regulation that made it compulsory for mutual fund houses to pay 20% of the compensation of 'key employees' of their actively managed funds, including fund managers, in the form of units of the funds that they oversee. The stated rationale for making it *mandatory* for active managers to co-invest in their fund is to align the interest of the key employees with the unitholders (investors) of the mutual fund. We use this empirical setting with exogenous managerial CI to answer two questions: First, does managerial CI affect fund performance? Second, does it affect managers' risk taking?

The exogenous nature of managerial co-investment in our setting mitigates concerns about endogenous self-selection and reverse causality present in existing studies that rely on *voluntary* co-investment data. In particular, we use a difference-in-differences (DiD) framework to identify the causal effect of co-investment

[1] Interactive Investor (3 December 2020), "FTSE 100's newest CEO Bill Ackman talks to interactive investor", https://www.ii.co.uk/analysis-commentary/ftse-100s-newest-ceo-bill-ackman-talks-interactive-investor-ii514374

[2] Financial Times. "UK funds split over disclosing how much 'skin in the game' they have." 11 October 2021. https://www.ft.com/content/2bca0fd0-7880-40d9-ac62-8e9b801dc140

[3] The proportion of co-investing mutual fund managers in the US has increased over time. While Khorana, Servaes, and Wedge (2007) observe that in 2004 only 43% of the managers in their sample invested in their own funds, Ma and Tang (2019) document that 70% of the managers in their sample stretching from 2007 to 2014 had some co-investment. Orlov, Ramelli, and Wagner (2023) find that over the period from 2015 to 2020, 77% of funds have at least one manager who co-invests personal wealth in the fund, with the average amount of co-investment about USD 800,000 (or 0.31% of AUM).

on fund performance and portfolio composition. In our DiD setup, the regulation that mandates CI is the treatment and actively-managed (passively-managed) funds form the treatment (control) group. We control for various fund characteristics that have been shown to be related to fund performance and risk.

We first examine the impact of managerial co-investment on fund performance. If CI aligns interests and incentivizes managers to be more diligent in their work, fund performance may improve after the implementation of the regulation. Although co-ownership among active (i.e., treated) funds significantly increases, we find no effect on their gross and net returns relative to the returns of the passive funds in the control group. However, closer examination reveals that funds without any voluntary co-investment in the six months prior to the implementation of the regulation do improve their returns when their managers are forced to co-invest. The net return of these funds increases by 0.2 percentage points (pps) per month, or 2.4 pps on annual basis. This improvement in fund performance attenuates as the amount of prior CI increases, because the regulation allows managers to set off their prior voluntary co-investment against the mandatory co-investment in the same fund.

We split fund returns into abnormal (alpha) and systematic components using the Carhart (1997) four-factor model. The regulatory reform leads to a decrease of 0.24 pps in monthly alpha, which implies a reduction in the return attributable to managers' stock-picking skill. The decrease in alpha is offset by an increase in systematic return of similar magnitude. We show that this increase in systematic return is due to time variation in factor premia and persistent differences in factor loadings between active and passive funds, rather than deliberate managerial actions. In contrast, alpha decreases because managers affected by the regulation choose to take smaller active bets and align their portfolios closer to passive benchmarks. Specifically, they decrease the active share, selectivity, and concentration of their portfolio compared to funds in the control group. In addition, their unobserved actions add less value than before the regulation, as is evident in a lower return gap. Collectively, these findings suggest that the reduction in the alpha of active funds post regulation is the result of a move away from discretionary investing toward systematic investing. A possible reason for this change in investment strategy is that managers may become more risk averse when their own capital is at stake and take fewer active bets to reduce the likelihood of underperformance of their fund relative to common benchmarks.

Next, we examine the effect of managerial CI on portfolio risk. We show that the regulation increases the volatility of monthly fund returns by 0.21 pps relative to funds in the control group. At first sight, it may seem surprising that we observe an *increase* in the volatility of funds with mandatory co-investment. We therefore examine if the increase in risk is due to intentional actions of fund managers or due to external

factors beyond their control. Specifically, we estimate the effect of mandatory co-investment on the risk shift measure proposed by Huang, Sialm, and Zhang (2011), which reflects the extent to which managers actively seek to change the risk profile of their fund. These authors show that funds that intentionally increase their risk levels over time have worse performance and suggest that this higher risk taking is due to agency conflicts. Thus, if mandatory CI helps align managers' interests with those of investors, it should lead to lower risk taking. Consistent with this prediction, we find a substantial reduction in risk taking by managers subject to mandatory co-investment, particularly for funds without any prior voluntary CI. Managers try to lower both the systematic and idiosyncratic risk of their fund when forced to co-invest, consistent with the regulator's objective of promoting more balanced risk decisions.

Further analyses show that the increase in the volatility of *realized* fund returns is unintended and completely attributable to an increase in systematic volatility driven by changes in factor correlations. These correlation dynamics affect treated funds and funds in the control group differently because of persistent differences in their factor exposures. Collectively, these results indicate that although the managers of treated funds aim to reduce the systematic risk of their portfolio in response to the regulation, they do not achieve this goal due to unanticipated changes in the covariance structure of factors.

Our work adds to the literature that studies the impact of managerial co-investment on mutual fund performance. Khorana, Servaes, and Wedge (2007) and Evans (2008) document that higher CI is associated with better performance of US-based funds. Using Swedish data, Ibert (2023) also observes a positive relation between managers' personal investments and fund performance. Hornstein and Hounsell (2016) find a positive relation between managerial ownership and the performance of solo-managed US funds, but a negative effect for team-managed funds. Kumlin and Puttonen (2009) find no relation between co-investment and performance of Finnish mutual funds. Because these studies rely on data from voluntary co-investments, their estimates of the relationship between co-investment and fund performance may be biased by endogenous self-selection and reverse causality. We contribute to this literature by providing causal evidence on the effect of co-investment on fund performance. Specifically, we exploit an exogenous regulatory shock to co-investment to test the theoretical prediction that managerial co-ownership improves fund performance by mitigating agency conflicts.

Our paper also adds to the literature on risk taking by mutual fund managers. In the absence of skin in the game, managers have an incentive to increase portfolio risk to increase assets under management (and thus their compensation), given the convex relation between mutual fund flows and past returns documented in the literature (Chevalier and Ellison (1997), Sirri and Tufano (1998)). Consistent with

co-investment aligning the interests of managers with investors, Ma and Tang (2019) find that risk-taking is inversely related to managerial CI, and Agarwal, Jiang, and Wen (2022) find that managers with a stake in their funds are less likely to hold lottery-like stocks. In contrast, Bührle and Yen (2025) find that co-investing managers increase portfolio risk when faced with higher capital gains taxes on their personal accounts. They document that this greater risk taking hurts fund performance and conclude that co-investment can worsen agency conflicts if it incentivizes managers to cater to their private interests. Because these papers study voluntary co-investment, they cannot assess if co-investment and risk taking are correlated because a manager with more skin in the game has a greater incentive to control the risk exposure of the fund or because a manager is more likely to co-invest when a fund's risk profile fits her own risk preference. Our causal identification strategy addresses this shortcoming in the literature and enables us to test whether co-investment curbs managers' incentives to take excessive risk.

The paper proceeds as follows. Section 2 provides an overview of the Indian mutual fund industry and explains the regulatory reform that mandates co-investment. Section 3 provides an overview of our data sources. Section 4 explains our empirical framework and presents the results. Section 5 concludes.

# 2 Institutional setting

## 2.1 Indian mutual fund industry

With more than USD 850bn of net assets under management (AUM), the Indian mutual fund industry ranks 12$^{th}$ in the world in terms of size and is the third largest among emerging markets behind China and Brazil.[4] The industry has expanded rapidly in recent years, growing at a compounded annual rate of 18.3% over the last ten years, which makes it the fastest growing mutual fund sector in this period amongst the 25 largest markets. In terms of the number of funds, the Indian mutual fund sector (1,641) ranks ahead of those in Switzerland (1,016) and the Netherlands (965). However, the size of the industry's AUM relative to gross domestic product (GDP) remains low at 16%, comparable to China (18%) but behind other countries with mutual fund sectors similar in size, such as the Netherlands (127%).[5] Equity funds account for 60.5% of the industry's AUM, followed by debt funds (14.5%), exchange-traded funds and funds of funds (12.6%), and money-market funds (12.4%).[6] Although the number of passive funds

[4] As per data available for Q2 2025 in Investment Company Institute's Worldwide Market Dataset available on https://www.ici.org/researchstatisticsmutualfunds/quarterly-worldwide-mutual-fund-market

[5] As per the latest data available in World Bank's Databank on Global Financial Development available on https://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database

[6] Association of Mutual Funds in India (Sep 2025), "Industry Trends (at a broad level)."

has grown in recent years, active funds still have a dominant share of the industry's AUM at 82.5%.[7]

India's mutual fund industry ranks among the best in terms of disclosure practices.[8] It is one of only two markets (besides Mexico) that requires mutual fund managers to disclose their portfolio holdings on a monthly basis, compared to quarterly disclosures in most other geographies. Of special interest to us, India is one of only four countries that requires disclosure of the fund managers' investments into their respective funds (the other three being USA, China, and New Zealand). It is also the only country that requires disclosure of the actual annual compensation received by fund employees (at least for the top ten employees by remuneration). Thus, in addition to the recent regulatory change mandating managerial co-investment, the quality of disclosures available and its relevance as a large and growing market make the Indian mutual fund industry an appropriate empirical setting.

### 2.2 Regulation mandating managerial co-investment

Over the last decade, SEBI has encountered and investigated a few instances of misconduct by mutual fund managers. In one such case, the market regulator found that private trading accounts related to the fund manager were involved in front-running the trades of the mutual fund.[9]In another case, fund managers and various senior employees of the fund house were found to have acted on material non-public information and redeemed their investments in certain family funds before shutting down redemptions for all investors.[10] Possibly motivated by growing concerns around fund managers violating their fiduciary duty and making private gains at the expense of their investors, in April 2021 SEBI announced a new regulation mandating managerial skin in the game.[11] The stated objective of this mandatory co-investment is to align the interests of designated employees of asset management companies with fund investors by ensuring that fund managers take balanced decisions on risk.

Eventually coming into effect from 1 October 2021, the regulation has made it compulsory for fund houses to pay 20% of the compensation of certain designated employees in the form of units of (or investment in) schemes in which the employee has a role or oversight.[12] The list of fund employees covered by the regulation includes fund managers, other members of the fund management and research team, chief executive officer (CEO), chief investment officer (CIO), chief risk officer (CRO), chief information

[7]Association of Mutual Funds in India, "AMFI Annual MF Report 2024."

[8]Morningstar Global Investor Experience Update: Fund Disclosures, available on https://www.morningstar.com/lp/global-investor-experience-disclosure

[9]SEBI Order (21 October 2022), "Adjudication Order in the matter of Deutsche Mutual Fund"

[10]SEBI Order (7 June 2021), "In the Matter of Inspection of Six Debt Schemes of Franklin Templeton Mutual Fund"

[11]SEBI Circular (28 April 2021), "Alignment of Interest of Key Employees of Asset Management Companies with the Unitholders of the Mutual Fund Schemes."

[12]In the Indian context, the terms 'mutual fund' and 'mutual fund scheme' are used interchangeably.

security officer (CISO), chief operations officer (COO), sales head, dealers, compliance officers, investor relations officers, heads of other departments, and other employees directly reporting to the CEO. The compensation considered is the sum of gross salary, perquisites, bonuses and non-cash compensation, net of income tax, statutory pension contributions, superannuation benefits and gratuity payments. Index funds, exchange traded funds and overnight funds are excluded from the scope of this regulation.

There are additional modalities pertaining to its implementation. The mandatory co-investment of an employee is to be made each month on the date of salary payment and split across schemes in which they have a role or oversight in proportion to the respective AUM of those schemes at the end of the previous month. Each co-investment is locked-in for a minimum period of three years. Furthermore, the units allotted are subject to a claw-back provision in the event of any violation of the code of conduct, fraud, or gross negligence. Employees with prior voluntary co-investment as on the date of implementation are allowed to set off that amount against any new mandatory co-investment required in the same schemes. To allow some diversification, for fund managers who manage a single scheme, only half of the required co-investment must be in units of that fund. The remaining half can be invested in funds with a risk value at least as high as the scheme managed by the fund manager.

Reactions to the new regulation within the mutual fund industry were critical. Common concerns included employees being unable to meet personal financial obligations with 20% of their compensation being locked away for three years and being forced to invest in a personally unsuitable mix of debt and equity simply due to the characteristics of the funds they are professionally involved in.[13] The wide list of designated employees was also criticized with the rationale that most executives (other than the CEO, CIO, and fund managers) and junior employees are not involved in portfolio selection decisions and have considerably smaller compensation packages.[14] The 'one-size-fits-all' approach was further condemned as a factor in making the mutual fund industry unattractive to prospective external talent. While SEBI did pay heed to the industry's concerns, such as by delaying the planned implementation by three months and reducing the co-investment requirement for junior employees (aged less than 35 years) in the first 24 months, it went ahead with bringing the regulation into effect from October 2021.

[13]Livemint (22 November 2022), "Skin in the game: A policy reform worth revisiting", available on https://www.livemint.com/money/personal-finance/skin-in-the-game-a-policy-reform-worth-revisiting-11669050690171.html

[14]Economic Times (4 December 2023), "SEBI re-examining 'skin in the game' policy for mutual funds", available on https://economictimes.indiatimes.com/mf/mf-news/sebi-re-examining-skin-in-the-game-policy-for-mutual-funds/articleshow/105713632.cms

# 3 Data and Variable Construction

## 3.1 Sample selection

Our sample consists of all mutual funds and ETFs domiciled in India that invest in domestic equity and were operational both before and after the co-investment regulation came into force (October 2021). The sample period extends from 1 January 2018 to 31 December 2024, which provides 45 months of data pre-implementation and 39 months of data post-implementation. The primary source of data is Morningstar and its survivorship-bias-free mutual fund (MF) and exchange traded fund (ETF) databases. Using the investment category fields provided by Morningstar, we select those funds that invest in domestic equities, i.e., pure equity and hybrid funds. We only pick those hybrid funds which have an average equity share in the portfolio over the sample period of at least 70%. To prevent any incubation period bias, we limit the sample to funds that have been operational for at least six months.

