CFR Working Paper NO. 22-02

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# Indexing and the Performance-Flow Relation of Actively Managed Mutual Funds

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January 2022

**Abstract**

We exploit the staggered introduction of index funds in different segments and countries to study how increased competition from indexing affects the performance-flow relation and incentives of actively managed equity mutual funds. An increase in the market shares of available country-level index funds in active fund benchmarks is associated with a significantly lower sensitivity of flows to past performance and with a shift from a convex performance-flow relation towards a more linear relation. The increased competition from index funds is also associated with a higher fund performance-liquidation sensitivity, suggesting real economic consequences for active fund managers and fund management companies.

**Keywords:** Performance-flow relation, performance-liquidation sensitivity, mutual funds, active management, passive management, competition

**JEL codes:** G11, G23, G41

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## 1 Introduction

Over the past few decades, an extensive literature has established that mutual fund flows are positively related to past performance and that the relationship is persistent and convex (see, e.g., Chevalier and Ellison, 1997; Sirri and Tufano, 1998; Ferreira, Keswani, Miguel, and Ramos, 2012). Funds with superior recent performance enjoy disproportionately large new money inflows, while funds with poor performance suffer smaller outflows. However, using a sample of broad-based U.S. equity and sector funds, Dannhauser and Pontiff (2019) note that the convexity of this relation appears to have vanished in recent years.

In this paper, we argue that one potential reason for this development is the rise of passive investment opportunities. We exploit the staggered introduction of Exchange Traded Funds (ETFs) in different segments and countries to study how increased competition from indexing affects the performance-flow relation and incentives of actively managed equity mutual funds.[1] We find that the introductions of ETFs and, more generally, an increase in the market shares of available country-level index funds in active fund benchmarks are associated with a significantly lower sensitivity of flows to past performance and with a shift from a convex performance-flow relation towards a more linear relation. Furthermore, we show that increased competition from index funds has real economic consequences for the active fund industry, as it is associated with a higher sensitivity of fund performance to fund liquidation.

Studying how competition affects the shape of the relationship between fund performance and flows to actively managed funds is important. Following several scandals and the relative underperformance of actively managed mutual funds over the last decades, retail investors have shifted investments to broadly diversified low-cost index funds. The popular press[2] highlights

[1] In line with Cremers, Ferreira, Matos, and Starks (2016), we find that the market share of ETFs and other index funds is negatively related to flows of actively managed mutual funds, indicating that active funds compete for flows with passive funds.

[2] For example, see "How ETFs have democratized investing", *Business Insider*, 2011.

the resulting "democratization of investments". Investor flows determine the size of funds, which in turn affects fund manager compensation and incentives.

How is competition from passive funds likely to impact the returns earned by actively managed funds and their performance-flow relationship? The extant literature offers mixed conclusions. One strand of literature on the effect of competition from passive funds on the returns earned by active management assumes that the presence of noise traders, such as retail investors, obscures the value of information in determining the fundamental value of assets. If retail investors shift into passive funds, Grossman and Stiglitz (1980) argue that the shift into passive funds increases the returns to information seeking activities by active mutual funds. The second strand of literature argues that retail investors drive prices away from fundamentals, which offers active fund managers the opportunities to earn returns by returning prices to fundamentals. In this vein, Bond and Garcia (2018) and Stambaugh (2014) argue that increased investment in passive funds reduces the degree of noise trading in the market as retail investors invest more of their money into index funds. This reduces professional investors' opportunities to earn returns from correcting this noise.

Similarly, the predictions from the prior literature on how competition from passive funds affects the performance-flow relationship are also mixed. Kostovetsky and Warner (2020) argue that a lower degree of product competition leads to a lower sensitivity of flow to performance because it is more difficult for investors to put their money in a comparable product. However, Huang, Wei, and Yan (2007) suggest that the degree of convexity changes depending on the participation costs faced by the investors. Participation costs consist of information costs of learning about new funds and transaction costs of purchasing or redeeming fund shares. For medium-performance funds, the sensitivity of flow to performance for active funds increases with participation costs. For high-performance funds, the relationship reverses.

To examine how indexing affects the performance-flow relation, we use an international sample of actively managed equity mutual funds for the period 1995-2018 based on the Lipper database. This setting is econometrically preferable because ETFs are introduced at different points in time for different segments and in different countries, allowing us to control for both segment and country × year fixed effects. The staggered variation in competition by index funds helps identify potential effects of indexing on the performance-flow relation. To measure competition at the country-year-benchmark level, we consider all countries where a passive investment product is available for sale.

We find that increased competition from index funds is associated with a lower sensitivity of investor flows to past fund performance. We also show that decreasing participation costs, associated with the presence of passive investment opportunities, translate into reducing the convexity of the performance-flow relation. Fund investors are less sensitive to high prior performance and more sensitive to poor past performance, indicating a shift from a convex functional form towards a more linear relation between past performance and flows. We find similar results when we limit our sample to U.S. funds alone. These results account for various fund characteristics (such as fund age, expenses, risk, and size) and are robust to including year×rank fixed effects, which capture time-varying heterogeneity across performance ranks. Additional difference-in-differences estimations around the introductions of the first ETFs per country and benchmark support the conclusion that competition from index funds reduces the convexity of the performance-flow relation.

Consistent with predictions from theory, we provide cross-sectional evidence indicating that competition from index funds has stronger effects on the performance-flow relation when investors' opportunity and participation costs are higher. At the country level, the effect of passive funds on the convexity relationship is more pronounced in countries where competition among actively managed mutual funds is higher. They are also stronger for investors who face

higher participation costs for investing in financial instruments. More specifically, we find that competition from index funds has a stronger effect in countries where a low share of population owns shares as well as in low-GDP countries. The effect on convexity is also stronger in countries with lower country-level governance standards where investors arguably face higher information costs when delegating their investment decisions. At the fund level, we find a more pronounced effect on convexity for funds with a high share of retail investors, small funds, and high-fee funds.

Lastly, we show that actively managed funds are significantly more likely to be liquidated for low performance when competition from index funds is high. We also find a marginally significant and positive relation between active fund liquidation and competition from index funds in general. This evidence suggests that the advent of competition from passive investment opportunities has real economic consequences for the active mutual fund industry, particularly for poorly performing fund managers and fund management companies.

Our study contributes to an emerging literature on the real economic implications of ETFs and other passive investments. Existing studies show that higher market share by passive funds influences, among others, the corporate governance of covered firms (Appel, Gormley and Keim, 2016), the volatility of the underlying securities (Ben-David, Franzoni, and Moussawi, 2018), and stock return correlations (Da and Shive, 2018). In a study related to ours, Cremers, Ferreira, Matos, and Starks (2016) show that actively managed equity mutual funds increase their active shares and charge lower fees in the face of competition from passive funds. While the authors suggest that fund managers increase their active share because fund investors value this behavior, the relation between flows to active mutual funds and competition from index funds remains unclear. This relation, however, is crucial to understand because it constitutes an important external governance mechanism in the mutual fund industry.

By showing that increased competition from index funds is associated with a significantly higher performance-liquidation sensitivity of active mutual funds, our study also contributes to the literature on managerial incentives in the mutual fund industry. Extant studies examine the relationship between fund managers' incentives and their risk-taking behavior arising from the convex flow-performance relation (see, e.g., Brown, Harlow, and Starks, 1996; Chevalier and Ellison, 1997; Kempf, Ruenzi, and Thiele, 2009) as well as the link between contractual incentives of fund managers and their performance (e.g., Elton, Gruber, and Blake, 2003; Dass, Massa, and Patgiri, 2008; Ma, Tang, and Gómez, 2019).

This paper proceeds as follows. Section 2 provides the theoretical underpinning of our study, while Section 3 presents the data and methodology. In Section 4, we present and discuss our empirical results. Section 5 concludes.

## 2 Theoretical Underpinning

Berk and Green (2004) develop a rational-choice equilibrium model for mutual funds where the equilibrium mechanism for mutual funds works via an adjustment of quantity. Fund investors react to information about managerial ability by adjusting their investment in the fund and create in- or outflows that change the size of a fund. Positive information about the funds' ability leads to inflows, while negative news leads to fund outflows. Fund managers' ability has decreasing returns to scale. Investment ideas are finite and, in consequence, the ability to deliver superior return is limited by fund size.

Berk and van Binsbergen (2017) note that the gross alpha generated by a fund manager depends on the amount of assets, $q$, she manages and is equal to

$$\alpha(q) = a - bq. \tag{1}$$

The fund manager can extract an amount $a$ on the first dollars under her discretion. As the supply of investment ideas is finite, she implements the best ideas first. The amount $a$ declines

at a rate $b$ for every increase of invested capital $q$. For more skilled fund managers, the rate $b$ is smaller. In other words, these fund managers have more/better investment ideas. More capital flows into funds of more capable managers. They can implement all their ideas until the fund becomes too large. The size of funds increases until the expected returns to fund investors are competitive and the market is in equilibrium. Therefore, the inability of fund managers as a group to outperform is not a sign of low skill. It only shows that capital provision is competitive and capital flows to the most productive investments, i.e., the average alpha from fund managers is zero.

Stambaugh (2014) develops a model that shows that the growth in indexing leads to noise traders (e.g., unsophisticated retail investors) switching from direct investments in stocks to passively managed funds. Bond and Garcia (2018) develop a similar model that also shows a reduction of uninformed agents trading in the market. They link this decline explicitly to the decline in costs of indexing strategies. French (2008) also documents that the number of unsophisticated investors who trade in individual stocks has declined. This decrease in noise traders leads to less noise that can be corrected by active fund managers. Stambaugh (2014) notes that "less noise trading implies a lower capacity for profitable active management" and "active management must then have a smaller footprint".