Analogous to the occurrence of multiple share classes within most US-based mutual funds, Indian funds also have more than one 'plan' or 'option' within a fund with different characteristics that may cater to different investors.[15] While the Morningstar data for Indian funds is also organized at this share class level, the database only provides one aggregate value of net assets at the fund level. Consequently, it is not possible to use share-class-size-weighted aggregate returns and expense ratios for a fund as is commonly done in studies based on US data. To address this shortcoming, we retain the data for only one share class per fund by identifying the plan most likely to be selected for managerial co-investment. Since the regulation requires co-investment to be made in the growth plan of the fund when possible, we first select those plans for which the plan name explicitly ends with the labels 'Gr' (for growth) and 'Dir' / 'Dr' (for direct, since employee co-investment is unlikely to be done through a distributor). When direct growth plans are unavailable, we select those plans for which the name ends with the labels 'Gr and 'Reg' / 'Rg' (for regular), and when not available, just 'Gr'. For those funds that do not have a plan identified as a growth plan, we select the oldest direct (if not available, then regular) plan that is not explicitly identified as a dividend-paying plan (by labels 'IDCW' / 'Div').

Our final sample consists of 497 funds that belong to 39 different fund families (AMCs or asset management companies). 384 of these funds are actively-managed funds which fall within the purview of

[15] These plans mostly differ in terms of whether a commission is paid to an intermediary distributor (regular plan) or not (direct plan), and whether any dividend distributions are paid out to investors (dividend-paying plan) or re-invested into the fund (growth plan). Some are also exclusively offered to institutional investors with a minimum investment criterion. As a result, these plans differ in the amount of net assets, net returns, and net expense ratios while sharing the same portfolio.

the regulation and constitute the treated group, while the remaining 113 are passive funds (index funds and ETFs) which are excluded from the regulation and form the control group. We obtain various data items for each fund from Morningstar, such as the monthly portfolio holdings, monthly net assets under management, daily and monthly net returns, annual net expense ratios, fund benchmark, and managerial history. We drop all observations for which the monthly net assets, net return, or net expense ratio values are missing. We detected a few transcription errors in the data that we corrected using the procedure described in the Online Appendix.

### 3.2 Co-investment by fund managers and designated key employees

We retrieve two types of co-investment data for Indian mutual funds, i.e., total co-investment (TCI) by fund managers and mandatory co-investment (MCI) by designated key employees. By definition, pre-regulation TCI only consists of voluntary co-investment (VCI) by fund managers, whereas post-regulation TCI is the sum of VCI and the part of MCI coming from fund managers. We cannot split manager-level co-investment TCI into voluntary and mandatory parts in the post-regulation period because MCI is only reported as one aggregate value for all designated key employees.

TCI data is available at the fund level in public disclosures known as 'scheme information documents' (SIDs). The SID for each fund is updated annually or semi-annually and is a comprehensive document detailing the fund's investment objective and strategy, target asset allocation, management details, risk factors, fees, expenses, and historical performance. The document also discloses the aggregate co-investment of the fund manager(s) as on date. The latest SID for each mutual fund is available on its AMC's website in PDF format. However, to identify whether a fund had any VCI prior to the regulation coming into force, we also require historical SIDs from previous periods. Although a few AMCs have an archive section on their website to access older SIDs, most do not. For such cases, we first explore the Internet Archive for each AMC to check whether older SIDs are available on past stored instances of the AMC's website. We also run custom Google searches for each AMC to look for SIDs that are publicly accessible if the exact URL is known but not directly accessible by clicking through the AMC's front-end website. In this way, we are able to retrieve past SIDs for 176 funds from 19 different fund families, or about a third of the total funds in our sample.

In most cases, the TCI data is available as an aggregate market value (in INR) of co-investment by the fund manager(s). In other cases, it is available in terms of MF units, which we convert to a monetary amount by multiplying it with the fund's net asset value (NAV) per unit as on date. Because the TCI

data is not updated every month, we carry forward the last disclosed value for months where there is no update.[16] There are two separate instances of a fund family being acquired by or merged into another in the sample period resulting in mergers of certain mutual funds. In such cases, we update the TCI data for the surviving mutual fund entity on the effective date with the sum of the latest-available TCI values of the merging funds.

As required under the regulation, mandatory co-investment data MCI is also available at the fund level in the form of monthly PDF or spreadsheet disclosures on the AMC's website. These disclosures list the total new amount (in INR) mandatorily co-invested by the designated key employees in each fund of the AMC in that month. We aggregate these monthly mandatory co-investment values over time to construct a cumulative MCI measure each month that shows the total mandatory co-investment as on date. The entire series of monthly disclosures since implementation is available for most AMCs. We merge the TCI and MCI data with the fund characteristics obtained from Morningstar using the latter's *FundId* identifier, which we first manually assign to each fund in the TCI and MCI datasets.

### 3.3 Manager characteristics

The information on the managerial history of a fund obtained from Morningstar includes the manager's name and her start and end date at the fund. We supplement this information with data on personal characteristics of managers retrieved from fund disclosures. Each fund SID includes manager-level data on age, tenure at the fund, educational qualifications, and past employers, in addition to listing the other funds being managed concurrently. For each manager-fund pair in our sample, we first examine the SID dated from a time in between the start and end dates of the manager's tenure at the fund. In cases where a SID is not available for this time period, we check for SIDs of other concurrently managed funds as inferred from the Morningstar data and, where available, verify that this SID lists the original fund as being concurrently managed. We then retrieve the manager's characteristics from this other fund's SID.[17] When no current or past fund-related disclosures are available, we search for the personal LinkedIn profile of the manager and collect data on age and gender from that webpage.[18]

[16] We do not carry forward TCI data from the pre-regulation period into the post-regulation period since co-investment is likely to have increased due to the regulation. Instead, for each fund, we treat the TCI values as missing for those initial months in the post-regulation period when its TCI data is not available from disclosures.

[17] If no such SIDs are found, we search for any other fund disclosure from that time period that has data on the manager's profile. When no such disclosure is found, we obtain a list from Morningstar of the funds currently being managed by the same manager. Since current SIDs are always available on the AMC's website, we collect the personal data from these SIDs.

[18] To infer the manager's age from LinkedIn profiles, we assume that the person was aged 17 when they started their first degree program, in line with the expected timeline of education in India. To infer the gender of the manager, we rely on the honorifics and pronouns mentioned in the SID, LinkedIn profile, or on other webpages that make references to the manager.

We also compute several other measures at the manager-fund-month level. Manager tenure is calculated as the number of years to date since the start of the manager's current term at the fund. We aggregate tenure at the fund-month level by computing the maximum across all managers managing the fund in that month. We further label a fund as team-managed if it has more than one manager for that month and as having a female manager if one or more of the managers in that month are female.

### 3.4 Fund performance and managerial skill

We consider a number of measures of fund performance and managerial skill. Daily and monthly net fund returns are obtained from Morningstar and gross returns are computed by adding back the net expense ratio. Sharpe ratio is calculated based on a three-month window of daily net returns. We further obtain four-factor alphas from the Carhart (1997) model by regressing net excess fund returns on the excess market return, SMB, HML, and MOM, using the most recent three months of daily data. As a proxy for managerial skill, we compute the value added measure proposed by Berk and Van Binsbergen (2015), defined as the product of a fund's gross four-factor alpha and its lagged AUM.

The daily yield on the 91-day Indian Treasury bill is sourced from LSEG Workspace (formerly Refinitive Eikon) as a proxy for the risk-free rate. We additionally obtain daily factor returns for India from the data set of Jensen, Kelly, and Pedersen (2023).[19] For each factor, we use the capped value-weighted returns of the long-short portfolio sorted on the corresponding characteristic. We convert the USD returns provided in the data set to INR using the historical daily exchange rate taken from Compustat.

### 3.5 Portfolio concentration and manager activeness

Data on monthly portfolio holdings from Morningstar is used to construct measures of portfolio concentration and manager activeness. We measure concentration by the total number of securities held in a fund's portfolio and by the Herfindahl-Hirschman Index (HHI), defined as the sum of the squared portfolio weights. We consider five measures of activeness. The first is portfolio turnover, computed as the minimum of the value of total purchases and sales in a month as a proportion of the AUM of the fund at the end of the previous month. To compute the value of purchases and sales, we collect security-level price data from LSEG Workspace. Because we do not know the exact date during the month on which a security was bought or sold, we assume all transactions to have taken place at the end of the month when portfolio holdings are disclosed. Changes in cash and cash-like securities and in other securities for

[19] Available on https://jkpfactors.com.

which price data is unavailable are excluded from our turnover calculation.[20]

Our second proxy for activeness is the active share measure proposed by Cremers and Petajisto (2009) that measures the proportion of a fund's portfolio that deviates from its benchmark. Treating a fund's publicly disclosed benchmark as its 'true' benchmark may not be appropriate because funds can game their disclosed benchmarks to show better relative performance to investors (Sensoy (2009)). Moreover, while Morningstar only provides the latest disclosed benchmark for a fund, it is possible that the benchmark has changed over time as the fund evolved. Following previous studies (e.g., Cremers and Petajisto (2009)), we therefore infer the benchmark of each fund from its disclosed portfolio holdings. Appendix A describes the steps that we follow to assign a dynamic benchmark to each fund.

The third activeness proxy is the selectivity measure of Amihud and Goyenko (2013), computed as one minus the $R^2$ obtained from a regression of a fund's daily net excess returns on the Carhart (1997) four-factor model, estimated over a three-month window. A low $R^2$ indicates greater selectivity and more active management as the fund's returns cannot be explained by standard factor exposures.

The fourth measure is the return gap proposed by Kacperczyk, Sialm, and Zheng (2008), which measures the *effect* of activeness. The return gap is computed as the difference between the monthly realized fund return and the return on a hypothetical portfolio that invests in the previously disclosed fund holdings. It is thus a direct measure of the value added or subtracted from the unobserved actions of the fund manager during the month relative to the holdings disclosed at the end of the previous month.

The fifth proxy is the risk shift proposed by Huang, Sialm, and Zhang (2011), which measures actively made changes to a fund's risk profile. We calculate a fund's risk shift as the difference between the volatility of the daily returns on a hypothetical portfolio that holds the fund positions disclosed at the end of the month over the prior three months and the volatility of the daily fund returns over this same period. A positive (negative) risk shift suggests that a manager intends to increase (decrease) the risk of the portfolio. Funds can change the riskiness of their portfolio by changing their exposure to systematic or idiosyncratic risk within their portfolio. To distinguish between these different mechanisms, we construct separate risk shift measures based on the systematic and idiosyncratic volatilities of the hypothetical and actual portfolios computed using the Carhart (1997) four-factor model.

[20]Cash-like securities are identified as such in the Morningstar data and likely have a maturity of less than one year. Missing price information occurs mainly for debt securities in hybrid fund portfolios. In such cases, we exclude the security in calculating the value of purchases and sales and scale down the AUM of the fund by the security's weight.

### 3.6 Summary statistics

Table 1 reports summary statistics for the main variables used in our analysis.[21] All continuous variables are left- and right-winsorized at the 1% level each month to reduce the impact of outliers. A detailed definition of each variable is given in Table B1 in Appendix B.

Our panel data sample consists of 36,099 fund-month observations for 497 funds across a 7-year period. The average fund in our sample has INR 36.9 billion (USD 473 million) in net assets and an age of 12 years. Because fund size is highly positively skewed, we use its logarithm in our regression analysis. The average net fund return is 1.37% per month while the average four-factor alpha is 0.13% per month, indicating that the average fund has a positive return from stock-picking skill. The value added by fund managers is INR 81 million per month on average, but the median value is close to zero. The average monthly fund volatility is 4.51%. There is significant variation in all of these metrics across funds.

In terms of portfolio composition, the average fund is invested in 52 securities while the share of cash in its portfolio is 3.5%. Active share against the passive benchmark is 0.50 on average and selectivity against the Carhart model is 16.6%. The distribution of managerial characteristics shows that the median size of the management team is two and that the team includes a female in 18% of the cases. The average tenure at the fund of the most experienced manager in the team is around four and a half years.

The management team co-invests INR 9.8 million (USD 127 thousand) into the fund, on average, which represents 0.02% of the fund's AUM.[22] Conditional on being co-invested, the corresponding amount is INR 14.4 million (USD 185 thousand) or 0.03% of the fund's AUM. To also build a measure of whether the managers had voluntarily co-invested prior to the regulation, we look at the TCI in the 6-month period leading up to the implementation (April - September 2021). If the TCI was positive in any of these months, we set the dummy variable *PriorCI* to 1, and 0 otherwise. Approximately half of the funds had voluntary managerial co-investment prior to the implementation of the regulation.

Table C1 in Appendix C compares key characteristics for the actively-managed funds in our sample with those reported in recent studies for actively-managed US equity funds. The average fund size in India (USD 519 million) is comparable to that in the US (USD 590 million). However, the median fund size in India (USD 161 million) is around a quarter of that in the US (USD 626 million). Indian funds

[21] Pairwise correlations between these variables are reported in Table C4 in Appendix C. We also report separate summary statistics for the treatment group (active funds) and control group (passive funds) in Table C5.

[22] As explained in Section 3.2, we only observe total managerial co-investment (TCI) for a subset of funds in our sample. In Table C6 in Appendix C, we compare the distributions of fund characteristics for this narrower sample of funds having available co-investment data with the distributions for the full sample. We find no meaningful differences between the two.

are younger than US funds, reflecting the rapid growth of the mutual fund sector in India in recent years. The mean and median expense ratio in both markets is close to 1% per year. The median monthly net return and four-factor alpha of Indian funds are around 20 bps higher than those of US funds, but fund volatility is almost identical in both markets. In terms of portfolio composition, we observe that the median Indian fund holds fewer securities than the median US fund (50 vs. 81), but the HHI is similar in both markets. The active share is lower for Indian funds while selectivity is higher. The fraction of funds that is team-managed is similar for both markets (71% vs. 79%). Total managerial co-investment is lower for Indian funds, both in terms of dollar amount and as a proportion of fund size, suggesting that voluntary co-investment is less common in the Indian mutual fund sector than in the US.

# 4 Empirical strategy and Results

## 4.1 Difference-in-differences framework

Our methodology is based on causal identification using a difference-in-differences (DiD) framework in which the regulation mandating co-investment for active funds comes as a 'shock' to their managers. While previously the fund manager could herself choose whether to co-invest or not, she is now exogenously driven to increase her CI. This enables us to consider the implementation of the regulation as a treatment where active funds form the treatment group and passive funds the control group. We examine the effects of this treatment on fund performance and portfolio characteristics using panel regressions of the form:

$$DepVar_{i,t} = \beta_0 + \beta_1 \left(Treat_i \times \ Post_t\right) + \Gamma^k \ Controls^k_{i,t-1} + \mu_i + \nu_t + \epsilon_{i,t} \tag{1}$$

where $i$ is an index for the fund and $t$ denotes the month of observation. $DepVar$ is the fund-level dependent variable for which we estimate the average treatment effect (ATE).[23] $Treat_i$ is a dummy variable that is equal to one when fund $i$ is part of the treatment group and zero otherwise. $Post_t$ is a dummy that equals one when the time period $t$ belongs to the post-treatment period and zero otherwise. Our main coefficient of interest is that of the interaction term, $\beta_1$, which estimates the average change in the difference in $DepVar$ between treated and control groups as a result of the treatment.

We additionally control for various fund characteristics that prior literature has shown to be related

[23] We lead dependent variables that are computed over a window longer than one month to avoid contamination of effects between the pre and post periods. For instance, when estimating the effect of the co-investment regulation on fund volatility, fund volatility is calculated at the end of month $t+2$ using daily fund returns in months $t$, $t+1$, and $t+2$.

to fund performance and portfolio composition. These include fund size, fund age, net flows, net expense ratio, turnover ratio, past fund return, fund volatility, fund family size, manager tenure, and dummy variables indicating whether the fund is managed by a team and whether it has a female manager. All control variables are lagged by one month. We include fund-level fixed effects ($\mu_i$) to control for unobserved time-invariant fund characteristics that may influence the $DepVar$, such as the fund's core operational structure and management team culture. We further include month-level fixed effects ($\nu_t$) to control for unobserved market-wide variables, such as the broader market sentiment.

To verify that the regulation indeed leads to progressively higher co-investment for treated funds when compared to control funds, we estimate the average treatment effect on total managerial co-investment in each year of our sample for those funds for which we have data on co-investment. Figure 1 shows that there is no clear pre-trend in $LogManagerTCI$ and confirms that the regulatory change leads to higher co-investment. As expected, this increases with time in the post-treatment period in a near-linear fashion, becoming statistically significant at the 5% level in 2024. We also check whether there are strong pre-trends in the fund-level variables that we use as $DepVar$ in the DiD framework, as such trends could continue into the post-treatment period and bias the estimated treatment effects. Figure 2 plots the ATE in each year for some of the key dependent variables in our analyses. We find no evidence of any salient pre-trends that continue post treatment. In fact, for certain variables, we either observe a new trend or a marked reversal of the pre-treatment trend after the regulatory change. The DiD framework therefore appears appropriate for our setting.

Because the regulation allows managers to set off any prior co-investment against the mandatory co-investment in the same fund, we expect the regulation to be less of a shock for those who already co-invested voluntarily. To test this hypothesis, we extend our main DiD regression to measure heterogeneous treatment effects conditional on the amount of prior co-investment by a fund's management team:

$$\begin{aligned} DepVar_{i,t} =& \beta_0 + \beta_1 \ (Treat_i \times Post_t) + \beta_2 \ (Treat_i \times Post_t \times LogPriorCI_i) \\ &+ \beta_3 \ (Post_t \times LogPriorCI_i) + \Gamma^k \ Controls^k_{i,t-1} + \mu_i + \nu_t + \epsilon_{i,t}, \end{aligned} \tag{2}$$

where $LogPriorCI_i$ is the log of the average co-investment of a fund's management team over the six months prior to the implementation of the regulation. The coefficient $\beta_1$ measures the average treatment effect for funds with no prior co-investment and $\beta_2$ shows how it changes with increasing levels of prior co-investment.

### 4.2 Does managerial co-investment affect fund returns?

We start by examining the impact of mandatory co-investment on fund performance. If skin in the game aligns the interests of managers with those of investors and incentivizes them to exert more effort, we expect performance to improve. However, if co-invested managers incorporate their personal preferences in portfolio selection decisions, agency conflicts may exacerbate and performance may go down.

Table 2 reports the estimated treatment effects for several measures of fund performance. Panel A presents results for the full sample of funds. Columns 1 and 2 show that the co-investment regulation has little impact on gross and net fund returns. In both cases, the ATE estimate is close to zero and statistically insignificant. In columns 3 and 4, we decompose the net excess return into an abnormal (alpha) and a systematic return component using the Carhart four-factor model. Interestingly, we find that the regulation results in a relative decrease of 0.24 percentage points (pps) in monthly alpha (or 2.8 pps when annualized). This effect is sizeable in magnitude compared to the sample mean of 0.13% and it is statistically significant at the 1% level. Thus, although the regulation does not affect the total return of the average treated fund, the return attributable to the manager's stock-picking skill appears to decrease. At the same time, this decrease in alpha is offset by an increase in a treated fund's systematic return of similar magnitude. Column 5 shows that there is no treatment effect on the value added of funds, which suggests that co-investment does not change this measure of managerial skill. The ATE on the Sharpe ratio in column 6 is positive, but the effect is economically small (0.03 points) and borderline significant at the 10% level. This suggests that the co-investment regulation leads to a slight improvement in risk-adjusted performance of the average fund.

We expect the regulation to have a greater effect on performance for funds without prior voluntary co-investment. In panel B of Table 2 we therefore report ATE estimates conditional on a fund's voluntary co-investment in the six months prior to the implementation of the regulation. In columns 1 and 2 we observe a substantial positive effect of the regulation on gross and net returns for funds with no prior CI. The conditional ATE estimates are economically meaningful (0.20 pps per month) and statistically significant at the 10% level. The positive effect of the regulation on fund returns attenuates as prior CI increases, in line with our conjecture that the regulation is less of a shock for managers who were already voluntarily co-investing in their fund. Column 3 shows that the negative effect of the regulation on alpha is less pronounced for funds with no prior CI while column 4 shows that the increase in systematic return is stronger for these funds. We further find in columns 5 and 6 that funds without prior CI exhibit a relative

decrease in value added but an increase in Sharpe ratio. Thus, although the co-investment regulation leads to a relative improvement in the returns and Sharpe ratios of funds with no prior co-investment, improvements do not appear to be driven by an increase in the stock-picking skill of its managers.

### 4.3 How does managerial co-investment affect fund volatility?

Next, we examine the effect of co-investment on fund volatility. Some existing studies show that greater managerial co-ownership is associated with lower portfolio risk (e.g., Khorana, Servaes, and Wedge (2007) and Ma and Tang (2019)), whereas other work finds a positive relation between CI and the idiosyncratic risk of a fund's portfolio (Kaniel, Tompaidis, and Zhou (2019)). Because these studies only examine voluntary managerial CI, they cannot draw conclusions on the causal relation between CI and fund risk. Specifically, co-investment and fund volatility can be correlated either because a manager with more skin in the game has a greater incentive to control the risk exposure of her fund or because a manager is more likely to co-invest when a fund's risk profile better fits her own risk preference. Our DiD framework enables us to provide causal evidence on the impact of co-investment on the volatility of fund returns.

Table 3 reports the results. The ATE estimate in column 1 in panel A shows that monthly fund volatility increases by 0.21 pps as a result of the regulation. This effect is statistically significant at the 1% level but the economic magnitude is fairly small relative to the sample mean volatility of 4.5%. To understand the drivers of the positive relation between mandatory CI and fund risk, we decompose total volatility into its systematic and idiosyncratic components according to the CAPM and the Carhart four-factor model and estimate separate treatment effects for each component. The results in columns 2 to 5 indicate that the relative increase in volatility is attributable to an increase in systematic volatility. Specifically, the ATEs for the systematic volatility components obtained from the CAPM and the Carhart model are 0.28 pps and 0.24 pps, respectively, and both significant at the 1% level. In contrast, the estimate of the treatment effect for idiosyncratic volatility is negative and significant under the CAPM and close to zero under the Carhart model. The conditional ATEs in Panel B show that the positive effect of the regulation on total and systematic volatility is stronger for funds without prior CI. We explore the determinants of the positive relation between the co-investment regulation and systematic risk in Section 4.6.

### 4.4 Does co-investment influence portfolio concentration and manager activeness?

We next examine the impact of co-investment on several measures of portfolio concentration and fund activeness to distinguish between different explanations for our findings on fund performance and risk. For example, the negative effect of the co-investment regulation on alpha in Table 2 may stem from worse individual security picks (decrease in skill) or from a reduction in the number of such active bets (decrease in breadth). Similarly, the decrease in idiosyncratic risk relative to the CAPM in Table 3 can be due to investing in securities with lower idiosyncratic volatility or due to greater portfolio diversification.

Panel A of Table 4 reports the unconditional ATE estimates for measures of portfolio concentration. Column 1 shows that the regulation results in a relative increase in the number of securities in treated funds' portfolios. On average, there are 8 more securities in the portfolio, which is a sizeable increase compared to the mean of 52. We observe a significant decrease in the HHI measure of portfolio concentration in column 2, which provides further evidence that the portfolios of treated funds become more diversified due to the regulation. The fact that we do not find a significant impact on the cash holdings of treated funds in column 3 suggests that the decrease in idiosyncratic volatility is driven by an increase in diversification and not by an increased allocation to riskless assets.

We continue by exploring various measures of fund activeness. The negative ATE estimates on active share and selectivity in columns 4 and 5 imply that the co-investment regulation leads to lower activeness. This reduction in activeness and the increase in portfolio diversification indicate that treated funds take smaller active bets and align their portfolios to be closer to passive benchmarks and factor portfolios. We also find a negative ATE on the return gap, which means that the unobserved actions of fund managers during a month add less value after the implementation of the regulation. We do not observe any impact of the treatment on portfolio turnover. Collectively, these findings suggest that the reduction in alpha and value added post regulation observed in Table 2 is the result of a move away from discretionary (focused) investing toward systematic (factor) investing and less successful unobserved trading decisions.

The results in panel B of Table 4 show that the ATE estimates for funds without prior CI are consistent with those for the full sample in panel A, except for the effect on active share which is no longer significant. The negative effect of the regulation on portfolio concentration is greater for funds with prior voluntary CI, but the negative effect on selectivity weakens with the amount of prior CI. We do not find a significant effect of prior co-investment on the ATE for the other measures of fund diversification and activeness.

### 4.5 What is the impact of mandatory co-investment on risk taking?

One of the stated objectives of the co-investment regulation is to better align the interests of fund managers and fund investors by pushing managers take balanced decisions on risk. In the absence of skin in the game, managers have an incentive to strategically increase risk levels to attract additional fund flows (and thus increase their compensation), given the convex relation between mutual fund flows and past returns documented in prior work (e.g., Chevalier and Ellison (1997) and Sirri and Tufano (1998)). At first sight, it may therefore seem surprising that we observe a relative increase in the volatility of treated funds in the post-implementation period. In this section, we shed light on this finding by examining if the increase in fund risk is due to deliberate actions of fund managers. Specifically, we estimate the effect of mandatory co-investment on the risk shift measure proposed by Huang, Sialm, and Zhang (2011), which reflects the extent to which managers actively seek to change the risk profile of their fund.

Table 5 presents the results. Column 1 in panel A shows a substantial reduction in risk taking by funds with mandatory co-investment relative to the control group after the implementation of the regulation. The decrease of 0.44 pps is sizeable compared to the sample mean of -0.33% and significant at the 1% level. The ATE estimates in columns 2 to 5 indicate that managers aim to lower both the systematic and idiosyncratic risk of their portfolio. This decrease in idiosyncratic risk is consistent with the increase in portfolio diversification documented in Table 4. The estimates in panel B show that the reduction in risk taking is strongest for funds without any prior CI, in line with our conjecture that the regulation mandating co-investment is a greater shock for the managers of these funds. These results suggest that forcing managers to have more skin in the game reduces their incentives to engage in excessive risk taking.

### 4.6 Why does mandatory co-investment increase systematic risk and return?

The evidence presented thus far shows that mandatory co-investment increases the systematic component of fund returns and fund volatility. In this section, we explore potential explanations for these effects. We first examine if the higher systematic return can be attributed to an improvement in factor timing. We assess factor timing ability using the approach of Treynor and Mazuy (1966) by estimating an extended version of the Carhart model that includes the squares of each factor return. A positive loading on a squared factor return indicates that the manager has been able to successfully time that factor.

Table 6 reports the estimated ATEs on each of these loadings. We find no evidence that the regulation significantly alters managers' ability to time the market, value, and momentum factors. The negative ATE

estimate for the size factor in column 4 suggests that for this factor, the timing ability of the managers of treated funds worsens. For robustness, we also evaluate timing skills using the model proposed by Henriksson and Merton (1981). The results of this analysis in Table C2 in Appendix C confirm that mandatory co-investment does not lead to an improvement in managers' factor timing skills. These findings suggests that the relative increase in the systematic return of treated funds is not the result of superior factor timing but a consequence of the increase in factor returns between the pre- and post-regulation periods.[24] This increase in factor premia benefits funds with mandatory co-investment more than funds in the control group because of their greater factor loadings throughout the sample period.

Next, we examine the determinants of the relative increase in the systematic volatility of treated funds. The evidence in Table 6 that the regulation does not have a significant impact on factor loadings suggests that the increase in systematic risk can be attributed to an increase in factor variance or a change in factor correlations between the pre- and post-regulation period. We therefore break down the systematic variance into four components associated with each of the factors in the Carhart model.

Table 7 shows the effect of the regulation on the total systematic variance and each of its components. We find that the positive ATE on systematic risk in column 1 is driven by a positive ATE on each of the four factor-specific components. However, the bulk of the increase comes from the increase in variance related to the market factor. Because factor loadings are fairly stable and factor variances *decrease* from the pre- to the post-regulation period, the relative increase in systematic risk of treated funds is driven by changes in factor correlations. For instance, the correlation between the market factor and the momentum factor increases from -0.28 in the pre-period to 0.48 in the post-period (see Table C3). These changes in factor correlations have a differential effect on the systematic risk of treated funds and funds in the control group because of persistent differences in their factor exposures. Overall, the evidence in Tables 6 and 7 indicates that the relative increase in the systematic risk and return of funds with mandatory co-investment following the implementation of the regulation is due to time variation in factor returns and correlations, rather than deliberate managerial actions. In fact, our results in Section 4.5 show that managers of treated funds aim to *lower* the systematic risk of their portfolio in response to the regulation. They fail to achieve this goal if they are unable to anticipate changes in the covariance structure of factors.

[24] Table C3 in Appendix C reports summary statistics for the monthly factor returns.

# 5 Conclusion

This paper provides causal evidence on the impact of managerial co-investment on mutual fund performance by exploiting a regulatory change in the Indian mutual fund industry that mandates co-investment for managers of active funds. The exogenous nature of managerial co-investment in our setting addresses concerns about endogenous self-selection and reverse causality that affect the existing literature that studies the consequences of co-investment using data on voluntary managerial co-investment.

We find that the co-investment regulation leads to an improvement in the return and Sharpe ratio of funds without any prior voluntary co-investment. This increase in fund performance is not attributable to an improvement in managers' stock-picking skills. In fact, we observe a significant reduction in the four-factor alpha of funds subject to the regulation. Alpha decreases because managers choose to take smaller active bets and align their portfolios closer to passive benchmarks. This decrease in alpha is offset by an increase in systematic returns driven by time variation in factor premia that benefits treated funds more than funds in the control group, rather than by deliberate managerial actions.