By transferring the insights from Stambaugh (2014) to the equilibrium model by Berk and Green (2004), the increase in passive funds leads to a decrease in the proportion of noise traders in the market, which in turn increases parameter $b$ in equation (1). As there are fewer opportunities for active managers to take advantage of that noise by applying profitable investment ideas, the importance of fund manager skill decreases. With a higher rate of $b$, the market equilibrating quantity $q$ decreases, leading to a decline in sensitivity of past performance on fund flows.

Turning to the convexity of the relation between performance and flow, Huang, Wei, and Yan (2007) develop a model that shows how participation costs create the convex performance-flow relation. The model is based on the following assumptions. First, investors learn about managerial ability from past performance as in Berk and Green (2004). Second, investors have participation costs. Huang, Wei, and Yan (2007, p. 1274) argue that this cost friction "can lead to different flow responses at different performance levels and can cause the cross-sectional variations in the flow-performance relationship". Differences in participation costs arise because of heterogeneity in investor sophistication, cost of active information collection, and transaction costs. In the model of Huang, Wei, and Yan (2007), past performance has to exceed a threshold value before an individual investor will start to investigate whether to invest in a fund. Investors with higher participation costs, such as retail investors, only start investigating a potential investment in a fund that has a high past performance. Because of this friction, investors with high opportunity costs only invest in funds with high past performance, which in turn, causes the observable cross-sectional pattern of a convex relation between performance and flows. Funds with high past performance experience disproportionately high inflows.

Passive funds arguably reduce participation costs in a market. They appeal to unsophisticated investors because of their simplicity, increased advertising and attention, and recommendations by financial experts. Bond and Garcia (2020, p.1) state that "the standard investment recommendation that financial economists offer to retail investors is to purchase a low-fee index mutual fund or exchange traded fund". The simplicity of an index-tracking product also reduces the cost of active information collection. The cost to make an informed investment decision in a passive product is considerably lower than those for the decision of investing in an actively managed product.

The prevalence of passive funds leads to a reduction in participation costs and therefore reduces the performance-flow convexity. Investors with previously higher participation costs

do not allocate capital to high past performers only. They no longer only investigate high-performing active funds because they have the opportunity to invest in low-cost indexing. This leads to a reduction of inflows for these high past-performers and the cross-sectional convexity of performance and flow becomes more linear. Thus, we expect the effect of competition by passive investments to be the strongest in an environment where participation costs are high and where potential gains from shifting flows to passive funds are large.

## 3 Data, Methodology, and Summary Statistics

### *3.1 Data Sources and Sample Selection*

We use an international sample of mutual funds on a yearly basis for the period 1995−2018. Our primary data source is the Lipper database that comprises a comprehensive sample of globally headquartered mutual funds. This data has been used extensively in prior research covering international funds (see, e.g., Cremers, Ferreira, Matos, and Starks, 2016; Ferreira, Keswani, Miguel, and Ramos, 2012). The Lipper data is survivorship-bias free as it includes operating, liquidated, and merged funds. We focus on open-ended equity mutual funds for which we obtain data on basic fund characteristics such as fund name, domicile, benchmark, returns, expense ratio, and total net assets. As the unit of observation, we use the share class that Lipper identifies as the primary share class. Variables at the fund-level, such as return and expense ratio, equal the total net asset (TNA)-weighted average across all fund share-classes. We exclude funds with TNA lower than 5mn US$, because of the incubation bias described by Evans (2010). In addition to actively managed equity funds, Lipper also provides information on passively managed open-end equity mutual funds and equity exchange traded funds (ETFs), specifically, the country where the share class is registered for sale and the same basic information as for the actively managed fund sample.

Our final sample consists of 11,928 open-end equity mutual funds with information on the market share of passive funds, fund size, expense ratio, and investor flows. Overall, our

regressions are based on 96,817 to 87,215 fund-year observations, depending on available control variables.

### *3.2 Key Variables and Methodology*

As in Cremers, Ferreira, Matos, and Starks (2016), our main independent variable is the market share of passive funds, denoted *MS Passive*. We use data on passive funds and calculate the sum of TNA by country of sale, year, and benchmark. Importantly, we consider all countries where a passive investment product is available for sale.[3] The benchmark is the index that the active fund states in its prospectus. Active mutual fund performance is measured against this benchmark performance. Using the same procedure for actively managed mutual funds, we calculate the market share of passive funds using the following formula:

$$MS_{c,bm,t} = \frac{\sum TNA^{p}_{c,bm,t}}{\sum TNA^{a}_{c,bm,t} + TNA^{p}_{c,bm,t}} \tag{2}$$

where $TNA^{p}_{c,bm,t}$ is the TNA of all passive funds in country *c* and benchmark *bm* in year *t*, and $TNA^{a}_{c,bm,t}$ is the TNA of all actively managed funds in country *c* and benchmark *bm* in year *t*. The market share of passive funds is matched to the actively managed fund sample by country, benchmark, and year.

As in Chevalier and Ellison (1997) and Sirri and Tufano (1998), we define the yearly flow as the growth rate of TNA not due to capital gains and dividends. The flow for fund *i* domiciled in country *c* in year *t* is:

$$Flow_{i,c,t} = \frac{TNA_{i,c,t} - TNA_{i,c,t-1}(1 + R_{i,c,t})}{TNA_{i,c,t-1}} \tag{3}$$

[3] For example, to calculate the market share of passive funds in Germany, we use the size of each fund that is available for sale in Germany. This may include passive funds that are officially registered in the U.S. or Ireland but available for sale in Germany.

where $TNA_{i,c,t}$ is the total net asset value in local currency for fund *i* in country *c* at the end of year *t*. $R_{i,c,t}$ is the raw return of fund *i* in country *c* in year *t*. We winsorize annual flows at the 1% level.

As performance measures, we use the funds' net raw return and Jensen's alpha, which is risk adjusted for the market risk factor. This risk factor has been shown to be the most relevant factor for mutual fund investors (see, e.g., Barber, Huang, and Odean, 2016; Berk and van Binsbergen, 2016). Lipper also provides information on funds' geographic focus. We use the market risk factor return of this geographic region to calculate risk adjusted returns. Market factor returns are provided on a global level by Frazzini and Pedersen (2014).

To measure the convexity in the relation between fund flows and past performance, we employ piecewise regressions as in Sirri and Tufano (1998) and many others. This approach allows for different performance-flow sensitivities depending on the level of performance. For each year and country, funds' fractional performance rank, ranging from 0 (worst relative performance) to 1 (best relative performance), is calculated. Performance is defined as funds' net raw return or Jensen's alpha. For each fund, we define three performance measures as:

$$\begin{aligned} Low_{i,c,t} &= min(0.2, Rank_{i,c,t}) \\ Mid_{i,c,t} &= min(0.6, Rank_{i,c,t} - Low_{i,c,t}) \\ Top_{i,c,t} &= Rank_{i,c,t} - (Low_{i,c,t} + Mid_{i,c,t}) \end{aligned} \tag{4}$$

For our baseline analysis, we pool the data and run the following OLS panel regression model (see equation (5)) with benchmark as well as country and year or country times year fixed effects depending on the specification:

$$\begin{aligned} Flow_{i,c,t} = \alpha + \beta_1 Low_{i,c,t-1} + \beta_2 Mid_{i,c,t-1} + \beta_3 Top_{i,c,t-1} + \beta_4 MS_{c,bm,t-1} \\ + \beta_5 Low_{i,c,t-1} \times MS_{c,bm,t-1} + \beta_6 Mid_{i,c,t-1} \times MS_{c,bm,t-1} + \beta_7 Top_{i,c,t-1} \times MS_{c,bm,t-1} \\ + Controls_{i,t-1} \end{aligned} \tag{5}$$

with variables as defined above. The coefficients $\beta_1$ to $\beta_3$ indicate the marginal change in flow with respect to past performance. This approach allows for different responses depending on the fund's performance quantile in the past year. Coefficient $\beta_4$ measures the marginal effect of the market share of passive funds. Most important, coefficients $\beta_5$ to $\beta_7$ measure the change in performance sensitivity due to the presence of passive investment opportunities in a market. The model includes the following control variables lagged by one period: expenses (*Expenses*), past flows (*Flow*), fund age (*Fund Age)* and fund size (*Fund size)*, an indicator for institutional investor clientele (*Institutional Fund*), the volatility of monthly returns over a period of twelve months (*Risk)*, an indicator for team-managed funds (*Team*), and the volatility of monthly fund flows over a period of twelve months (*Volatility Flow*).

All regressions also include fixed effects for a fund's benchmark in conjunction with either i) country and year fixed effects, or ii) country × year fixed effects, or iii) country and year × rank fixed effects. These fixed effects control for (un)observed heterogeneity at the benchmark, country, and year level. Importantly, the use of country × year fixed effects allow us to control for virtually any (time-invariant and time-variant) heterogeneity at the country level, which addresses the issue that our results might be driven by some underlying factor at the annual country level. Lastly, year × rank fixed effects account for time-varying heterogeneity across performance ranks.