We further document that funds affected by the regulation exhibit an increase in realized volatility. Portfolio-level analyses show that this increase in risk is unintended and due to changes in factor correlations that managers do not anticipate. In fact, we show that managers of treated funds actively try to lower the risk of their fund by increasing the number of stocks in their portfolio and reducing portfolio concentration. This reduction in risk taking is strongest for funds without voluntary prior co-investment.

From a policy perspective, our findings show that forcing managers to co-invest curbs their incentives to engage in excessive risk taking, in line with the regulator's objective to better align the interests of fund managers and fund investors. An open question is how active managers' move away from discretionary investing toward systematic investing affects market efficiency and price informativeness.

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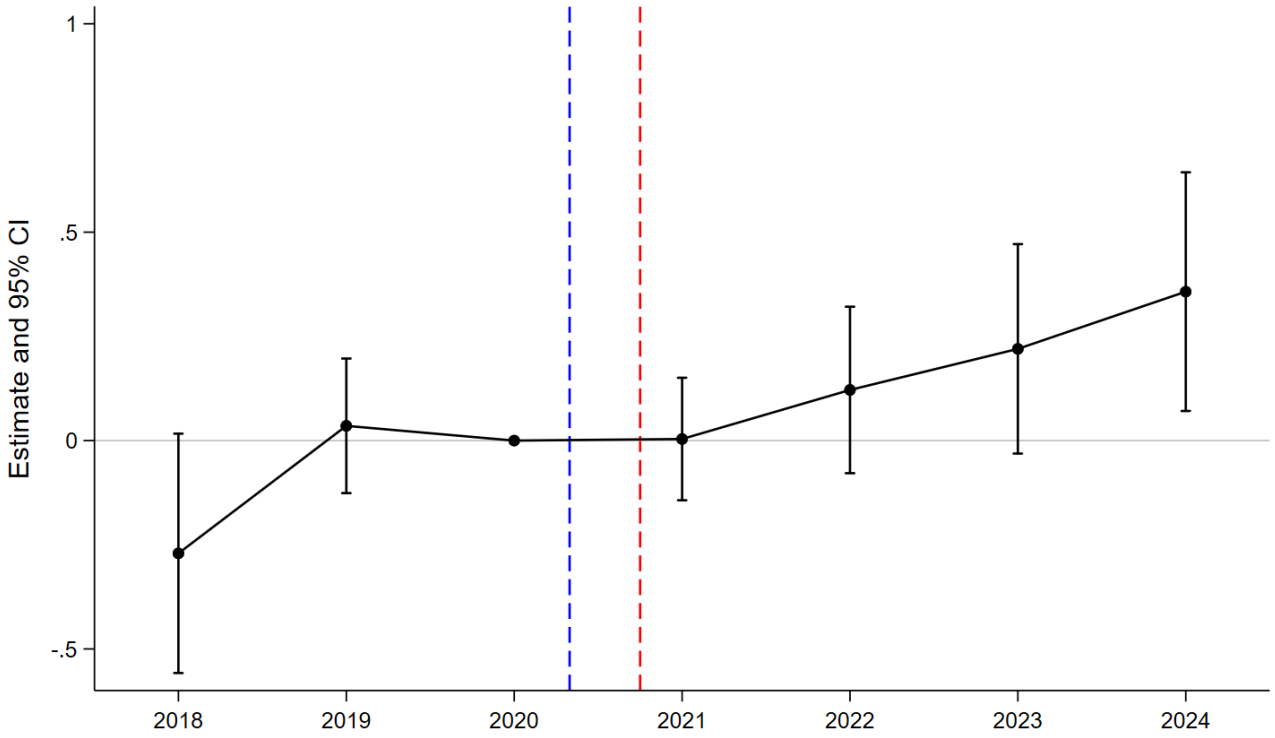
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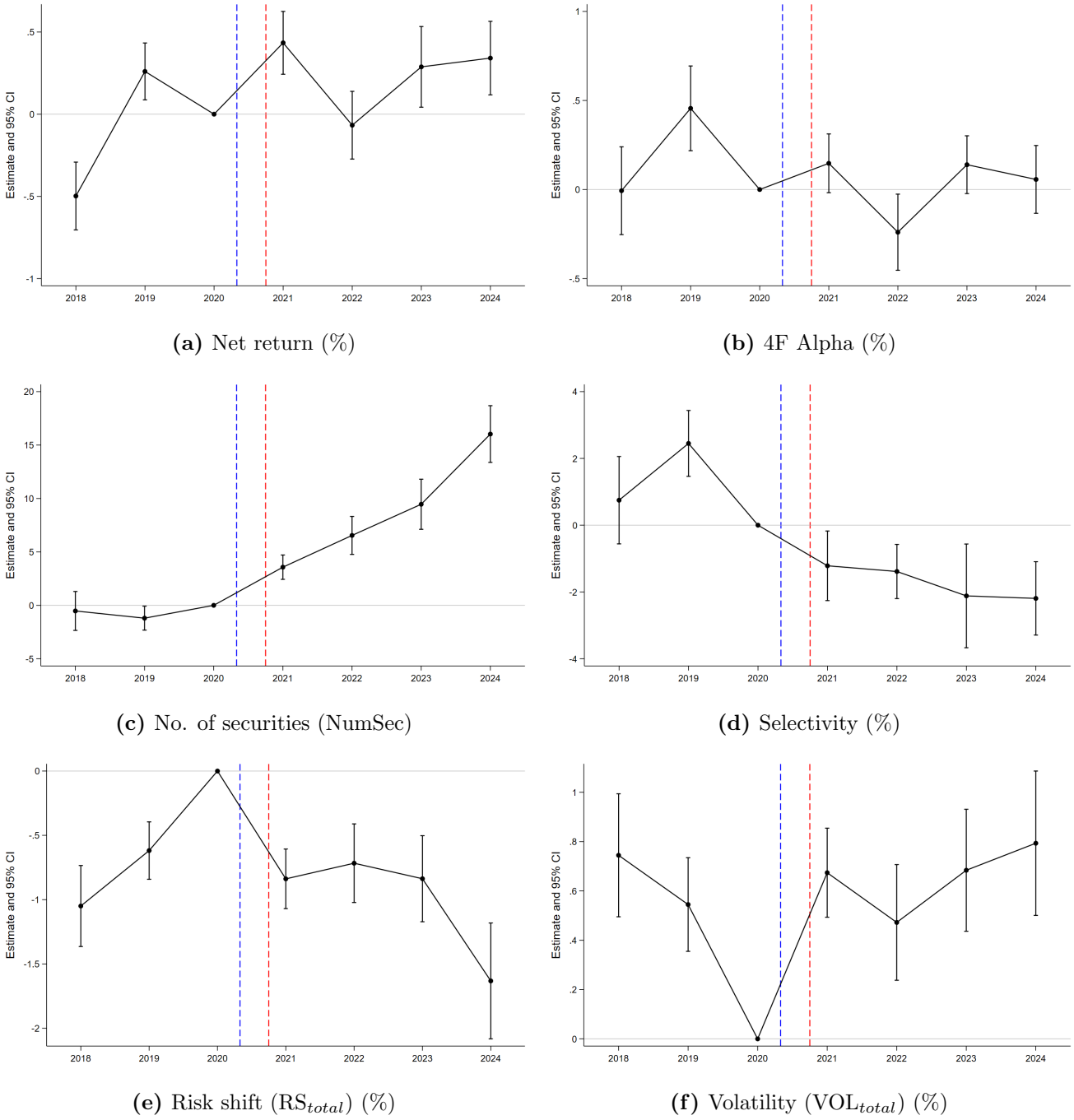
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**Figure 1.** Difference-in-differences event study: Managerial co-investment (LogManagerTCI)




This figure displays the results of a difference-in-differences event study where the treatment is the implementation of the regulation mandating co-investment for active managers. The figure depicts the average treatment effect for the log of (1 + Manager TCI) along with bars representing the 95% confidence interval. The blue dashed line (– –) represents the announcement of the regulation on 28 April 2021 and the red dashed lined (– –) represents its implementation on 1 October 2021. The estimate of the year preceding the treatment (2020) is normalized to zero. The estimation controls for fund and month fixed effects and standard errors are clustered at the fund level.

**Figure 2.** Difference-in-differences event study: Key fund characteristics




**(a)** Net return (%)

**(b)** 4F Alpha (%)

**(c)** No. of securities (NumSec)

**(d)** Selectivity (%)

**(e)** Risk shift ($\text{RS}_{total}$) (%)

**(f)** Volatility ($\text{VOL}_{total}$) (%)

This figure displays the results of difference-in-differences event studies where the treatment is the implementation of the regulation mandating co-investment for active managers. Each plot depicts the average treatment effect for a key fund characteristic related to fund performance (*Net return* and *4F Alpha*), portfolio selection and fund activeness (*NumSec* and *Selectivity*), and fund risk profile ($RS_{total}$ and $VOL_{total}$), along with bars representing the 95% confidence interval. The blue dashed line (– –) represents the announcement of the regulation (on 28 April 2021) while the red dashed lined (– –) represents its implementation on (01 October 2021). The estimate of the year preceding the treatment (2020) is normalized to zero. The estimation controls for fund and month fixed effects and standard errors are clustered at the fund level. Lagged control variables include log of fund size, log of fund age, net flows, net expense ratio, log of (1 + turnover ratio), lagged 3-month fund return, lagged 3-month fund volatility, log of fund family size, log of manager tenure, and dummy variables indicating whether the fund is managed by a team and whether it has a female manager.

**Table 1.** Summary statistics: Distributions of key variables

| Variable | N | Mean | Std | P10 | P25 | Median | P75 | P90 |
|---|---|---|---|---|---|---|---|---|
| Fund size (INR mn) | 36,099 | 36,906 | 73,896 | 465 | 2,188 | 8,970 | 34,945 | 98,111 |
| Fund age (years) | 36,099 | 12.28 | 7.91 | 2.40 | 4.89 | 12.10 | 18.00 | 23.84 |
| Net flows (%) | 36,038 | 1.12 | 6.37 | -2.11 | -0.80 | 0.06 | 1.76 | 4.86 |
| Net expense ratio (%) | 36,099 | 0.08 | 0.05 | 0.01 | 0.04 | 0.08 | 0.11 | 0.14 |
| Turnover ratio (%) | 36,031 | 3.55 | 5.29 | 0.00 | 0.17 | 1.83 | 4.64 | 9.03 |
| Family size (INR bn) | 36,099 | 1,823 | 2,006 | 40 | 237 | 1,086 | 2,777 | 4,692 |
| Gross return (%) | 35,122 | 1.46 | 3.21 | -2.03 | -0.30 | 1.65 | 3.48 | 5.03 |
| Net return (%) | 36,098 | 1.37 | 3.19 | -2.07 | -0.39 | 1.55 | 3.37 | 4.93 |
| 4F Alpha (%) | 36,098 | 0.13 | 1.11 | -1.06 | -0.49 | 0.11 | 0.74 | 1.35 |
| 4F Systematic return (%) | 36,098 | 0.81 | 3.07 | -2.62 | -0.91 | 0.82 | 2.80 | 4.17 |
| Value added (INR mn) | 35,061 | 81 | 647 | -176 | -20 | 4 | 82 | 399 |
| Sharpe ratio | 36,098 | 0.31 | 0.71 | -0.61 | -0.20 | 0.31 | 0.76 | 1.21 |
| Volatility ($VOL_{total}$) (%) | 36,098 | 4.51 | 2.23 | 2.61 | 3.18 | 4.05 | 5.16 | 6.35 |
| No. of securities | 36,094 | 52 | 26 | 25 | 32 | 51 | 62 | 79 |
| Herfindahl-Hirschman Index (HHI) | 36,094 | 0.05 | 0.03 | 0.02 | 0.03 | 0.04 | 0.05 | 0.07 |
| Cash (%) | 36,094 | 3.47 | 3.71 | 0.10 | 0.73 | 2.46 | 4.84 | 8.16 |
| Active share | 36,094 | 0.50 | 0.28 | 0.00 | 0.38 | 0.57 | 0.69 | 0.80 |
| Selectivity (%) | 36,098 | 16.58 | 12.69 | 5.25 | 8.00 | 12.76 | 20.90 | 33.18 |
| Return gap (%) | 35,104 | 0.04 | 4.17 | -5.03 | -2.34 | 0.24 | 2.63 | 4.78 |
| Risk shift ($RS_{total}$) (%) | 35,111 | -0.33 | 2.58 | -2.48 | -1.24 | 0.20 | 1.11 | 1.95 |
| No. of managers | 36,041 | 1.87 | 0.83 | 1 | 1 | 2 | 2 | 3 |
| Female manager (dummy variable) | 36,041 | 0.18 | 0.38 | 0 | 0 | 0 | 0 | 1 |
| Manager tenure (years) | 36,041 | 4.40 | 3.72 | 0.78 | 1.65 | 3.33 | 5.96 | 9.92 |
| Managers' total co-investment (TCI) (INR mn) | 8,212 | 9.83 | 39.57 | 0.00 | 0.00 | 0.27 | 1.87 | 18.03 |
| TCI as % of fund size | 8,212 | 0.022 | 0.066 | 0.000 | 0.000 | 0.003 | 0.012 | 0.044 |
| Managers' prior co-investment (Prior CI) (INR mn) | 14,207 | 10.21 | 45.07 | 0.00 | 0.00 | 0.00 | 1.00 | 16.60 |
| Prior CI (dummy variable) | 14,375 | 0.49 | 0.50 | 0 | 0 | 0 | 1 | 1 |
| Prior CI as % of fund size | 14,207 | 0.030 | 0.097 | 0.000 | 0.000 | 0.000 | 0.010 | 0.058 |

This table reports the pooled summary statistics for our key variables of interest. The sample consists of 497 India-domiciled funds that invest in domestic equities and were operational at the time the regulation mandating co-investment for active managers came into force (in October 2021). The sample period ranges from January 2018 to December 2024. All variables are observed and measured at the monthly frequency and all continuous variables are left- and right-winsorized at the 1% level each month. Detailed definitions of all variables are provided in Table B1 in Appendix B.

**Table 2.** Effect of mandatory co-investment regulation on fund performance

**Panel A: Unconditional treatment effect**

| | Gross return (%) | Net return (%) | 4F Alpha (%) | 4F Systematic (%) | ValAdd (INRbn) | Sharpe ratio |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| ATE | 0.002 | 0.012 | -0.237*** | 0.254*** | -0.059 | 0.031* |
| | (0.078) | (0.078) | (0.044) | (0.054) | (0.036) | (0.019) |
| LogSize | -0.265*** | -0.259*** | -0.167*** | -0.092*** | -0.007 | -0.061*** |
| | (0.040) | (0.040) | (0.025) | (0.027) | (0.009) | (0.010) |
| LogAge | -0.121* | -0.130** | -0.104** | -0.025 | -0.066*** | -0.022 |
| | (0.064) | (0.064) | (0.044) | (0.050) | (0.015) | (0.015) |
| NetFlows | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | -0.000 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.000) | (0.000) |
| ExpRatio | 0.733 | 0.347 | 1.064** | -0.640* | 0.194* | 0.032 |
| | (0.479) | (0.497) | (0.474) | (0.374) | (0.118) | (0.128) |
| LogTurnover | 0.042*** | 0.042*** | 0.047*** | -0.004 | 0.013** | 0.009*** |
| | (0.013) | (0.013) | (0.011) | (0.010) | (0.005) | (0.003) |
| Volatility | -0.102*** | -0.103*** | -0.004 | -0.104*** | -0.010 | |
| | (0.026) | (0.026) | (0.020) | (0.020) | (0.009) | |
| LogFamilySize | 0.119** | 0.117** | -0.017 | 0.135*** | -0.012 | 0.024** |
| | (0.049) | (0.049) | (0.029) | (0.039) | (0.016) | (0.012) |
| TeamManaged | 0.003 | 0.002 | 0.033 | -0.031 | -0.018 | -0.004 |
| | (0.048) | (0.048) | (0.033) | (0.040) | (0.018) | (0.012) |
| LogManagerTenure | -0.040** | -0.040** | -0.011 | -0.029** | -0.014 | -0.012*** |
| | (0.018) | (0.018) | (0.013) | (0.013) | (0.009) | (0.004) |
| FemaleManager | 0.157*** | 0.157*** | 0.113*** | 0.042 | 0.080*** | 0.061*** |
| | (0.048) | (0.048) | (0.037) | (0.041) | (0.030) | (0.013) |
| Fund FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Month FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 33,022 | 33,022 | 33,022 | 33,022 | 33,022 | 33,022 |
| Adj. $R^2$ | 0.8624 | 0.8622 | 0.1892 | 0.9245 | 0.1709 | 0.8525 |

**Panel B: Treatment effect conditional on prior voluntary managerial co-investment**

| | Gross return (%) | Net return (%) | 4F Alpha (%) | 4F Systematic (%) | ValAdd (INRbn) | Sharpe ratio |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| ATE | 0.195* | 0.201* | -0.207*** | 0.408*** | -0.226** | 0.060** |
| | (0.117) | (0.117) | (0.055) | (0.093) | (0.097) | (0.030) |
| ATE × LogPriorCI | -0.722*** | -0.718*** | -0.103 | -0.617*** | 0.028 | -0.136*** |
| | (0.256) | (0.255) | (0.070) | (0.196) | (0.164) | (0.047) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Fund FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Month FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 12,582 | 12,582 | 12,582 | 12,582 | 12,582 | 12,582 |
| Adj. $R^2$ | 0.8805 | 0.8791 | 0.2400 | 0.9321 | 0.2147 | 0.8718 |

This table reports results for panel regressions estimated at the fund-month level that predict various measures of fund performance in a difference-in-differences framework. The treatment is the implementation of the regulation in October 2021 that mandates co-investment by managers of active funds. The sample consists of 497 India-domiciled equity funds, of which 384 belong to the treatment group (active funds) and 113 to the control group (passive funds). The sample period ranges from January 2018 to December 2024. Panel A includes all funds and panel B includes the subset of funds for which we have data on voluntary co-investment in the six months prior to the implementation of the regulation (Prior CI). $ATE$ denotes the average treatment effect and $LogPriorCI$ is the log of (1 + Prior CI). Lagged control variables include the log of fund size, log of fund age, net flows, net expense ratio, log of (1 + turnover ratio), lagged 3-month fund volatility, log of fund family size, log of manager tenure, and dummy variables indicating whether the fund is managed by a team and whether it has a female manager. We do not control for fund volatility in column 6 as volatility is persistent and mechanically related to the Sharpe ratio. Coefficients on the control variables are not reported in panel B for brevity. Standard errors in parentheses are clustered by fund. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

**Table 3.** Effect of mandatory co-investment regulation on fund risk

**Panel A: Unconditional treatment effect**

| | | *CAPM* | | *Carhart model* | |
|---|---|---|---|---|---|
| | $VOL_{total}(\%)$ | $VOL_{syst,1f}(\%)$ | $VOL_{idio,1f}(\%)$ | $VOL_{syst,4f}(\%)$ | $VOL_{idio,4f}(\%)$ |
| | (1) | (2) | (3) | (4) | (5) |
| ATE | 0.214*** | 0.285*** | -0.084** | 0.242*** | -0.009 |
| | (0.067) | (0.062) | (0.040) | (0.062) | (0.035) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ |
| Fund FE | ✓ | ✓ | ✓ | ✓ | ✓ |
| Month FE | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 33,511 | 33,511 | 33,511 | 33,511 | 33,511 |
| Adj. $R^2$ | 0.9331 | 0.9300 | 0.8270 | 0.9326 | 0.8209 |

**Panel B: Treatment effect conditional on prior voluntary managerial co-investment**

| | | *CAPM* | | *Carhart model* | |
|---|---|---|---|---|---|
| | $VOL_{total}(\%)$ | $VOL_{syst,1f}(\%)$ | $VOL_{idio,1f}(\%)$ | $VOL_{syst,4f}(\%)$ | $VOL_{idio,4f}(\%)$ |
| | (1) | (2) | (3) | (4) | (5) |
| ATE | 0.320*** | 0.394*** | -0.047 | 0.346*** | 0.005 |
| | (0.115) | (0.105) | (0.076) | (0.105) | (0.064) |
| ATE × LogPriorCI | -0.679*** | -0.750*** | -0.023 | -0.728*** | 0.004 |
| | (0.082) | (0.084) | (0.079) | (0.082) | (0.061) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ |
| Fund FE | ✓ | ✓ | ✓ | ✓ | ✓ |
| Month FE | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 12,685 | 12,685 | 12,685 | 12,685 | 12,685 |
| Adj. $R^2$ | 0.9361 | 0.9358 | 0.7932 | 0.9379 | 0.7920 |

This table reports results for panel regressions estimated at the fund-month level that predict various measures of fund volatility in a difference-in-differences framework. The treatment is the implementation of the regulation in October 2021 that mandates co-investment by managers of active funds. The sample consists of 497 India-domiciled equity funds, of which 384 belong to the treatment group (active funds) and 113 to the control group (passive funds). The sample period ranges from January 2018 to December 2024. Panel A includes all funds and panel B includes the subset of funds for which we have data on voluntary co-investment in the six months prior to the implementation of the regulation (Prior CI). *ATE* denotes the average treatment effect and *LogPriorCI* is the log of (1 + Prior CI). Lagged control variables include log of fund size, log of fund age, net flows, net expense ratio, log of (1 + turnover ratio), lagged 3-month fund return, log of fund family size, log of manager tenure, and dummy variables indicating whether the fund is managed by a team and whether it has a female manager. Coefficients on the control variables are not reported for brevity. Standard errors in parentheses are clustered by fund. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

**Table 4.** Effect of mandatory co-investment regulation on portfolio selection and fund activeness

**Panel A: Unconditional treatment effect**

| | NumSec | HHI | Cash (%) | Active share | Selectivity (%) | Return gap (%) | LogTurnover |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| ATE | 8.656*** | -30.801*** | -0.093 | -0.028*** | -1.406*** | -0.513*** | 0.013 |
| | (0.826) | (9.161) | (0.202) | (0.007) | (0.400) | (0.102) | (0.029) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Fund FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Month FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 33,062 | 33,062 | 33,062 | 33,062 | 33,062 | 33,062 | 33,062 |
| Adj. $R^2$ | 0.8869 | 0.9017 | 0.5342 | 0.9424 | 0.8099 | 0.8256 | 0.4979 |

**Panel B: Treatment effect conditional on prior voluntary managerial co-investment**

| | NumSec | HHI | Cash (%) | Active share | Selectivity (%) | Return gap (%) | LogTurnover |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| ATE | 6.821*** | -34.123*** | -0.230 | -0.016 | -1.852*** | -0.440*** | 0.002 |
| | (2.007) | (11.940) | (0.481) | (0.015) | (0.631) | (0.135) | (0.060) |
| ATE × LogPriorCI | 2.904 | -20.458* | -0.271 | -0.006 | 4.251*** | -0.285 | 0.062 |
| | (1.869) | (10.966) | (0.390) | (0.012) | (0.742) | (0.231) | (0.041) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Fund FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Month FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 12,594 | 12,594 | 12,594 | 12,594 | 12,594 | 12,594 | 12,594 |
| Adj. $R^2$ | 0.8735 | 0.9189 | 0.5027 | 0.9214 | 0.8027 | 0.8570 | 0.5461 |

This table reports results for panel regressions estimated at the fund-month level that predict various measures of portfolio selection and fund activeness in a difference-in-differences framework. The treatment is the implementation of the regulation in October 2021 that mandates co-investment by managers of active funds. The sample consists of 497 India-domiciled equity funds, of which 384 belong to the treatment group (active funds) and 113 to the control group (passive funds). The sample period ranges from January 2018 to December 2024. Panel A includes all funds and panel B includes the subset of funds for which we have data on voluntary co-investment in the six months prior to the implementation of the regulation (Prior CI). *ATE* denotes the average treatment effect and *LogPriorCI* is the log of (1 + Prior CI). *HHI* has been scaled by multiplying it by 10,000. Lagged control variables include log of fund size, log of fund age, net flows, net expense ratio, log of (1 + turnover ratio), lagged 3-month fund return, lagged 3-month fund volatility, log of fund family size, log of manager tenure, and dummy variables indicating whether the fund is managed by a team and whether it has a female manager. Coefficients on the control variables are not reported for brevity. Standard errors in parentheses are clustered by fund. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

**Table 5.** Effect of mandatory co-investment regulation on risk-taking activity

**Panel A: Unconditional treatment effect**

| | | *CAPM* | | *Carhart model* | |
|---|---|---|---|---|---|
| | $RS_{total}(\%)$ | $RS_{syst,1f}(\%)$ | $RS_{idio,1f}(\%)$ | $RS_{syst,4f}(\%)$ | $RS_{idio,4f}(\%)$ |
| | (1) | (2) | (3) | (4) | (5) |
| ATE | -0.441*** | -0.327*** | -0.144** | -0.307*** | -0.208*** |
| | (0.095) | (0.070) | (0.067) | (0.078) | (0.062) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ |
| Fund FE | ✓ | ✓ | ✓ | ✓ | ✓ |
| Month FE | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 33,064 | 33,064 | 33,064 | 33,064 | 33,064 |
| Adj. $R^2$ | 0.9019 | 0.9234 | 0.8057 | 0.9203 | 0.8057 |

**Panel B: Treatment effect conditional on prior voluntary managerial co-investment**

| | | *CAPM* | | *Carhart model* | |
|---|---|---|---|---|---|
| | $RS_{total}(\%)$ | $RS_{syst,1f}(\%)$ | $RS_{idio,1f}(\%)$ | $RS_{syst,4f}(\%)$ | $RS_{idio,4f}(\%)$ |
| | (1) | (2) | (3) | (4) | (5) |
| ATE | -0.551*** | -0.450*** | -0.165 | -0.435*** | -0.218** |
| | (0.156) | (0.117) | (0.116) | (0.130) | (0.106) |
| ATE × LogPriorCI | 0.944*** | 0.831*** | 0.279*** | 0.902*** | 0.230*** |
| | (0.114) | (0.099) | (0.082) | (0.110) | (0.069) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ |
| Fund FE | ✓ | ✓ | ✓ | ✓ | ✓ |
| Month FE | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 12,597 | 12,597 | 12,597 | 12,597 | 12,597 |
| Adj. $R^2$ | 0.9086 | 0.9307 | 0.8068 | 0.9265 | 0.8081 |

This table reports results for panel regressions estimated at the fund-month level that predict various measures of risk shifting in a difference-in-differences framework. The treatment is the implementation of the regulation in October 2021 that mandates co-investment by managers of active funds. The sample consists of 497 India-domiciled equity funds, of which 384 belong to the treatment group (active funds) and 113 to the control group (passive funds). The sample period ranges from January 2018 to December 2024. Panel A includes all funds and panel B includes the subset of funds for which we have data on voluntary co-investment in the six months prior to the implementation of the regulation (Prior CI). *ATE* denotes the average treatment effect and *LogPriorCI* is the log of (1 + Prior CI). Lagged control variables include log of fund size, log of fund age, net flows, net expense ratio, log of (1 + turnover ratio), lagged 3-month fund return, log of fund family size, log of manager tenure, and dummy variables indicating whether the fund is managed by a team and whether it has a female manager. Coefficients on the control variables are not reported for brevity. Standard errors in parentheses are clustered by fund. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

**Table 6.** Effect of mandatory co-investment regulation on factor timing (Treynor-Mazuy model)

| | $\beta_{mkt}$ | $\gamma_{mkt^2}$ | $\beta_{smb}$ | $\gamma_{smb^2}$ | $\beta_{hml}$ | $\gamma_{hml^2}$ | $\beta_{mom}$ | $\gamma_{mom^2}$ |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| ATE | 0.003 | -0.364 | -0.007 | -2.540*** | -0.030*** | -0.034 | 0.056*** | 0.768 |
| | (0.008) | (0.339) | (0.008) | (0.376) | (0.011) | (0.311) | (0.015) | (0.576) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Fund FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Month FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 33,511 | 33,511 | 33,511 | 33,511 | 33,511 | 33,511 | 33,511 | 33,511 |
| Adj. $R^2$ | 0.5779 | 0.2634 | 0.7282 | 0.3295 | 0.6355 | 0.2568 | 0.4212 | 0.2747 |

To analyze the sensitivity of fund returns to each of the four factors of the Carhart model, we use the return decomposition proposed by Treynor and Mazuy (1966) and extend it to a four-factor framework. Thus, we break down daily excess fund returns for fund $i$ at time $t$ as:

$$NetRet_{i,t} - RF_t = \alpha_i + \beta_{mkt,i}(MKT_t - RF_t) + \gamma_{mkt^2,i}(MKT_t - RF_t)^2 + \beta_{smb,i}SMB_t + \gamma_{smb^2,i}(SMB_t)^2 + \beta_{hml,i}HML_t + \gamma_{hml^2,i}(HML_t)^2 + \beta_{mom,i}MOM_t + \gamma_{mom^2,i}(MOM_t)^2 + \epsilon_{i,t}$$