We retrieve from Lipper the binary variable *Liquidation*, indicating whether a fund is liquidated. We use *Liquidation* as another dependent variable and estimate a linear probability model in this case. In later analyses, we use heterogeneity at the country level for subsample regressions. Data on GDP per Capita and country-level governance are from the World Bank. We construct a country-level governance index based on the World Governance Indicators (WGI) provided by the World Bank, which include the following yearly indicators: Voice and

Accountability, Rule of Law, Regulatory Quality, Political Stability and Absence of Violence, Government Effectiveness, and Control of Corruption. Based on the median of each variable we classify each country as well governed (1) or poorly governed (0). We sum up all indicator variables and create an index ranging from 0 (worst governance) to 6 (best governance). The percentage of population owning shares is from Grout, Megginson, and Zalewska (2009).

### *3.3 Summary Statistics*

Table 1 reports summary statistics for the market share of passive investments in a benchmark by country (Panel A) and for active fund characteristics such as fund size, expense ratio, return, and Jensen's alpha (Panel B). The market share of passive investment funds varies significantly across countries. In our sample, India and Egypt have the lowest market share of passive funds with 1% in each country while Japan represents the maximum with 41% of the market consisting of passive funds. While we find significant variation across countries, we also find considerable variation within countries, depending on the fund's benchmark within the country (e.g., S&P500, DAX30).

The average annual flow into our active fund sample is about 17%. The funds offer a mean yearly return of 5.23% while the average Jensen alpha is slightly negative with -1.08 % p.a. Overall, fund performance measures are consistent with other studies reporting similar risk-adjusted returns (e.g., Barber, Huang, and Odean, 2016; Ferreira, Keswani, Miguel, and Ramos, 2012). The average fund has a TNA of US$ 955 million with a minimum of US$5 million and a maximum of US$ 188 billion. In our sample, 27.7 % of funds offer institutional investor share classes. The annual expense ratio is 1.47% on average.

## 4 Empirical Results

Figure 1 depicts the relation between flows to actively managed mutual funds and our main independent variable, the market share of passive funds (*MS Passive*). In line with Cremers,

Ferreira, Matos, and Starks (2016) as well as with our expectations, the market share of passive funds is negatively related to flows of actively managed mutual funds. This result indicates that fund investors regard active and passive funds as substitutes. Accordingly, active funds increasingly compete for flows with passive funds. Figure 2a illustrates the relation between past performance and flows for equity funds. As documented by the extensive literature on mutual fund flows (see, e.g., Chevalier and Ellison, 1997; Sirri and Tufano, 1998; Ferreira, Keswani, Miguel, and Ramos, 2012), this relation is clearly convex, i.e., good past performers experience disproportionately high inflows of capital, while poor past performers do not experience large outflows.

We next sort the active funds into quintiles depending on the market share of passive funds. Figure 2b shows the performance flow relation for two separate groups of funds. *High Passive* are active funds that belong to the quintile with the highest competition from passive funds and *Low Passive* are active funds in the lowest quintile of passive competition. Figure 2b documents a significantly different relation between flows and past performance depending on the level of passive competition. First, we find a difference in the overall sensitivity of flows to past performance depending on the level of competition from passive funds. Among funds with high competition from indexers, the relation between flows and performance is significantly less pronounced, suggesting flows are less sensitive to past performance. Turning to the functional form of the relation, we find that funds in the lowest passive quintile (i.e., those with the lowest passive competition) display a similar convex relation, consistent with the prior literature. In contrast, actively managed funds with a high level of competition show a linear relation between past performance and flows. Investors are less sensitive to high past performance and more sensitive to low past performance.

### *4.1 Baseline regression results*

Our results are similar in a multivariate regression framework. We first conduct fund-level regressions of flows on past performance and our variable of interest, *MS Passive,* including the control variables described in Section 3.2. Table 2 reports the coefficients for OLS regressions of flow on past performance (*Ranked Performance*$_{t\text{-}1}$) conditional on the market share of passive funds, as captured by the interaction term *Ranked Perf*$_{t\text{-}1}$ × *MS Passive*$_{t\text{-}1}$. The performance indicator in columns (1) to (3) is the fund's raw return, while in columns (4) to (6) it is the Jensen's alpha. Across all six regressions, the coefficient on the interaction term of past performance and the market share of passive funds is negative and significant at the 1% level. Flow appears to be consistently less sensitive to past performance if the market share of passive funds is high.

With respect to the control variables, we find that flows are lower for larger and more expensive funds. We also find a negative relation for older and riskier funds. The coefficients for control variables are documented in prior literature (e.g., Ferreira, Keswani, Miguel, and Ramos, 2012; Sirri and Tufano, 1998).

Table 3 reports coefficients for regressions testing the functional form of the relation between flows and past performance in the presence of passive competition. Here, the performance ranks are calculated using the piecewise linear regression framework described above. The control variables and fixed effects are the same as in Table 2. The coefficients for the performance ranks are consistent with the well-documented convex relation between flows and past performance. While the coefficient on the bottom quintile of performance is positive, the magnitude of the coefficient is relatively small. In contrast, the coefficients for the top quintile of past performance are much larger in terms of economic (and, in part, statistical) significance for all specifications. Investors are more sensitive to good past performance than to bad past performance, consistent with the convexity displayed in Figure 2a. The difference

between the coefficients of bottom and top performance is statistically significant at the 1% level (p-value = 0.003; column (2)).

Most importantly, the interaction terms of the different performance ranks and the market share of passive funds are statistically significant in all specifications. In line with Huang, Wei, and Yan (2007), we find that when passive funds reduce fund investors' participation costs, the relation of past performance and flows becomes less convex. The coefficient on *Low Ranked* $Perf_{t-1}$ × *MS* $Passive_{t-1}$ is positive and statistically significant, which suggests that the relation between flows and poor performance is more sensitive for low-performance funds. In contrast, the coefficient on *Top Ranked* $Perf_{t-1}$ × *MS* $Passive_{t-1}$ is negative and statistically significant, indicating a lower sensitivity of flows to past performance for high-performance funds. Overall, when passive fund competition is high, investors appear more willing to sell active funds that with poor past performance, while not chasing past active funds with high prior performance.

In economic terms, a one standard deviation increase in *MS Passive* increases the sensitivity of flows to low performance by 0.233 and decreases the sensitivity of flows to good performance by 0.279 (column (2)). Adding the baseline coefficients, we find that an increase by one standard deviation of *MS Passive* indicates a coefficient of 0.379 for low performance and 0.237 for high performance. The difference in coefficients for low and high past performance is no longer significant (p-value = 0.2209). This result suggests that investors are as sensitive to low performance as to high past performance in the presence of high passive fund competition. The function between past performance and flows is no longer convex but linear. The coefficients on the control variables are similar to those in Table 2 and the prior literature.

Because the U.S. accounts for 40% of the observations in our sample, we restrict the fund universe to the U.S. alone and re-estimate the regressions presented in Table 3. We find

qualitatively similar results, as shown in Table 4. To mitigate concerns that our results might be driven exclusively by the U.S., we re-estimate our baseline regressions shown in Tables 2 and 3 using weighted least squares (WLS). The results, which we present in Panels A and B of Appendix B, are qualitatively similar.

### *4.2 Introduction of Exchange Traded Funds*

The emergence of ETFs as an investment product accelerated the growth in capital managed by passive funds tremendously. We use the staggered international introduction of ETFs as an event that increased competition for actively managed mutual funds. Panel A of Table 5 lists the launch dates of the first domestic equity ETF per country while Panel B further lists examples of introduction dates by benchmark and country.

Panel C of Table 5 reports the results of a difference-in-differences analysis around the introduction of passive funds by country and benchmark. Specifically, the indicator variable *Post* is equal to one for the period after the first introduction of an ETF in a specific country and benchmark. The regressions include the same extensive set of controls as in Table 3 and fixed effects on the benchmark, country, and year level. Column (2) additionally includes an indicator variable for the period before the introduction of ETFs, denoted *Pre*, which serves as a test for the parallel trends assumption of staggered difference-in-differences estimations.

In both specifications, our results are similar to those in Table 3, where we consider ETFs and other index funds. After the introduction of ETFs as a potential investment product, the convex relation between past performance and flows becomes more linear. Investors are more sensitive to low performance and less sensitive to high performance in the periods after ETFs are introduced to the specific market, as indicated by the positive coefficient on *Low Ranked* $Perf_{t-1} \times Post$ and the negative coefficient on *Top Ranked* $Perf_{t-1} \times Post$.

The parallel trends assumption is not violated. Markets do not appear to differ significantly with respect to the performance-flow relation before the introduction of ETFs as indicated by the insignificant coefficients on the indicator variable *Pre* in column (2). However, one possible concern is that the introduction of ETFs is not plausibly exogenous to fund families that simultaneously offer actively managed mutual funds. We address this issue by restricting the treatment to only those ETFs that are introduced by fund families that do not offer actively managed mutual funds. As shown in column (3) of Table 5, the results stay robust to this change. In column (4), we employ a propensity score matching approach. We match all treated funds with a control group of funds consisting of the nearest neighbor with respect to average fund size, fund expenses, and the market share of passive funds in the respective benchmark over the 3 years before treatment. The conclusions remain unchanged.

Overall, Table 5 supports the evidence in Table 3 that passive investment funds, especially ETFs, act as an investment product that decreases investors' participation costs and, in line with this reduction in costs, also reduces the convexity of performance and flows for actively managed mutual funds.

### *4.3 Cross-sectional results*

The evidence from Tables 3 and 5 so far indicate that passive investment funds act as instruments that reduce participation costs and the convexity of active mutual funds. In this section, we show cross-sectional evidence, at both the country- and at the fund-level, that the effect of passive funds on the convexity relationship is most pronounced where ex-ante participation and opportunity costs are high.