This table reports results for panel regressions estimated at the fund-month level that predict various measures of factor timing pertaining to the Treynor-Mazuy model (estimated each month) in a difference-in-differences framework. The treatment is the implementation of the regulation in October 2021 that mandates co-investment by managers of active funds. The sample consists of 497 India-domiciled equity funds, of which 384 belong to the treatment group (active funds) and 113 to the control group (passive funds). The sample period ranges from January 2018 to December 2024. $ATE$ denotes the average treatment effect. Lagged control variables include log of fund size, log of fund age, net flows, net expense ratio, log of (1 + turnover ratio), lagged 3-month fund return, log of fund family size, log of manager tenure, and dummy variables indicating whether the fund is managed by a team and whether it has a female manager. Coefficients on the control variables are not reported for brevity. Standard errors in parentheses are clustered by fund. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

**Table 7.** Effect of mandatory co-investment regulation on systematic risk

| | $\text{SVAR}_{total}$ | $\text{SVAR}_{mkt}$ | $\text{SVAR}_{smb}$ | $\text{SVAR}_{hml}$ | $\text{SVAR}_{mom}$ |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| ATE | 5.014*** | 3.505*** | 1.001*** | 0.211** | 0.310* |
| | (0.917) | (0.716) | (0.115) | (0.093) | (0.164) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ |
| Fund FE | ✓ | ✓ | ✓ | ✓ | ✓ |
| Month FE | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 33,511 | 33,511 | 33,511 | 33,511 | 33,511 |
| $R^2$ | 0.9129 | 0.9267 | 0.2822 | 0.4719 | 0.2129 |

This table reports results for panel regressions estimated at the fund-month level that predict various measures of systematic variance in a difference-in-differences framework. The treatment is the implementation of the regulation in October 2021 that mandates co-investment by managers of active funds. The sample consists of 497 India-domiciled equity funds, of which 384 belong to the treatment group (active funds) and 113 to the control group (passive funds). The sample period ranges from January 2018 to December 2024. $SVAR_{total}$ denotes a fund's total systematic variance attributed by the Carhart model. The contribution of factor $j$ to the total systematic variance is given by $SVAR_j = \beta_j \Sigma_{k=1}^{4} \beta_k Cov(F_j, F_k)$, where $\beta_j$ is the fund's beta on factor $j$ and $Cov(F_j, F_k)$ denotes the covariance between the returns on factors $j$ and $k$. $ATE$ denotes the average treatment effect. Lagged control variables include log of fund size, log of fund age, net flows, net expense ratio, log of (1 + turnover ratio), lagged 3-month fund return, log of fund family size, log of manager tenure, and dummy variables indicating whether the fund is managed by a team and whether it has a female manager. Coefficients on the control variables are not reported for brevity. Standard errors in parentheses are clustered by fund. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

# Appendices

## A Benchmark Assignment

We assign a dynamic benchmark to each fund based on the fund's observed returns and holdings. Because we do not have data on the constituents and weights of funds' disclosed benchmark portfolios, we first determine which passive fund can serve as a proxy for each benchmark index. Specifically, we identify the set of indices that are the disclosed benchmarks for the passive funds in our sample and that have daily returns available in Morningstar. This results in a set of 25 benchmark indices listed in Table A1. For each index, we compute the tracking error of all passive funds benchmarked against it using daily fund returns since inception. We select the passive fund with the lowest tracking error among those with an inception date prior to January 2018 (start of our sample period) as the proxy for the benchmark index. If none of the passive funds has an inception date prior to January 2018, then we select the fund with the earliest inception date as the benchmark proxy.

Next, we compare the monthly holdings of all funds in our sample with those of each benchmark proxy and compute the active share for each fund-benchmark pair. The benchmark proxy against which the fund has the lowest average monthly active share over a calendar year is assigned as the inferred benchmark for that fund-year. Thus, the assigned benchmark is the index that is closest to the fund in terms of portfolio holdings throughout the year. Table A1 shows the relative frequency of assignment in the sample. The two primary large-cap indices (Nifty 50 and BSE SENSEX) account for 40% of the benchmark assignments while sectoral indices have a relatively low frequency. We find that in nearly 70% of the fund transitions from one year to the next, the assigned benchmark remains unchanged, as would be expected when funds have a stable investment strategy.

**Table A1.** List of selected benchmark indices

| **Name of benchmark index** | **Fund-year assignments** | **% of total** |
|---|---|---|
| Nifty 50 | 703 | 21.0% |
| BSE SENSEX | 641 | 19.1% |
| S&P BSE 500 India | 290 | 8.6% |
| Nifty 100 | 285 | 8.5% |
| NIFTY Midcap 100 | 169 | 5.0% |
| Nifty Infrastructure | 155 | 4.6% |
| Nifty Bank | 126 | 3.8% |
| Nifty Next 50 | 120 | 3.6% |
| Nifty India Consumption | 118 | 3.5% |
| Nifty Midcap 150 | 113 | 3.4% |
| Nifty Smallcap 250 | 108 | 3.2% |
| Nifty Div Opportunities 50 | 98 | 2.9% |
| Nifty 500 | 82 | 2.4% |
| Nifty50 Value 20 | 49 | 1.5% |
| Nifty50 Shariah | 44 | 1.3% |
| Nifty Financial Services | 43 | 1.3% |
| Nifty IT | 42 | 1.3% |
| Nifty Pharma | 41 | 1.2% |
| Nifty Alpha Low-Volatility 30 | 36 | 1.1% |
| Nifty100 ESG Sector Leaders | 25 | 0.7% |
| Nifty CPSE | 23 | 0.7% |
| Nifty PSU Bank | 15 | 0.4% |
| Nifty Private Bank | 12 | 0.4% |
| Nifty FMCG | 10 | 0.3% |
| Nifty200 Momentum 30 | 7 | 0.2% |

This table lists the benchmark indices that are used to infer and assign the benchmark of a fund in each year. For each index, the passive fund in our sample that has the lowest tracking error against it is labeled as the benchmark proxy. The proxy that yields the lowest average monthly active share for a fund in a year is assigned as its benchmark for that year. The table shows the total number and percentage of times each index is inferred as the benchmark for a fund-year.

# B Variable Definitions

**Table B1.** Definitions of variables

| Variable | Definition |
|---|---|
| Fund size | Fund's net assets under management, as reported. In INR million, unless otherwise specified. |
| Fund age | Number of years since the fund's inception date |
| Net flows | A measure of the net monthly inflows into the fund (as proposed by Sirri and Tufano (1998)): $= \frac{\text{Fund size} - ((1 + \text{Gross return}) \times \text{Lagged fund size})}{\text{Lagged fund size}}$ |
| Net expense ratio | Net expense ratio (NER) of the fund. We compute monthly expense ratios by dividing the reported annual values by 12. For some funds, Morningstar also provides net expense ratios at a monthly frequency. We use these more granular values of net expense ratios if available. |
| Turnover ratio | Monthly turnover ratio calculated based on the month-on-month change in number of shares of securities held in the portfolio: $= \frac{\min(\text{Purchases, Sales})}{\text{Lagged fund size}}$ |
| Family size | The cumulative size of all funds belonging to the same fund family. In INR million, unless otherwise specified. |
| Gross return | Fund return gross of expenses: $\text{Monthly gross return} = \text{Monthly net return} + \frac{\text{Annual NER}}{12}$ $\text{Daily gross return} = \text{Daily net return} + \frac{\text{Annual NER}}{365}$ *Note: For regression analyses with fund return as the dependent variable, we use monthly return computed as (21 * the average daily return over a three-month period) to make the estimates comparable with those for alpha and systematic return.* |
| Net return | Net fund return, as reported. Also, see note under *Gross return.* |

*Continued on the next page...*

*Table B1 (continued)*

| **Variable** | **Definition** |
|---|---|
| 4F Alpha | The alpha of the fund's net returns relative to the Carhart 4-factor model, computed by regressing daily net excess returns on a constant and on daily returns on the market factor ($MKT$), size factor ($SMB$), value factor ($HML$), and momentum factor ($MOM$).<br>*In our default definition, we use a lookback window of 3 months for the computation while we also consider 1 and 6 month windows for robustness. We require having at least 15, 45 and 90 days of return history for the 1M, 3M and 6M lookback windows, respectively.* |
| 4F Systematic | The portion of the fund's net returns explained by exposure to the factor premia in the Carhart 4-factor model, computed by regressing daily net excess returns against daily returns on the corresponding factors and a constant, and then subtracting the alpha from the fitted component. Also, see note under *4F Alpha*. |
| Value added | The nominal value created by the fund management versus the Carhart 4-factor model (analogous to the real value added measure proposed by Berk and Van Binsbergen (2015)):<br>= 4F Alpha (gross) × Lagged fund size<br>In INR billion, unless otherwise specified. |
| Sharpe ratio | The average net excess return of the fund divided by the volatility of net returns over the same period; computed using daily returns:<br>$= \frac{\mathbb{E}[\text{Daily net return} - \text{Daily risk-free rate}]}{\text{Daily net return volatility}}$ |
| Volatility ($\text{VOL}_{tot}$) | The standard deviation of daily net returns.<br>*In our default definition, we use a lookback window of 3 months for the computation while we also consider 1 and 6 month windows for robustness. We require having at least 15, 45 and 90 days of return history for the 1M, 3M and 6M lookback windows, respectively.* |
| Systematic volatility ($\text{VOL}_{syst}$) | Systematic volatility of daily net returns based on the CAPM or Carhart model, computed as the standard deviation of fitted returns obtained upon regressing daily net excess returns against daily returns on the corresponding factors and a constant. Also, see note under *Volatility*. |
| Idiosyncratic volatility ($\text{VOL}_{idio}$) | Firm-specific or non-systematic volatility of daily net returns based on the CAPM or Carhart model, computed as the standard deviation of residual returns obtained upon regressing daily net excess returns against daily returns on the corresponding factors and a constant. Also, see note under *Volatility*. |

*Continued on the next page...*

*Table B1 (continued)*

| **Variable** | **Definition** |
|---|---|
| No. of securities ($NumSec$) | Total number of unique securities (identified as having a unique ISIN identifier) held in the fund's portfolio. Note that cash and cash-like securities (as indicated in the Morningstar data) are treated as one security. |
| HHI | Herfindahl-Hirschman Index (HHI) calculated based on the portfolio weights of each unique security $i$: $= \sum_i (\text{Portfolio weight})^2$ |
| Cash | The sum of portfolio weights of cash or cash-like securities |
| Active share | A measure of the proportion of the fund's portfolio which differs from its corresponding benchmark's portfolio (as proposed by Cremers and Petajisto (2009)). With $i$ identifying a unique security in the union of fund and benchmark portfolios: $= \frac{1}{2} \sum_i \lvert \text{Portfolio weight in fund}_i - \text{Portfolio weight in benchmark}_i \rvert$ |
| Selectivity | A measure of activeness proposed by Amihud and Goyenko (2013), defined as the proportion of variation in net fund returns unexplained by the Carhart 4-factor model, i.e., $1 - R^2$. |
| Return gap | A measure of activeness defined as the difference between observed fund returns and the returns of a hypothetical portfolio based on disclosed portfolio weights, updated monthly, as proposed by Kacperczyk, Sialm, and Zheng (2008). Note that gross returns are used instead of net returns for an even comparison because the transaction expenses for the hypothetical portfolio are indeterminate. Further, returns of the hypothetical portfolio are unadjusted for splits and bonus issues. Also, see note under *4F Alpha*. |
| Risk shift ($\text{RS}_{tot}$, $\text{RS}_{syst}$, $\text{RS}_{idio}$) | A holdings-based measure of intentional change in portfolio volatility (as proposed by Huang, Sialm, and Zhang (2011)), computed as the difference between the past volatility of a hypothetical constant-weight portfolio based on current portfolio weights and the observed fund volatility over the same period. Note that gross returns are used instead of net returns for an even comparison because the transaction expenses for the hypothetical portfolio are indeterminate. Further, returns of the hypothetical portfolio are unadjusted for splits and bonus issues. Also, see note under *Volatility*. |
| No. of managers | The number of managers managing the fund, as inferred from Morningstar's managerial history data. |

*Continued on the next page...*

*Table B1 (continued)*

| **Variable** | **Definition** |
|---|---|
| Team managed | A dummy variable set to 1 if the number of managers managing the fund is more than one, and 0 otherwise. |
| Female manager | A dummy variable set to 1 if there is at least one female amongst the managers managing the fund, and 0 otherwise. |
| Manager tenure | The maximum (amongst all managers managing the fund) number of years till date since the start of the managers' current terms at the fund, as inferred from Morningstar's managerial history data. |
| TCI | Total co-investment (TCI) – both voluntary and mandatory – as on date by fund managers into the fund, as reported. In INR million, unless otherwise specified. |
| Prior CI | A measure of co-investment (CI) made by fund managers into the fund prior to the regulation coming into force, computed as the average *TCI* in the six month period from April 2021 to September 2021. In INR million, unless otherwise specified. |
| Prior CI (dummy variable) | A dummy variable set to 1 if *Prior CI* is positive, and 0 otherwise. |

# C Additional tables

**Table C1.** Summary statistics: Comparison with US market

| | India | | USA | | |
|---|---|---|---|---|---|
| **Variable** | **Mean** | **Median** | **Mean** | **Median** | **Source** |
| Fund size (USD mn) | 519 | 161 | 590 | 626 | Orlov, Ramelli, and Wagner (2023) |
| Fund age (years) | 13.49 | 13.70 | 24.10 | 20.85 | Orlov, Ramelli, and Wagner (2023) |
| Net flows (%) | 0.71 | -0.02 | 0.01 | -0.01 | Orlov, Ramelli, and Wagner (2023) |
| Net expense ratio (%) | 0.09 | 0.09 | 0.09 | 0.08 | Orlov, Ramelli, and Wagner (2023) |
| Turnover ratio (%) | 4.30 | 2.61 | 4.75 | 3.75 | Orlov, Ramelli, and Wagner (2023) |
| Family size (USD bn) | 21 | 11 | 13 | 22 | Orlov, Ramelli, and Wagner (2023) |
| Net return (%) | 1.39 | 1.56 | 1.00 | 1.33 | Orlov, Ramelli, and Wagner (2023) |
| 4F Alpha (%) | 0.14 | 0.12 | -0.05 | -0.06 | Bührle and Yen (2025) |
| Volatility ($VOL_{total}$) (%) | 4.41 | 3.97 | 4.41 | 3.97 | Orlov, Ramelli, and Wagner (2023) |
| No. of securities | 52 | 50 | – | 81 | Kaniel and Wang (2025) |
| Herfindahl-Hirschman Index (HHI) | 0.04 | 0.04 | – | 0.04 | Kaniel and Wang (2025) |
| Active share | 0.62 | 0.62 | 0.80 | 0.87 | Cline and Gilstrap (2021) |
| Selectivity (%) | 15.88 | 12.37 | 4.36 | 3.65 | Bührle and Yen (2025) |
| Team managed (dummy variable) | 0.71 | 1 | 0.79 | 1 | Bührle and Yen (2025) |
| Manager tenure (years) | 4.67 | 3.55 | 9.31 | 8.08 | Bührle and Yen (2025) |
| Total co-investment (TCI) (USD '000) | 160 | 7 | 802 | 600 | Orlov, Ramelli, and Wagner (2023) |
| TCI as % of fund size | 0.026 | 0.004 | 0.310 | 0.040 | Orlov, Ramelli, and Wagner (2023) |

This table compares the mean and median values of some key fund characteristics for the actively-managed subset of our sample of Indian equity funds with the corresponding values reported for actively-managed US-domiciled equity funds in recent studies. All variables are observed and measured at the monthly frequency. We convert the monetary INR amounts for *Fund size*, *Family size* and *TCI* to USD using month-end values from the historical exchange rate data provided by Compustat. Detailed definitions of each variable for our sample are provided in Table B1 in Appendix B.