First, in Table 6, we present results on cross-country variation. In each regression specification, we divide our sample in two groups based on the median number of actively managed funds as a proportion of GDP, % of population owning shares, GDP/capita, and a country-level Governance index, respectively. All specifications include the same extensive

set of control variables as column (2) in Table 3. Additionally, we use benchmark and country-year fixed effects to control for heterogeneity at the benchmark and country level.

First, in Table 6, we examine whether the effect on convexity is related to the level of competition among active mutual funds in the country. We expect that additional competition from index funds is especially important in affecting the convexity relationship when there already is a significant level of competition among active funds. Columns (1) and (2) in Table 6 compare countries with a high vs. low number of actively managed funds. The reduced sensitivity of the performance-flow relation appears to be particularly pronounced in countries with a high level of competition among active funds.

It is plausible that less sophisticated investors face higher financial market participation costs because they have higher search costs and high information asymmetries. Khorana, Servaes, and Tufano (2009) and Ferreira, Keswani, Miguel, and Ramos (2012) argue that GDP/capita and the proportion of population owning shares are proxies for investor sophistication. In columns (3)-(6), we compare countries on these two proxies. The effect of *MS Passive* on the flow-performance sensitivity relation is stronger for countries with lower financial market sophistication, i.e., in countries with lower GDP and a lower percentage of people owning shares, exactly where ex-ante participation costs are high and the convexity is most pronounced. Competition from passive funds reduce this ex-ante high level of participation costs substantially. In consequence, investors are more sensitive to low performance and less sensitive to high performance, making the relation between past performance and flows for active funds less convex. This finding is in line with Huang, Wei, and Yan (2007) who argue that lower participation costs result in a reduction in the convexity of the relation between past performance and flows and with empirical findings by Ferreira, Keswani, Miguel, and Ramos (2012).

Columns (7) and (8) divide the samples of countries on the basis of country-level proxies for governance (e.g., rule of law, regulatory quality, and control of corruption). The performance-flow relation is likely to be an important governance mechanism for mutual funds, more so than other governance mechanisms, such as the board of directors. Fama and Jensen (1983, p. 318) argue that "the strong form of diffuse decision control [is] inherent in the redeemable residual claims of financial mutuals … their boards are less important in the control process than the boards of open nonfinancial corporations". However, this mechanism can only act as an effective tool if investors reduce investment in poorly performing funds but do not disproportionately award flows to high past performers. The potential gains from this external governance mechanism are likely to be high where other governance mechanisms are missing. Column (8) shows that competition from passive funds reduces convexity, and thus strengthens governance for active funds, where countrywide governance is low. In countries where investors are not well protected via country-wide governance mechanisms, such as for example by the rule of law, passive competition strengthens the external governance mechanism of mutual funds by decreasing convexity.

Second, in Table 7, we present results on cross-fund variation. We divide the sample on the basis of institutional investor presence, the level of fees, and fund size. As in Table 5, we find that passive competition is most effective in reducing convexity where participation and opportunity costs are ex ante higher. Consistent with Huang, Wei, and Yan (2007), we find that the relation between flows and past performance is more convex for retail, smaller and more expensive funds. Columns (1) and (2) show that passive competition has a strong effect on fund flows from retail funds, and basically no effect on institutional funds. This result is consistent with Evans and Fahlenbrach (2012) who document that institutional investors are more sensitive to poor past performance. As participation costs are higher for less sophisticated

investors, the emergence of passive funds as an investment alternative has a stronger effect on this sub-group of funds.

Columns (3) and (4) separate funds into high and low fee funds by median. Opportunity costs are higher for more expensive active funds. Investors gain more from switching to a low-cost index fund than when they are investing in comparatively less expensive active mutual funds. In line with this argument, we find a stronger reduction in convexity for high-cost mutual funds.

Using fund size as a proxy for search and information costs, Columns (5) and (6) divide the sample on the basis of size. Information asymmetries, and therefore information costs, are higher for smaller funds where only limited information is available. Consistent with our prior results, we again find that competition from passive funds reduces the convexity of the fund flow-performance relationship, especially for smaller funds.

Overall, the evidence from both our cross-sectional country- and fund-level indicate that competition from passive funds affects the performance-flow relation of active funds most if ex ante participation costs are higher.

### *4.4 Fund liquidation*

Finally, we attempt to address the important question of whether the advent of competition from passive funds has real economic consequences for the active mutual fund industry. Specifically, we examine the performance-liquidation sensitivity of active funds in the presence of competition from passive funds. We test whether the larger sensitivity to past performance for poorly performing funds is associated with a higher likelihood of fund liquidation, which constitutes an important external governance mechanism. In Table 8, we present estimates from OLS regressions similar to those in Table 2 with the indicator variable *Liquidation* as the dependent variable. This variable equals one if a fund is liquidated in year *t*.

We document that active funds are more likely to be liquidated for low performance in the presence of higher passive fund competition. Across all four columns, we find a negative relation between past performance and the likelihood for liquidation. Funds with higher performance are significantly less likely to be terminated. However, high competition from passive funds, measured by the indicator variable *High MS Passive*$_{t-1}$, which equals one if *MS Passive* takes values above its sample median, increases the likelihood of fund termination. Most important, we find that the probability that a fund is liquidated becomes more sensitive to past fund performance (both raw returns and Jensen alpha) in the presence of higher competition from passive funds. Specifically, the interaction term between past performance and the market share of passive funds, i.e., *Ranked Perf*$_{t-1}$ × *High MS Passive*$_{t-1}$, is negative and statistically significant at the 1% level across all columns. This finding suggests that the increased sensitivity of flows to past performance for poor performers results in real consequences for fund managers and fund management companies.

## 5 Conclusions

This paper contributes to the emerging literature on the real economic consequences of passive investment funds. In particular, we attempt to examine how competition from ETFs and other index funds may affect the active mutual fund industry. We exploit the staggered introduction of ETFs in different segments and countries to study how increased competition from indexing affects the performance-flow relation and incentives of actively managed equity mutual funds. We find that the introductions of ETFs and, more generally, an increase in the market shares of available country-level index funds in active fund benchmarks are associated with a significantly lower sensitivity of flows to past performance and with a shift from a convex performance-flow relation towards a more linear relation. Consistent with theory, we show that competition from index funds has stronger effects on the performance-flow relation when investors' opportunity and participation costs are higher.

Furthermore, we show that increased competition from index funds is associated with a significantly higher sensitivity of fund performance to fund liquidation, indicating real consequences for active fund managers and fund management companies. The evidence suggests that competition from index funds constitutes an important external governance mechanism for actively managed mutual funds, thereby fostering our understanding of mutual fund governance.

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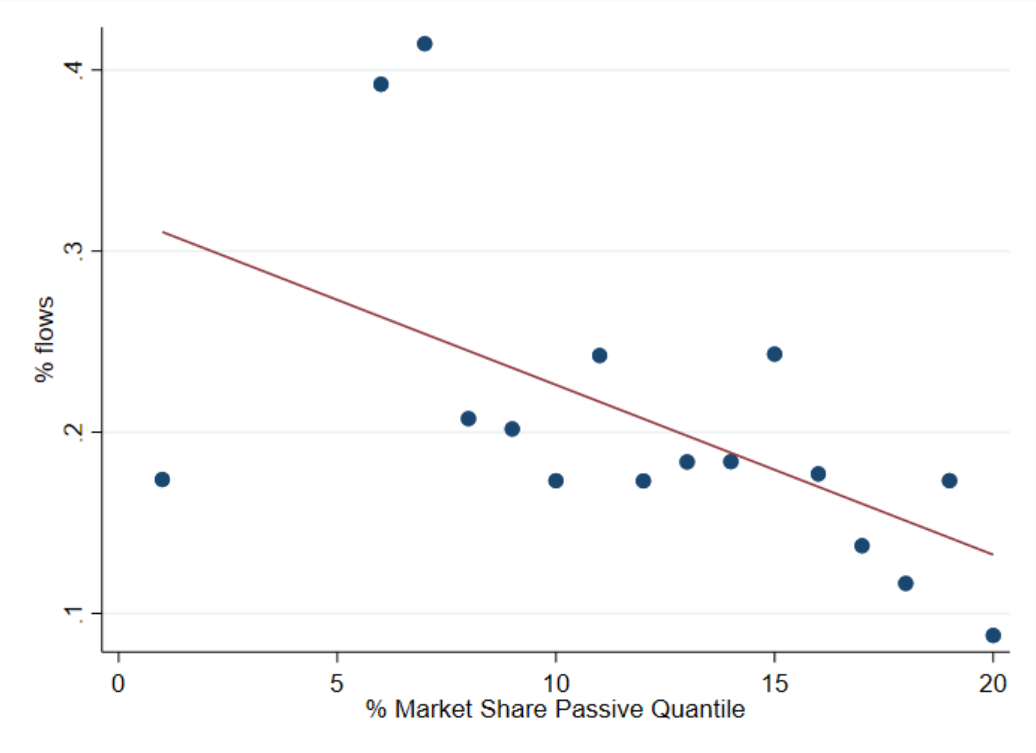
## Figure 1: Flows to Active Funds and Market Share of Passive Funds

This figure illustrates the relation between *% flows* and *MS Passive*, which is the sum of total net assets of index funds divided by the sum of total net assets of actively managed funds and index funds by country and benchmark for a given year. *MS Passive* is divided in 20 groups depending on the size of the market share. *Flow* is the average yearly growth rate of actively managed mutual fund's total net assets due to inflows of new capital.