**Table C2.** Effect of mandatory co-investment regulation on factor timing (Merton-Henriksson model)

| | $\beta_{mkt}$ | $\gamma_{mkt>0}$ | $\beta_{smb}$ | $\gamma_{smb>0}$ | $\beta_{hml}$ | $\gamma_{hml>0}$ | $\beta_{mom}$ | $\gamma_{mom>0}$ |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| ATE | 0.011 | -0.000* | -0.006 | -0.000 | 0.004 | -0.000*** | 0.068*** | -0.000 |
| | (0.010) | (0.000) | (0.008) | (0.000) | (0.011) | (0.000) | (0.016) | (0.000) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Fund FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Month FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 33,511 | 33,511 | 33,511 | 33,511 | 33,511 | 33,511 | 33,511 | 33,511 |
| Adj. $R^2$ | 0.5255 | 0.2440 | 0.6674 | 0.2864 | 0.5819 | 0.2228 | 0.4194 | 0.3041 |

To analyze the sensitivity of fund returns to each of the four factors of the Carhart model, we use the return decomposition proposed by Henriksson and Merton (1981) and extend it to a four-factor framework. Thus, we break down daily excess fund returns for fund $i$ at time $t$ as:

$$NetRet_{i,t} - RF_t = \alpha_i + \beta_{mkt,i}(MKT_t - RF_t) + \gamma_{mkt>0,i}(MKT_t - RF_t) > 0 + \beta_{smb,i}SMB_t + \gamma_{smb>0,i}(SMB_t) > 0 \\ + \beta_{hml,i}HML_t + \gamma_{hml>0,i}(HML_t) > 0 + \beta_{mom,i}MOM_t + \gamma_{mom>0,i}(MOM_t) > 0 + \epsilon_{i,t}$$

This table reports results for panel regressions estimated at the fund-month level that predict various measures of factor timing pertaining to the Merton-Henriksson model (estimated each month) in a difference-in-differences framework. The treatment is the implementation of the regulation in October 2021 that mandates co-investment by managers of active funds. The sample consists of 497 India-domiciled equity funds, of which 384 belong to the treatment group (active funds) and 113 to the control group (passive funds). The sample period ranges from January 2018 to December 2024. *ATE* denotes the average treatment effect. Lagged control variables include log of fund size, log of fund age, net flows, net expense ratio, log of (1 + turnover ratio), lagged 3-month fund return, log of fund family size, log of manager tenure, and dummy variables indicating whether the fund is managed by a team and whether it has a female manager. Coefficients on the control variables are not reported for brevity. Standard errors in parentheses are clustered by fund. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

**Table C3.** Factor premium statistics

**Panel A: Mean return and volatility**

| Period | MKT factor | | SMB factor | | HML factor | | MOM factor | |
|---|---|---|---|---|---|---|---|---|
| | Return | Volatility | Return | Volatility | Return | Volatility | Return | Volatility |
| Full sample | 0.74% | 5.06% | 0.44% | 3.36% | 0.42% | 3.46% | 1.22% | 3.76% |
| Pre-regulation | 0.56% | 5.42% | -0.18% | 3.62% | -0.63% | 3.88% | 1.19% | 4.07% |
| Post-regulation | 0.95% | 4.61% | 1.16% | 3.02% | 1.62% | 2.88% | 1.27% | 3.36% |

**Panel B: Pairwise correlations**

| | *Full sample* | | | | *Pre-regulation* | | | | *Post-regulation* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *MKT* | *SMB* | *HML* | *MOM* | *MKT* | *SMB* | *HML* | *MOM* | *MKT* | *SMB* | *HML* | *MOM* |
| MKT | 1.00 | | | | 1.00 | | | | 1.00 | | | |
| SMB | -0.08 | 1.00 | | | -0.15 | 1.00 | | | 0.04 | 1.00 | | |
| HML | 0.32 | 0.39 | 1.00 | | 0.33 | 0.41 | 1.00 | | 0.31 | 0.37 | 1.00 | |
| MOM | 0.01 | 0.23 | -0.07 | 1.00 | -0.28 | 0.17 | -0.36 | 1.00 | 0.48 | 0.33 | 0.47 | 1.00 |

This table reports summary statistics for the factor premia in the Carhart four-factor model. Panel A shows the average monthly return and volatility for each factor and Panel B shows the pairwise factor correlations. The statistics are computed using daily returns and the means and volatilities are scaled to a monthly horizon. We report statistics for the full sample period (January 2018 to December 2024), the pre-regulation period (January 2018 to September 2021), and the post-regulation period (October 2021 to December 2024).

**Table C4.** Pairwise correlations between key variables

| | *Fund size* | *Fund age* | *Net flows* | *Net expense ratio* | *Turnover ratio* | *Family size* | *Gross return* | *Net return* | *4F Alpha* | *4F Systematic return* | *Value added* | *Sharpe ratio* | *Volatility* | *No. of securities* | *HHI* | *Cash* | *Active share* | *Selectivity* | *Return gap* | *Risk shift* | *No. of managers* | *Female manager* | *Manager tenure* | *Managers' TCI* | *TCI as % of fund size* | *Managers' Prior CI* | *Prior CI (dummy)* | *Prior CI as % of fund size* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fund size | 1.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fund age | 0.26 | 1.00 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Net flows | -0.04 | -0.03 | 1.00 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Net expense ratio | -0.11 | 0.10 | -0.11 | 1.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| Turnover ratio | -0.11 | -0.03 | 0.07 | 0.20 | 1.00 | | | | | | | | | | | | | | | | | | | | | | | |
| Family size | 0.35 | 0.15 | 0.03 | -0.19 | -0.21 | 1.00 | | | | | | | | | | | | | | | | | | | | | | |
| Gross return | 0.04 | 0.08 | -0.01 | -0.05 | 0.05 | 0.06 | 1.00 | | | | | | | | | | | | | | | | | | | | | |
| Net return | 0.04 | 0.07 | -0.01 | -0.06 | 0.04 | 0.06 | 1.00 | 1.00 | | | | | | | | | | | | | | | | | | | | |
| 4F Alpha | 0.02 | 0.01 | 0.07 | -0.00 | 0.02 | 0.04 | 0.29 | 0.29 | 1.00 | | | | | | | | | | | | | | | | | | | |
| 4F Systematic return | 0.03 | 0.07 | -0.04 | -0.06 | 0.04 | 0.05 | 0.94 | 0.94 | -0.06 | 1.00 | | | | | | | | | | | | | | | | | | |
| Value added | 0.31 | 0.08 | 0.00 | -0.02 | -0.03 | 0.13 | 0.11 | 0.11 | 0.41 | -0.03 | 1.00 | | | | | | | | | | | | | | | | | |
| Sharpe ratio | 0.04 | 0.08 | -0.01 | -0.06 | 0.05 | 0.06 | 0.88 | 0.88 | 0.28 | 0.82 | 0.11 | 1.00 | | | | | | | | | | | | | | | | |
| Volatility | -0.08 | -0.07 | 0.05 | 0.00 | 0.03 | -0.06 | -0.37 | -0.37 | -0.16 | -0.31 | -0.08 | -0.29 | 1.00 | | | | | | | | | | | | | | | |
| No. of securities | 0.24 | 0.06 | 0.00 | -0.08 | -0.04 | 0.04 | 0.03 | 0.03 | -0.02 | 0.03 | 0.08 | 0.06 | -0.12 | 1.00 | | | | | | | | | | | | | | |
| HHI | -0.08 | -0.06 | 0.05 | -0.13 | -0.09 | 0.13 | -0.05 | -0.04 | 0.01 | -0.05 | -0.02 | -0.07 | 0.16 | -0.55 | 1.00 | | | | | | | | | | | | | |
| Cash | 0.06 | -0.06 | 0.03 | 0.25 | 0.15 | -0.06 | -0.08 | -0.08 | 0.01 | -0.09 | 0.03 | -0.06 | -0.07 | 0.03 | -0.00 | 1.00 | | | | | | | | | | | | |
| Active share | 0.05 | -0.00 | -0.06 | 0.52 | 0.27 | -0.15 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.03 | -0.07 | 0.06 | -0.35 | 0.44 | 1.00 | | | | | | | | | | | |
| Selectivity | -0.05 | -0.01 | 0.02 | -0.06 | -0.05 | 0.15 | 0.18 | 0.18 | 0.11 | 0.14 | -0.00 | 0.23 | -0.31 | -0.38 | 0.53 | -0.04 | -0.10 | 1.00 | | | | | | | | | | |
| Return gap | 0.01 | -0.00 | 0.02 | 0.02 | 0.04 | 0.03 | 0.68 | 0.67 | 0.30 | 0.59 | 0.13 | 0.54 | -0.22 | -0.00 | -0.01 | -0.03 | 0.02 | 0.00 | 1.00 | | | | | | | | | |
| Risk shift | 0.07 | 0.12 | -0.01 | -0.04 | -0.02 | 0.10 | 0.32 | 0.32 | 0.16 | 0.26 | 0.08 | 0.22 | -0.88 | 0.06 | -0.05 | -0.03 | 0.02 | 0.30 | 0.21 | 1.00 | | | | | | | | |
| No. of managers | 0.17 | 0.10 | -0.01 | 0.10 | 0.13 | 0.11 | 0.05 | 0.05 | 0.04 | 0.03 | 0.06 | 0.07 | -0.12 | 0.15 | -0.11 | 0.23 | 0.31 | 0.01 | 0.00 | 0.11 | 1.00 | | | | | | | |
| Female manager | 0.09 | 0.01 | -0.04 | 0.06 | 0.02 | 0.18 | 0.03 | 0.02 | 0.04 | 0.01 | 0.07 | 0.03 | -0.03 | 0.04 | -0.04 | 0.09 | 0.09 | 0.00 | 0.03 | 0.01 | 0.30 | 1.00 | | | | | | |
| Manager tenure | 0.32 | 0.30 | -0.04 | 0.10 | -0.08 | 0.18 | -0.00 | -0.00 | 0.01 | -0.00 | 0.08 | 0.00 | -0.03 | 0.07 | -0.07 | 0.02 | 0.12 | -0.01 | 0.00 | 0.02 | 0.16 | 0.04 | 1.00 | | | | | |
| Managers' TCI | 0.43 | 0.06 | -0.01 | -0.01 | -0.05 | 0.24 | 0.00 | 0.00 | 0.02 | -0.00 | 0.14 | 0.01 | -0.01 | 0.11 | -0.04 | 0.07 | 0.12 | -0.04 | 0.03 | 0.01 | 0.11 | -0.00 | 0.43 | 1.00 | | | | |
| TCI as % of fund size | 0.02 | -0.05 | 0.03 | 0.07 | 0.03 | -0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.01 | 0.04 | 0.03 | -0.06 | -0.02 | 0.09 | 0.14 | 0.00 | 0.04 | -0.05 | 0.04 | -0.00 | 0.11 | 0.39 | 1.00 | | | |
| Managers' Prior CI | 0.47 | 0.07 | -0.02 | 0.01 | -0.06 | 0.28 | 0.00 | 0.00 | 0.04 | -0.01 | 0.26 | 0.01 | -0.01 | 0.15 | -0.00 | 0.07 | 0.08 | -0.03 | 0.01 | 0.01 | 0.09 | -0.01 | 0.29 | 0.59 | 0.19 | 1.00 | | |
| Prior CI (dummy) | 0.24 | 0.11 | -0.06 | 0.11 | -0.06 | 0.11 | -0.00 | -0.00 | -0.00 | -0.00 | 0.07 | 0.00 | 0.00 | 0.04 | -0.06 | 0.03 | 0.23 | -0.00 | 0.01 | -0.01 | 0.11 | 0.08 | 0.29 | 0.16 | 0.22 | 0.23 | 1.00 | |
| Prior CI as % of fund size | 0.09 | 0.04 | -0.02 | 0.04 | -0.03 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.01 | 0.01 | 0.04 | -0.06 | 0.06 | 0.09 | -0.05 | 0.01 | -0.02 | 0.04 | -0.03 | 0.09 | 0.33 | 0.58 | 0.42 | 0.31 | 1.00 |

This table reports the pairwise (Pearson) correlation coefficients for our key variables of interest, which are measured for each sample fund at a monthly frequency. The sample consists of 497 India-domiciled funds which invest in domestic equities and were operational at the time the co-investment regulation came into force (in October 2021). The sample period extends from January 2018 to December 2024. Detailed definitions of each variable are provided in Table B1.