## Figure 2: Performance-Flow Relation

This figure illustrates the relation between *% flows* and past *Performance*. Figure 2a depicts the performance-flow relation. Figure 2b depicts the performance-flow relation separately for low *MS passive* and high *MS passive*. *Performance* is measured as raw return and divided in 20 groups depending on the level of past performance. *% flows* is the average yearly growth rate of actively managed mutual fund's total net assets due to inflows of new capital. *MS passive* is the sum of total net assets of index funds divided by the sum of total net assets of actively managed funds and index funds by country and benchmark for a given year. Low *MS passive* corresponds to the bottom quintile of *MS passive* and *high MS passive* corresponds to the top quintile of *MS passive.*

**Figure 2a: Performance-flow relation**

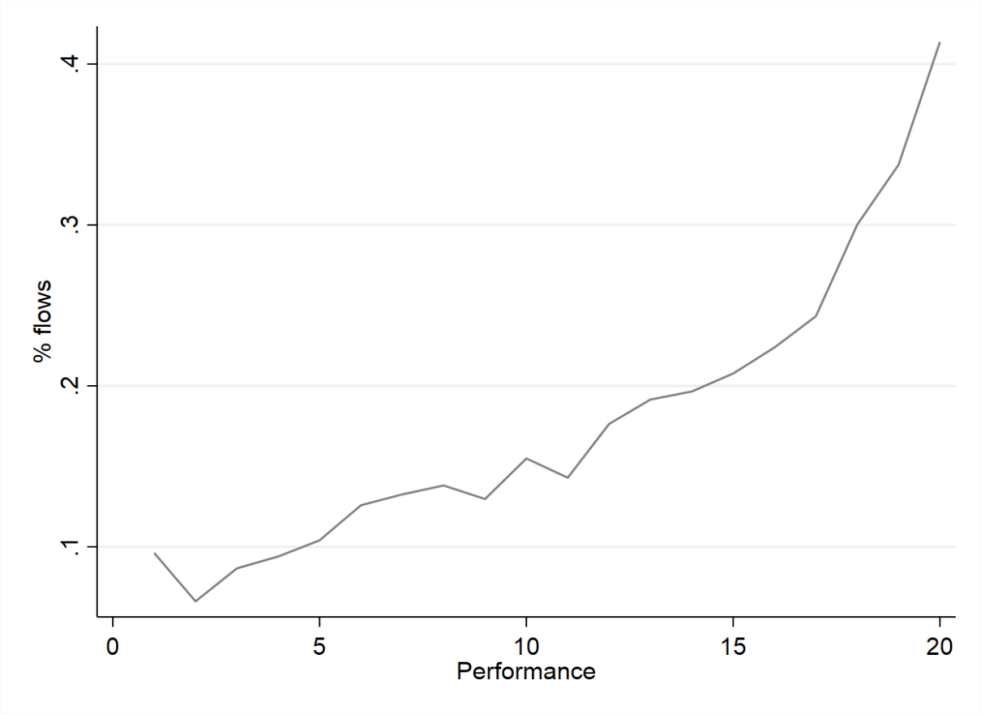
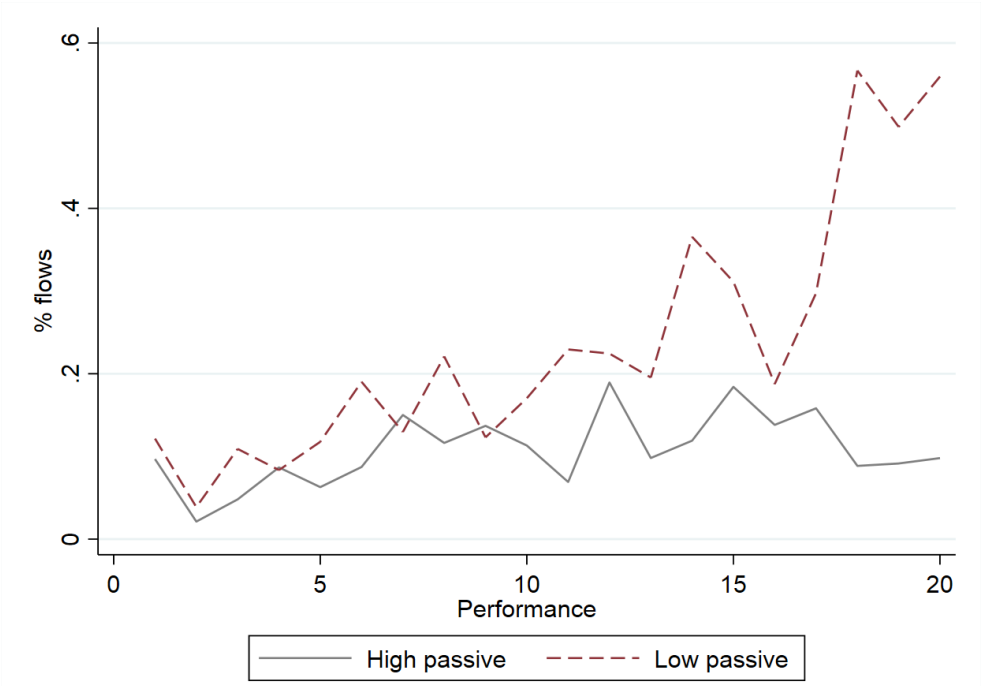



**Figure 2b: Performance-flow relation by low and high market share passive funds**



# Table 1: Descriptive Statistics

Panel A shows country-level summary statistics for the variable *MS Passive* for those countries with available fund-level data. *MS Passive* is defined as the sum of total net assets of index funds divided by the sum of total net assets of actively managed funds and index funds by country, year and benchmark. Frequency indicates the number of actively managed mutual funds per country. Panel B shows summary statistics for fund-level characteristics. The sample period comprises funds from 1995 to 2018.

**Panel A: Market share of passive funds by country**

| | MS passive | | | | |
|---|---|---|---|---|---|
| Country | Mean | Freq. | Country | Mean | Freq. |
| ARE | 0.05 | 25 | KOR | 0.05 | 1,203 |
| AUS | 0.20 | 2,797 | KWT | 0.11 | 106 |
| AUT | 0.11 | 679 | MEX | 0.24 | 405 |
| BEL | 0.12 | 760 | MYS | 0.03 | 2,082 |
| BRA | 0.04 | 4,853 | NLD | 0.08 | 652 |
| CAN | 0.05 | 7,750 | NOR | 0.09 | 1,128 |
| CHE | 0.08 | 2,403 | NZL | 0.07 | 155 |
| CHL | 0.36 | 39 | PAK | 0.04 | 14 |
| DEU | 0.16 | 1,918 | PER | 0.28 | 7 |
| DNK | 0.08 | 1,674 | PHL | 0.22 | 170 |
| EGY | 0.01 | 50 | RUS | 0.01 | 154 |
| ESP | 0.08 | 2,678 | SAU | 0.00 | 549 |
| FIN | 0.08 | 1,560 | SGP | 0.05 | 1,352 |
| FRA | 0.11 | 9,483 | SWE | 0.10 | 2,101 |
| GBR | 0.07 | 6,964 | THA | 0.03 | 1,869 |
| HKG | 0.10 | 572 | TUR | 0.11 | 31 |
| IDN | 0.02 | 492 | TWN | 0.02 | 1,067 |
| IND | 0.01 | 2,136 | USA | 0.13 | 46,550 |
| ITA | 0.04 | 218 | ZAF | 0.06 | 1,034 |
| JPN | 0.41 | 5,065 | | | |
| | | | Total | 0.11 | 114,208 |

**Panel B: Fund-level characteristics**

| | N | mean | sd | min | max | p50 |
|---|---|---|---|---|---|---|
| Fund size (in US$) | 96,817 | 954.8 | 4,310 | 5.000 | 188,834 | 146.7 |
| Std. dev. mret | 96,817 | 0.0436 | 0.0173 | 0 | 0.135 | 0.0410 |
| Std. dev. flow | 94,884 | 0.0403 | 0.0448 | 0 | 0.429 | 0.0251 |
| Total expense ratio | 96,383 | 0.0147 | 0.00671 | -0.00510 | 0.174 | 0.0140 |
| Log(fund age) | 96,817 | 2.453 | 0.665 | 1.099 | 4.554 | 2.485 |
| Flow | 96,817 | 0.169 | 0.855 | -0.751 | 9.123 | -0.00713 |
| Return | 96,817 | 0.0523 | 0.206 | -0.524 | 0.770 | 0.0606 |
| Jensen alpha | 83,777 | -0.0108 | 0.113 | -0.324 | 0.359 | -0.0159 |
| Institutional fund | 96,817 | 0.277 | 0.447 | 0 | 1 | 0 |

## Table 2: Sensitivity to Past Performance

This table reports the results from OLS regressions of *Flow* on *MS Passive* (which is the market share of passive funds in the country and benchmark where the actively managed fund is available for sale), *Ranked Performance* (which is the fractional performance rank, measured as raw performance and Jensen's alpha defined from 0 (worst) to 1 (best) by country and year), the interaction between *Ranked Performance* and *MS Passive* (which measures the change in sensitivity of performance on flows due to the market share of passive funds), and fund characteristics as control variables. *Flow* is the yearly growth rate of an actively managed mutual fund's total net assets due to inflows of new capital. *MS Passive* is the sum of total net assets of index funds divided by the sum of total net assets of actively managed funds and index funds by country and benchmark for a given year. All variables are defined in Appendix A. Robust t-statistics (in parentheses) are based on standard errors clustered by fund. ***, **, * denote statistical significance at the 1%, 5% and 10% level, respectively.