**Table C5.** Summary statistics: Treatment and Control groups

| | *Treatment group* | | | | *Control group* | | | |
|---|---|---|---|---|---|---|---|---|
| **Variable** | **N** | **Mean** | **Median** | **Std** | **N** | **Mean** | **Median** | **Std** |
| Fund size (INR mn) | 28,250 | 40,328 | 12,260 | 72,539 | 7,849 | 28,424 | 1,916 | 1,06,068 |
| Fund age (years) | 28,250 | 13.49 | 13.70 | 7.96 | 7,849 | 7.93 | 6.10 | 5.97 |
| Net flows (%) | 28,205 | 0.71 | -0.02 | 4.09 | 7,833 | 3.20 | 0.70 | 24.70 |
| Net expense ratio (%) | 28,250 | 0.09 | 0.09 | 0.04 | 7,849 | 0.02 | 0.02 | 0.02 |
| Turnover ratio (%) | 28,200 | 4.30 | 2.61 | 5.68 | 7,831 | 0.91 | 0.00 | 2.85 |
| Family size (INR bn) | 28,250 | 1,599 | 803 | 1,915 | 7,849 | 2,627 | 2,339 | 2,119 |
| Gross return (%) | 27,492 | 1.49 | 1.66 | 3.18 | 7,630 | 1.34 | 1.58 | 3.34 |
| Net return (%) | 28,249 | 1.39 | 1.56 | 3.16 | 7,849 | 1.30 | 1.51 | 3.32 |
| 4F Alpha (%) | 28,249 | 0.14 | 0.12 | 1.08 | 7,849 | 0.11 | 0.08 | 1.30 |
| 4F Systematic return (%) | 28,249 | 0.82 | 0.83 | 3.03 | 7,849 | 0.76 | 0.80 | 3.24 |
| Value added (INR mn) | 27,447 | 89 | 8 | 608 | 7,614 | 61 | 0 | 1,141 |
| Sharpe ratio | 28,249 | 0.32 | 0.32 | 0.72 | 7,849 | 0.27 | 0.28 | 0.66 |
| Volatility ($VOL_{total}$) (%) | 28,249 | 4.41 | 3.97 | 2.15 | 7,849 | 4.92 | 4.35 | 2.51 |
| No. of securities | 28,246 | 52 | 50 | 22 | 7,848 | 55 | 51 | 63 |
| Herfindahl-Hirschman Index (HHI) | 28,246 | 0.04 | 0.04 | 0.02 | 7,848 | 0.07 | 0.05 | 0.06 |
| Cash (%) | 28,246 | 4.34 | 3.32 | 3.80 | 7,848 | 0.38 | 0.16 | 0.78 |
| Active share | 28,246 | 0.62 | 0.62 | 0.15 | 7,848 | 0.06 | 0.00 | 0.15 |
| Selectivity (%) | 28,249 | 15.88 | 12.37 | 12.01 | 7,849 | 19.06 | 14.83 | 14.74 |
| Return gap (%) | 27,480 | 0.07 | 0.28 | 4.16 | 7,624 | -0.08 | 0.14 | 4.24 |
| Risk shift ($RS_{total}$) (%) | 27,484 | -0.29 | 0.20 | 2.50 | 7,627 | -0.44 | 0.20 | 2.86 |
| No. of managers | 28,237 | 2.01 | 2 | 0.85 | 7,804 | 1.36 | 1 | 0.53 |
| Female manager (dummy variable) | 28,237 | 0.21 | 0 | 0.40 | 7,804 | 0.08 | 0 | 0.27 |
| Manager tenure (years) | 28,237 | 4.67 | 3.55 | 3.89 | 7,804 | 3.46 | 2.75 | 2.92 |
| Total co-investment (TCI) (INR mn) | 6,782 | 12.42 | 0.52 | 47.22 | 1,430 | 0.09 | 0.00 | 0.47 |
| TCI as % of fund size | 6,782 | 0.026 | 0.004 | 0.073 | 1,430 | 0.005 | 0.000 | 0.057 |
| Prior co-investment (Prior CI) (INR mn) | 11,812 | 13.73 | 0.07 | 60.39 | 2,395 | 0.38 | 0.00 | 1.45 |
| Prior CI (dummy variable) | 11,896 | 0.55 | 1 | 0.50 | 2,479 | 0.18 | 0 | 0.39 |
| Prior CI as % of fund size | 11,812 | 0.030 | 0.000 | 0.090 | 2,395 | 0.082 | 0.000 | 0.407 |

This table compares the summary statistics for the treatment and control groups. The sample consists of 497 India-domiciled equity funds, of which 384 belong to the treatment group (active funds) and 113 to the control group (passive funds). The sample period ranges from January 2018 to December 2024. All variables are observed and measured at the monthly frequency and all continuous variables are left- and right-winsorized at the 1% level each month. Detailed definitions of all variables are provided in Table B1 in Appendix B.

**Table C6.** Distributions of key variables: Full sample v/s Sample with TCI data

| | *Full sample* | | | | *Sample with TCI data* | | | |
|---|---|---|---|---|---|---|---|---|
| **Variable** | **N** | **P10** | **Median** | **P90** | **N** | **P10** | **Median** | **P90** |
| Fund size (INR mn) | 36,099 | 465 | 8,970 | 98,111 | 13,487 | 596 | 8,917 | 1,20,425 |
| Fund age (years) | 36,099 | 2.40 | 12.10 | 23.84 | 13,487 | 2.88 | 13.38 | 24.94 |
| Net flows (%) | 36,038 | -2.11 | 0.06 | 4.86 | 13,462 | -1.82 | 0.06 | 4.20 |
| Net expense ratio (%) | 36,099 | 0.01 | 0.08 | 0.14 | 13,487 | 0.02 | 0.08 | 0.15 |
| Turnover ratio (%) | 36,031 | 0.00 | 1.83 | 9.03 | 13,458 | 0.00 | 2.21 | 10.10 |
| Family size (INR bn) | 36,099 | 40 | 1,086 | 4,692 | 13,487 | 34 | 405 | 3,127 |
| Gross return (%) | 35,122 | -2.03 | 1.65 | 5.03 | 13,282 | -2.02 | 1.63 | 4.97 |
| Net return (%) | 36,098 | -2.07 | 1.55 | 4.93 | 13,486 | -2.07 | 1.53 | 4.88 |
| 4F Alpha (%) | 36,098 | -1.06 | 0.11 | 1.35 | 13,486 | -1.03 | 0.09 | 1.26 |
| 4F Systematic return (%) | 36,098 | -2.62 | 0.82 | 4.17 | 13,486 | -2.65 | 0.81 | 4.20 |
| Value added (INR mn) | 35,061 | -176 | 4 | 399 | 13,257 | -211 | 4 | 477 |
| Sharpe ratio | 36,098 | -0.61 | 0.31 | 1.21 | 13,486 | -0.62 | 0.31 | 1.20 |
| Volatility ($VOL_{total}$) (%) | 36,098 | 2.61 | 4.05 | 6.35 | 13,486 | 2.62 | 4.04 | 6.30 |
| No. of securities | 36,094 | 25 | 51 | 79 | 13,485 | 27 | 51 | 79 |
| Herfindahl-Hirschman Index (HHI) | 36,094 | 0.02 | 0.04 | 0.07 | 13,485 | 0.02 | 0.04 | 0.06 |
| Cash (%) | 36,094 | 0.10 | 2.46 | 8.16 | 13,485 | 0.14 | 2.67 | 7.74 |
| Active share | 36,094 | 0.00 | 0.57 | 0.80 | 13,485 | 0.00 | 0.56 | 0.79 |
| Selectivity (%) | 36,098 | 5.25 | 12.76 | 33.18 | 13,486 | 5.15 | 12.13 | 29.93 |
| Return gap (%) | 35,104 | -5.03 | 0.24 | 4.78 | 13,270 | -5.08 | 0.22 | 4.72 |
| Risk shift ($RS_{total}$) (%) | 35,111 | -2.48 | 0.20 | 1.95 | 13,276 | -2.49 | 0.23 | 1.99 |
| No. of managers | 36,041 | 1 | 2 | 3 | 13,475 | 1 | 2 | 3 |
| Female manager (dummy variable) | 36,041 | 0 | 0 | 1 | 13,475 | 0 | 0 | 1 |
| Manager tenure (years) | 36,041 | 0.78 | 3.33 | 9.92 | 13,475 | 0.74 | 3.07 | 9.46 |
| Total co-investment (TCI) (INR mn) | 8,212 | 0.00 | 0.27 | 18.03 | 8,100 | 0.00 | 0.27 | 16.60 |
| TCI as % of fund size | 8,212 | 0.000 | 0.003 | 0.044 | 8,100 | 0.000 | 0.003 | 0.042 |
| Prior co-investment (Prior CI) (INR mn) | 14,207 | 0.00 | 0.00 | 16.60 | 13,487 | 0.00 | 0.00 | 17.13 |
| Prior CI (dummy variable) | 14,375 | 0 | 0 | 1 | 13,487 | 0 | 0 | 1 |
| Prior CI as % of fund size | 14,207 | 0.000 | 0.000 | 0.058 | 13,487 | 0.000 | 0.000 | 0.048 |

This table compares the distributions of key fund characteristics within the full sample with those in the narrower sample for which TCI data is available. The full sample consists of 497 India-domiciled equity funds while the sample with TCI data is a subset with 176 funds. The sample period ranges from January 2018 to December 2024. All variables are observed and measured at the monthly frequency and all continuous variables are left- and right-winsorized at the 1% level each month. Detailed definitions of all variables are provided in Table B1 in Appendix B.

# D Online Appendix

In this Online Appendix we provide additional details about the transcription errors in the raw data set and the procedure we followed to correct these errors.

### D.1 Net assets of the fund (obtained from Morningstar)

*Note: The net asset values mentioned in the following list are in INR million. Corrections to the Morningstar data are made using fund disclosures from the period in consideration.*
For the month of October 2023,

- HSBC Brazil Fund (FundID: FSUSA0BGAV) - Erroneous value: 0.000038965;
  Corrected value: 361.5
- HSBC Managed Solutions India Fund - Conservative Plan (FundID: FS0000ARUY) - Erroneous value: 0.000070936;
  Corrected value: 291.2
- HSBC Global Emerging Markets Fund (FundID: FSUSA08QAJ) - Erroneous value: 0.000084924;
  Corrected value: 275.5
- HSBC Asia Pacific (Ex-Japan) Dividend Yield Fund (FundID: FS0000AM6Z) - Erroneous value: 0.000094915;
  Corrected value: 67.7
- HSBC Nifty Next 50 Index Fund (FundID: FS0000FXEJ) - Erroneous value: 0.000110901;
  Corrected value: 683.6
- HSBC Medium Duration Fund (FundID: FS0000BO4I) - Erroneous value: 0.000123889;
  Corrected value: 6890.5
- HSBC Business Cycles Fund (FundID: FS0000B0KN) - Erroneous value: 0.00013388;
  Corrected value: 6203.8
- HSBC Gilt Fund (FundID: FSGBR071IP) - Erroneous value: 0.000165019;
  Corrected value: 2122.7
- HSBC Credit Risk Fund (FundID: FSUSA0A8H0) - Erroneous value: 0.000166851;
  Corrected value: 5233.9
- HSBC Managed Solutions India Fund - Growth Plan (FundID: FS0000ARUW) - Erroneous value: 0.000170847;
  Corrected value: 377.0
- HSBC Infrastructure Fund (FundID: FSUSA08GUX) - Erroneous value: 0.000180838;
  Corrected value: 18106.8
- HSBC Tax Saver Equity Fund (FundID: FSUSA08D4O) - Erroneous value: 0.000186999;
  Corrected value: 1920.4
- HSBC Small Cap Fund (FundID: FS0000ASQ3) - Erroneous value: 0.000278917;
  Corrected value: 115515.8
- HSBC Value Fund (FundID: FSUSA0AG3H) - Erroneous value: 0.000337031;
  Corrected value: 92886.9
- HSBC Flexi Cap Fund (FundID: FSGBR071TV) - Erroneous value: 0.000454926;
  Corrected value: 35041.8
- HSBC Large Cap Fund (FundID: FSUSA08GB3) - Erroneous value: 0.000886872;
  Corrected value: 15023.1

### D.2 Total co-investment by fund managers (obtained from fund SIDs)

*Note: The co-investment values mentioned in the following list are in INR million. Corrections to the SID data are made by dividing the reported values by 100,000 since the error originates from the disclosures having erroneously mentioned the value's unit as INR lakhs (1 lakh = 100,000) when the amount is actually in INR, as evident when comparing the co-investment value with the fund size.*
For the month of September 2021,

- Baroda Dynamic Equity Fund (FundID: FS0000E1VY) - Erroneous value: 8147;
  Corrected value: 0.08147
- Baroda Hybrid Equity Fund (merged into FundID: FS0000E1VY) - Erroneous value: 55933.967;
  Corrected value: 0.55933967
- Baroda Equity Savings Fund (FundID: FS0000FF59) - Erroneous value: 5647.5;
  Corrected value: 0.056475

### D.3 Mandatory co-investment by designated key employees (obtained from fund disclosures)

- The mandatory co-investment disclosures for Bandhan MF from October 2021 to July 2024 include a fund named as 'Untitled Fund'. However, since the other fund names in the disclosure are consistently listed in a broadly alphabetical order, comparing the list with the disclosures from months August 2024 onwards makes it evident that this untitled fund is Bandhan Equity Savings Fund (FundID: FSUSA08XM9), and we relabel it accordingly.
- The mandatory co-investment disclosures for HSBC MF from May and June 2023 do not distinguish between the different plans (Conservative / Growth / Moderate) of HSBC Managed Solutions India Fund and provide the same fund name ('HSBC Managed Solutions India') in all three rows corresponding to these plans. However, since the order in which the other funds are listed is the same as that found in disclosures of the immediately preceding months (April 2023 and earlier), we infer their respective positions and identify each similarly named row as belonging to one of HSBC Managed Solutions India Fund - Conservative Plan (FundID: FS0000ARUY), HSBC Managed Solutions India Fund - Growth Plan (FundID: FS0000ARUW) and HSBC Managed Solutions India Fund - Moderate Plan (FundID: FS0000ARUX), and relabel it accordingly.

### D.4 Manager-level data (obtained from Morningstar)

There are several instances where the same individual is identified by different names in the Morningstar data. While perusing the fund disclosures to obtain information on personal characteristics, it was observed that the differing names are genuinely of the same individual. The likely reasons for such mismatches are the use of initials, a change in surname (such as after marriage) or simple transcription errors. In effect, Morningstar identifies the following pairs of names as separate individuals but we manually code them with the same unique manager-level identifier:

- A. Anandha Padmanabhan AND Anandha Padmanabhan Anjeneyan
- George Heber Joseph AND George Herber Joesph
- Hardik Varma AND Hardik Verma
- Kaushik Basu AND Kausik Baura
- Nishita Doshi AND Nishita Shah

Conversely, in two separate instances, different individuals are identified by the same name in the Morningstar data. This was noted while perusing the employment history of the managers and then cross-checking with their personal LinkedIn profiles and other online references that the individuals are indeed distinct. In effect, Morningstar identifies the following pairs of names as the same individual but we manually code them with different unique manager-level identifiers:

- Ashwani Kumar Agarwalla (manager at Edelweiss and Baroda MFs) AND Ashwani Kumar (manager at Nippon MF)
- Alok Ranjan (manager at ITI, LIC, IDBI and Shriram MFs) AND Alok Ranjan (manager at HSBC and L&T MFs)

We also found one instance where the end date of the manager's term was not updated in the Morningstar data:

- Nikhil Rungta's term as manager of Nippon India Flexi Cap Fund (FundID: FS0000H0W3) ended on 20 November 2023, as per fund disclosures. However, the fund's managerial history obtained from Morningstar shows him as manager at least until the end of our sample period in December 2024. Therefore, we manually add the end date of his tenure as this fund's manager to the data.