| Dependent variable | **$Flow_t$** | | | | | |
|---|---|---|---|---|---|---|
| Performance Measure | Raw return | | | Jensen alpha | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $Ranked\ Performance_{t-1}$ | 0.269*** | 0.269*** | 0.250*** | 0.291*** | 0.290*** | 0.237*** |
| | (22.53) | (22.51) | (13.63) | (23.27) | (23.10) | (15.05) |
| $MS\ Passive_{t-1}$ | 0.208*** | 0.223*** | 0.170*** | 0.210*** | 0.219*** | 0.177*** |
| | (4.30) | (4.56) | (3.52) | (4.00) | (4.15) | (3.37) |
| **$Ranked\ Perf_{t-1} \times MS\ Passive_{t-1}$** | **-0.353*** ** | **-0.350*** ** | **-0.280*** ** | **-0.320*** ** | **-0.322*** ** | **-0.251*** ** |
| | **(-5.43)** | **(-5.35)** | **(-4.28)** | **(-4.68)** | **(-4.69)** | **(-3.65)** |
| $Fund\ size_{t-1}$ | -0.057*** | -0.055*** | -0.057*** | -0.054*** | -0.052*** | -0.054*** |
| | (-21.37) | (-20.96) | (-21.58) | (-19.38) | (-18.99) | (-19.67) |
| $Flow_{t-1}$ | 0.067*** | 0.066*** | 0.063*** | 0.072*** | 0.072*** | 0.067*** |
| | (13.75) | (13.53) | (13.06) | (12.60) | (12.46) | (11.83) |
| $Expenses_{t-1}$ | -2.310*** | -2.510*** | -2.389*** | -2.778*** | -2.933*** | -2.893*** |
| | (-3.40) | (-3.63) | (-3.53) | (-3.69) | (-3.84) | (-3.87) |
| $Risk_{t-1}$ | -3.142*** | -3.626*** | -2.925*** | -3.340*** | -3.715*** | -3.069*** |
| | (-9.11) | (-9.53) | (-8.29) | (-8.94) | (-9.22) | (-8.01) |
| $Volatility\ Flow_{t-1}$ | 7.581*** | 7.617*** | 7.563*** | 7.328*** | 7.360*** | 7.301*** |
| | (33.76) | (33.63) | (33.74) | (30.46) | (30.35) | (30.44) |
| $Log\ Fund\ Age_{t-1}$ | -0.038*** | -0.041*** | -0.038*** | -0.042*** | -0.044*** | -0.042*** |
| | (-7.44) | (-7.96) | (-7.37) | (-7.72) | (-8.15) | (-7.71) |
| $Institutional\ Fund\ Dummy_{t-1}$ | -0.005 | -0.004 | -0.005 | -0.003 | -0.002 | -0.002 |
| | (-0.66) | (-0.44) | (-0.60) | (-0.34) | (-0.19) | (-0.25) |
| Team Dummy | -0.004 | -0.005 | -0.003 | -0.011 | -0.012 | -0.010 |
| | (-0.50) | (-0.63) | (-0.40) | (-1.38) | (-1.42) | (-1.27) |
| Observations | 87,215 | 87,186 | 87,215 | 75,840 | 75,823 | 75,840 |
| Adjusted R-squared | 0.238 | 0.241 | 0.244 | 0.228 | 0.231 | 0.235 |
| Fixed Effects | Country, Year, Benchmark | Country × Year, Benchmark | Country, Benchmark, Year × Rank | Country, Year, Benchmark | Country × Year, Benchmark | Country, Benchmark, Year × Rank |

## Table 3: Convexity of Performance-Flow Relation

This table reports the results from OLS regressions of *Flow* on *MS Passive* (which is the market share of passive funds in the country and benchmark where the actively managed fund is available for sale), the fractional performance rank (measured as raw performance and Jensen's alpha defined from 0 (worst) to 1 (best) by country, and year), the interaction between the fractional performance rank and *MS Passive* (which measures the change in sensitivity of performance on flows due to the market share of passive funds), and fund characteristics as control variables. The coefficients on fractional performance ranks are estimated using a piecewise linear regression framework over five quintiles. These performance quintiles are grouped in *Low Ranked Performance* (bottom quintile), *Mid Ranked Performance* (2nd to 4th quintile) and *Top Ranked Performance* (top quintile). *Flow* is the yearly growth rate of an actively managed mutual fund's total net assets due to inflows of new capital. *MS Passive* is the sum of total net assets of index funds divided by the sum of total net assets of actively managed funds and index funds by country and benchmark for a given year. All variables are defined in Appendix A. Robust t-statistics (in parentheses) are based on standard errors clustered by fund. ***, **, * denote statistical significance at the 1%, 5% and 10% level, respectively.

| Dependent variable | **$Flow_t$** | | | | | |
|---|---|---|---|---|---|---|
| Performance measure | Raw return | | | Jensen alpha | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Low Ranked Performance$_{t-1}$ | 0.147* | 0.146* | 0.284** | 0.350*** | 0.333*** | 0.281*** |
| | (1.75) | (1.74) | (2.51) | (3.91) | (3.71) | (2.91) |
| Mid Ranked Performance$_{t-1}$ | 0.255*** | 0.250*** | 0.251*** | 0.247*** | 0.246*** | 0.210*** |
| | (14.02) | (13.80) | (12.43) | (11.90) | (11.85) | (9.65) |
| Top Ranked Performance$_{t-1}$ | 0.485*** | 0.516*** | 0.349*** | 0.564*** | 0.575*** | 0.437*** |
| | (4.96) | (5.27) | (2.59) | (5.53) | (5.64) | (3.97) |
| MS Passive$_{t-1}$ | -0.080 | -0.046 | -0.100 | -0.007 | 0.003 | -0.038 |
| | (-1.16) | (-0.66) | (-1.44) | (-0.09) | (0.03) | (-0.45) |
| **Low Ranked Perf$_{t-1}$ × MS Passive$_{t-1}$** | **1.538*** ** | **1.389*** ** | **1.506*** ** | **1.013*** | **1.015*** | **1.074** ** |
| | **(3.46)** | **(3.13)** | **(3.38)** | **(1.95)** | **(1.95)** | **(2.05)** |
| **Mid Ranked Perf$_{t-1}$ × MS Passive$_{t-1}$** | **-0.418*** ** | **-0.384*** ** | **-0.358*** ** | **-0.311** ** | **-0.318*** ** | **-0.252** ** |
| | **(-4.16)** | **(-3.77)** | **(-3.57)** | **(-2.56)** | **(-2.60)** | **(-2.06)** |
| **Top Ranked Perf$_{t-1}$ × MS Passive$_{t-1}$** | **-1.587*** ** | **-1.662*** ** | **-1.330*** ** | **-1.581*** ** | **-1.548*** ** | **-1.449*** ** |
| | **(-3.38)** | **(-3.52)** | **(-2.83)** | **(-3.15)** | **(-3.09)** | **(-2.89)** |
| Fund size$_{t-1}$ | -0.057*** | -0.055*** | -0.057*** | -0.054*** | -0.052*** | -0.054*** |
| | (-21.39) | (-20.98) | (-21.60) | (-19.40) | (-19.00) | (-19.67) |
| Flow$_{t-1}$ | 0.067*** | 0.066*** | 0.063*** | 0.072*** | 0.072*** | 0.067*** |
| | (13.70) | (13.47) | (13.05) | (12.57) | (12.43) | (11.84) |
| Expenses$_{t-1}$ | -2.261*** | -2.472*** | -2.307*** | -2.734*** | -2.896*** | -2.831*** |
| | (-3.32) | (-3.56) | (-3.41) | (-3.62) | (-3.77) | (-3.77) |
| Risk$_{t-1}$ | -3.115*** | -3.616*** | -2.823*** | -3.252*** | -3.636*** | -2.973*** |
| | (-9.12) | (-9.58) | (-8.10) | (-8.71) | (-9.01) | (-7.77) |
| Volatility Flow$_{t-1}$ | 7.585*** | 7.619*** | 7.572*** | 7.331*** | 7.362*** | 7.305*** |
| | (33.85) | (33.71) | (33.86) | (30.46) | (30.34) | (30.46) |
| Log Fund Age$_{t-1}$ | -0.038*** | -0.041*** | -0.038*** | -0.042*** | -0.044*** | -0.041*** |
| | (-7.40) | (-7.93) | (-7.34) | (-7.71) | (-8.14) | (-7.69) |
| Institutional Fund Dummy$_{t-1}$ | -0.006 | -0.004 | -0.005 | -0.003 | -0.001 | -0.002 |
| | (-0.67) | (-0.43) | (-0.61) | (-0.33) | (-0.18) | (-0.25) |
| Team Dummy | -0.004 | -0.005 | -0.003 | -0.011 | -0.012 | -0.011 |
| | (-0.49) | (-0.61) | (-0.40) | (-1.40) | (-1.44) | (-1.30) |
| Observations | 87,215 | 87,186 | 87,215 | 75,840 | 75,823 | 75,840 |
| Adjusted R-squared | 0.238 | 0.242 | 0.244 | 0.228 | 0.231 | 0.235 |
| Fixed Effects | Country, Year, Benchmark | Country × Year, Benchmark | Country, Benchmark, Year × Rank | Country, Year, Benchmark | Country × Year, Benchmark | Country, Benchmark, Year ×Rank |

## Table 4: Convexity of Performance-Flow Relation – U.S. only

This table reports the results from OLS regressions of *Flow* on *MS Passive* (which is the market share of passive funds in the country and benchmark where the actively managed fund is available for sale), the fractional performance rank (measured as raw performance and Jensen's alpha ) defined from 0 (worst) to 1 (best) by country, and year), the interaction between the fractional performance rank and *MS Passive* (which measures the change in sensitivity of performance on flows due to the market share of passive funds), and fund characteristics as control variables. The coefficients on fractional performance ranks are estimated using a piecewise linear regression framework over five quintiles. These performance quintiles are grouped in *Low Ranked Performance* (bottom quintile), *Mid Ranked Performance* (2nd to 4th quintile) and *Top Ranked Performance* (top quintile). *Flow* is the yearly growth rate of an actively managed mutual fund's total net assets due to inflows of new capital. *MS Passive* is the sum of total net assets of index funds divided by the sum of total net assets of actively managed funds and index funds by country and benchmark for a given year. All variables are defined in Appendix A. Robust t-statistics (in parentheses) are based on standard errors clustered by fund. ***, **, * denote statistical significance at the 1%, 5% and 10% level, respectively.

| Dependent variable | **$Flow_t$** | | | |
|---|---|---|---|---|
| Performance measure | Raw return | | Jensen alpha | |
| | (1) | (2) | (3) | (4) |
| Low Ranked $Performance_{t-1}$ | 0.019 | 0.216 | 0.402*** | 0.344** |
| | (0.13) | (1.08) | (2.73) | (2.20) |
| Mid Ranked $Performance_{t-1}$ | 0.387*** | 0.371*** | 0.338*** | 0.279*** |
| | (12.09) | (10.80) | (9.89) | (7.68) |
| Top Ranked $Performance_{t-1}$ | 1.053*** | 0.760*** | 0.784*** | 0.497*** |
| | (5.42) | (2.85) | (4.52) | (2.73) |
| MS $Passive_{t-1}$ | 0.315** | 0.267* | 0.356** | 0.300** |
| | (2.25) | (1.92) | (2.46) | (2.06) |
| **Low Ranked $Perf_{t-1}$ × MS $Passive_{t-1}$** | **2.117*** ** | **2.069*** ** | **1.312** | **1.470*** |
| | **(2.67)** | **(2.60)** | **(1.54)** | **(1.69)** |
| **Mid Ranked $Perf_{t-1}$ × MS $Passive_{t-1}$** | **-0.867*** ** | **-0.715*** ** | **-0.579*** ** | **-0.432**** |
| | **(-4.74)** | **(-3.89)** | **(-2.78)** | **(-2.04)** |
| **Top Ranked $Perf_{t-1}$ × MS $Passive_{t-1}$** | **-3.186*** ** | **-2.372*** ** | **-2.568*** ** | **-2.185*** ** |
| | **(-3.77)** | **(-2.76)** | **(-3.14)** | **(-2.68)** |
| Fund $size_{t-1}$ | -0.048*** | -0.049*** | -0.047*** | -0.048*** |
| | (-11.72) | (-11.99) | (-11.57) | (-11.85) |
| $Flow_{t-1}$ | 0.063*** | 0.060*** | 0.073*** | 0.067*** |
| | (10.29) | (9.89) | (9.48) | (8.85) |
| $Expenses_{t-1}$ | -7.238*** | -7.241*** | -6.947*** | -7.064*** |
| | (-4.50) | (-4.52) | (-4.30) | (-4.41) |
| $Risk_{t-1}$ | -5.000*** | -4.480*** | -4.503*** | -4.021*** |
| | (-8.71) | (-7.35) | (-7.88) | (-6.62) |
| Volatility $Flow_{t-1}$ | 8.594*** | 8.568*** | 8.356*** | 8.310*** |
| | (20.83) | (20.79) | (20.25) | (20.22) |
| Log Fund $Age_{t-1}$ | -0.064*** | -0.063*** | -0.058*** | -0.058*** |
| | (-8.34) | (-8.10) | (-7.52) | (-7.46) |
| Institutional Fund $Dummy_{t-1}$ | 0.021* | 0.022* | 0.022* | 0.022** |
| | (1.88) | (1.89) | (1.94) | (2.00) |
| Team Dummy | -0.038*** | -0.037*** | -0.038*** | -0.037*** |
| | (-2.92) | (-2.82) | (-2.97) | (-2.86) |
| Observations | 46,109 | 46,109 | 45,083 | 45,083 |
| Adjusted R-squared | 0.233 | 0.240 | 0.227 | 0.235 |
| Fixed Effects | Year, Benchmark | Year × Rank, Benchmark | Year, Benchmark | Year × Rank, Benchmark |

## Table 5: Introduction of first ETF per Country and Benchmark

This table reports the launch dates of the first equity ETF per country (Panel A), the first two equity ETF per country-benchmark pair (Panel B) and the results from OLS regressions of *Flow* on *Post* (which is an indicator variable that is equal to one for the time period after the first equity ETF is introduced in a given country-benchmark pair, and else equal to zero), the fractional performance rank (measured as raw performance defined from 0 (worst) to 1 (best) by country and year), the interaction between the fractional performance rank and *Post* (which measures the change in sensitivity of performance on flows due to the introduction of ETFs), and fund characteristics as control variables (Panel C). Column (2) additionally includes *Pre* (which is a dummy variable that is equal to one for the period before the introduction of the first ETF, and else equal to zero) and the interaction of *Pre* and the fractional performance rank. Column (3) excludes ETFs launched by fund families which offer simultaneously actively managed mutual funds. In column (4) we match treated funds based on their propensity scores to their nearest neighbor with respect to the three-year average of fund size, fund expenses and market share of passive funds within the benchmark. The coefficients on fractional performance rank are estimated using a piecewise linear regression framework over five quintiles. These performance quintiles are grouped in *Low Ranked Performance* (bottom quintile), *Mid Ranked Performance* ($2^{nd}$ to $4^{th}$ quintile) and *Top Ranked Performance* (top quintile). *Flow* is the yearly growth rate of an actively managed mutual fund's total net assets due to inflows of new capital. *MS Passive* is the sum of total net assets of index funds divided by the sum of total net assets of actively managed funds and index funds by country and benchmark for a given year. All variables are defined in Appendix A. Robust t-statistics (in parentheses) are based on standard errors clustered by fund. All regressions include country, year and benchmark fixed effects. ***, **, * denote statistical significance at the 1%, 5% and 10% level, respectively.

**Panel A: Introduction dates of first overall ETF per country**

| Country | First launch date | Country | First launch date |
|---|---|---|---|
| AUS | 6/5/1998 | JPN | 4/12/1995 |
| AUT | 3/1/2006 | KOR | 10/11/2002 |
| BRA | 7/15/2004 | MEX | 4/30/2002 |
| CAN | 9/28/1999 | MYS | 6/7/2007 |
| CHE | 10/6/1999 | NLD | 12/14/2009 |
| CHL | 8/30/2013 | NOR | 3/1/2005 |
| CHN | 3/27/1998 | NZL | 6/30/1997 |
| COL | 7/6/2011 | PHL | 12/2/2013 |
| DEU | 12/27/2000 | QAT | 2/12/2018 |
| EGY | 1/1/2015 | RUS | 7/1/2010 |
| ESP | 7/14/2006 | SAU | 3/28/2010 |
| FIN | 2/8/2002 | SGP | 4/11/2002 |
| FRA | 12/13/2000 | SWE | 10/30/2000 |
| GRC | 1/24/2008 | THA | 9/4/2007 |
| HKG | 11/12/1999 | TUR | 12/2/2004 |
| HUN | 12/11/2006 | TWN | 6/25/2003 |
| IDN | 12/17/2007 | USA | 1/22/1993 |
| IND | 12/28/2001 | VNM | 9/18/2014 |
| ISL | 12/14/2004 | ZAF | 11/30/2000 |
| ISR | 1/29/2009 | | |

**Panel B: Sample of introduction dates by country and benchmark (incomplete)**

| Country | Benchmark | First launch date |
|---|---|---|
| AUS | S&P/ASX 200 TR AUD | 6/5/1998 |
| AUS | S&P/ASX 50 TR | 8/24/2001 |
| BRA | Sao Paulo SE IBrX 50 CR | 7/15/2004 |
| CAN | S&P/TSX 60 TR | 9/28/1999 |
| CAN | S&P/TSX Composite Cap CR | 2/16/2001 |
| CHE | Swiss Market Index TR | 10/6/1999 |
| CHE | SXI Real Estate Funds Broad TR | 11/3/2009 |
| COL | COLCAP CR COP | 7/6/2011 |
| DEU | DAX 30 TR | 12/27/2000 |
| DEU | STOXX Europe 50 USD CR | 12/27/2000 |
| DNK | MSCI AC World NR USD | 1/21/2005 |
| EGY | EGX 30 | 1/1/2015 |
| ESP | IBEX 35 TR | 7/14/2006 |
| ESP | IBEX 35 CR | 9/7/2006 |
| FIN | MSCI EM (Emerging Markets) NR EUR | 9/25/2013 |
| FRA | CAC 40 TR | 12/13/2000 |
| FRA | EURO STOXX 50 NR EUR | 2/19/2001 |
| HKG | Hang Seng TR | 11/12/1999 |
| HKG | MSCI China TR USD | 11/23/2001 |
| IDN | Jakarta SE Liquidity 45 CR | 12/17/2007 |
| IND | S&P BSE SENSEX TR | 1/13/2003 |
| IND | Nifty TRI | 7/17/2003 |
| JPN | Nikkei 225 CR | 7/9/2001 |
| JPN | Topix CR | 7/11/2001 |
| KOR | KOSPI 200 CR | 10/11/2002 |
| KOR | KOSPI 100 CR | 10/27/2005 |
| MEX | S&P/BMV IPC | 4/30/2002 |
| MEX | S&P/BMV FIBRAS TR MXN | 10/29/2014 |
| MYS | FTSE Bursa Malaysia KLCI CR | 6/7/2007 |
| MYS | FTSE ASEAN 40 CR USD | 7/9/2010 |
| NLD | AEX TR | 12/14/2009 |
| NOR | OSE Benchmark TR | 3/1/2005 |
| NOR | Oslo Bors OBX | 4/7/2005 |
| PHL | Philippine PSE Composite CR | 12/2/2013 |
| RUS | RTS CR | 7/1/2010 |
| RUS | NASDAQ 100 TR | 11/26/2018 |
| SGP | Singapore Straits Times CR | 4/11/2002 |
| SWE | OMX Stockholm 30 CR | 10/30/2000 |
| THA | Thailand SET 50 CR | 9/4/2007 |
| THA | Thailand SET High Dividend 30 | 8/10/2011 |
| TUR | BIST 30 Index | 4/13/2007 |
| TUR | MSCI Turkey TR | 7/2/2010 |
| TWN | Taiwan SE/Electronic CR | 7/4/2007 |
| TWN | TAIEX CR | 9/6/2011 |
| USA | S&P 500 TR | 1/22/1993 |
| USA | S&P Mid Cap 400 TR | 4/28/1995 |
| ZAF | Johannesburg Stock Exchange Top 40 Tradeable ZAR | 11/30/2000 |

**Panel C: Difference-in-differences estimation around introduction of first ETF per country and benchmark**

| Dependent variables | **$Flow_t$** | | | |
|---|---|---|---|---|
| | | | Treatment excl. families offering actively managed funds | PSM matched sample |
| | (1) | (2) | (3) | (4) |
| Low Ranked $Performance_{t-1}$ | -0.105 | -0.082 | 0.089 | 0.060 |
| | (-0.45) | (-0.32) | (0.59) | (0.24) |
| Mid Ranked $Performance_{t-1}$ | 0.486*** | 0.430*** | 0.334*** | 0.417*** |
| | (8.17) | (7.12) | (9.92) | (6.91) |
| Top Ranked $Performance_{t-1}$ | 1.496*** | 1.426*** | 0.991*** | 1.232*** |
| | (4.13) | (3.67) | (4.88) | (3.21) |
| Post | 0.050 | 0.040 | -0.060 | -0.018 |
| | (1.16) | (0.87) | (-1.62) | (-0.41) |
| **Low Ranked $Perf_{t-1}$ × Post** | **0.502**** | **0.477*** | **0.407**** | **0.495*** |
| | **(1.98)** | **(1.75)** | **(2.06)** | **(1.84)** |
| **Mid Ranked $Perf_{t-1}$ × Post** | **-0.268***** | **-0.212***** | **-0.143***** | **-0.213***** |
| | **(-4.22)** | **(-3.30)** | **(-3.33)** | **(-3.26)** |
| **Top Ranked $Perf_{t-1}$ × Post** | **-1.121***** | **-1.051**** | **-0.713***** | **-0.912**** |
| | **(-2.90)** | **(-2.56)** | **(-2.78)** | **(-2.22)** |
| $Pre_{t-1}$ | | -0.100 | 0.016 | -0.105 |
| | | (-1.06) | (0.16) | (-1.12) |
| Low Ranked $Perf_{t-1}$ x $Pre_{t-1}$ | | 0.124 | -0.291 | 0.184 |
| | | (0.20) | (-0.50) | (0.30) |
| Mid Ranked $Perf_{t-1}$ x $Pre_{t-1}$ | | 0.267 | 0.149 | 0.250 |
| | | (1.57) | (1.09) | (1.46) |
| Top Ranked $Perf_{t-1}$ x $Pre_{t-1}$ | | 0.360 | -1.045 | 0.306 |
| | | (0.36) | (-1.36) | (0.31) |
| Fund $size_{t-1}$ | -0.050*** | -0.050*** | -0.050*** | -0.028*** |
| | (-15.78) | (-15.79) | (-15.76) | (-8.28) |
| $Flow_{t-1}$ | 0.074*** | 0.074*** | 0.074*** | 0.093*** |
| | (12.18) | (12.20) | (12.31) | (10.25) |
| $Expenses_{t-1}$ | -4.055*** | -4.066*** | -4.064*** | -2.010* |
| | (-4.48) | (-4.49) | (-4.48) | (-1.67) |
| $Risk_{t-1}$ | -4.001*** | -4.018*** | -3.955*** | -2.422*** |
| | (-8.79) | (-8.82) | (-8.67) | (-5.71) |
| Volatility $Flow_{t-1}$ | 7.491*** | 7.489*** | 7.495*** | 7.987*** |
| | (24.55) | (24.55) | (24.55) | (24.58) |
| Log Fund $Age_{t-1}$ | -0.047*** | -0.047*** | -0.048*** | -0.032*** |
| | (-7.29) | (-7.30) | (-7.30) | (-3.45) |
| Institutional Fund $Dummy_{t-1}$ | 0.008 | 0.008 | 0.009 | -0.035*** |
| | (0.84) | (0.84) | (0.91) | (-3.49) |
| Team Dummy | -0.030*** | -0.030*** | -0.030*** | 0.004 |
| | (-2.92) | (-2.92) | (-2.95) | (0.32) |
| Observations | 53,164 | 53,164 | 53,164 | 29,621 |
| Adjusted R-squared | 0.238 | 0.238 | 0.237 | 0.259 |
| Fixed Effects | Country, Year, Benchmark | Country, Year, Benchmark | Country, Year, Benchmark | Country, Year, Benchmark |

## Table 6: Cross-section of Countries

This table reports the results from OLS regressions of *Flow* on *MS Passive* (which is the market share of passive funds in the country and benchmark where the actively managed fund is available for sale), the fractional performance rank (measured as raw performance defined from 0 (worst) to 1 (best) by country and year), the interaction between the fractional performance rank and *MS Passive* (which measures the change in sensitivity of performance on flows due to the market share of passive funds), and fund characteristics as control variables for country-level sub samples based on the median of *# actively managed funds/GDP*, *% Population owning shares*, *GDP/capita*, and a *Governance index*. The coefficients on fractional performance rank are estimated using a piecewise linear regression framework over five quintiles. These performance quintiles are grouped in *Low Ranked Performance* (bottom quintile), *Mid Ranked Performance* (2nd to 4th quintile) and *Top Ranked Performance* (top quintile). *Flow* is the yearly growth rate of an actively managed mutual fund's total net assets due to inflows of new capital. *MS Passive* is the sum of total net assets of index funds divided by the sum of total net assets of actively managed funds and index funds by country and benchmark for a given year. All variables are defined in Appendix A. Robust t-statistics (in parentheses) are based on standard errors clustered by fund. All specifications include country times year and benchmark fixed effects. Control variables as in specification (3) and (4) of Table 2. ***, **, * denote statistical significance at the 1%, 5% and 10% level, respectively.

| Dependent variables | **$Flow_t$** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | # Actively managed funds/GDP | | % Population owning shares | | GDP/capita | | Governance index | |
| | High | Low | High | Low | High | Low | High | Low |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Low Ranked $Performance_{t-1}$ | 0.096 | 0.154 | 0.078 | 0.158 | 0.143 | 0.125 | 0.128 | 0.216* |
| | (0.71) | (1.41) | (0.48) | (1.50) | (1.15) | (1.09) | (1.14) | (1.73) |
| Mid Ranked $Performance_{t-1}$ | 0.351*** | 0.181*** | 0.125*** | 0.293*** | 0.186*** | 0.301*** | 0.220*** | 0.216*** |
| | (11.99) | (7.54) | (3.38) | (13.05) | (7.02) | (11.91) | (9.07) | (7.66) |
| Top Ranked $Performance_{t-1}$ | 0.857*** | 0.302** | 0.239 | 0.593*** | 0.364*** | 0.634*** | 0.441*** | 0.273* |
| | (5.01) | (2.57) | (1.44) | (4.72) | (2.77) | (4.59) | (3.55) | (1.89) |
| MS $Passive_{t-1}$ | 0.352*** | -0.119 | -0.080 | 0.049 | -0.007 | -0.109 | -0.111 | 0.067 |
| | (2.69) | (-1.54) | (-0.54) | (0.57) | (-0.07) | (-1.09) | (-1.12) | (0.64) |
| **Low Ranked $Perf_{t-1}$ × MS $Passive_{t-1}$** | **1.740**** | **1.020**** | **0.462** | **1.483***** | **0.874** | **1.910***** | **1.037** | **1.502**** |
| | **(2.37)** | **(2.02)** | **(0.49)** | **(2.78)** | **(1.47)** | **(2.79)** | **(1.63)** | **(2.38)** |
| **Mid Ranked $Perf_{t-1}$ × MS $Passive_{t-1}$** | **-0.762***** | **-0.232*** | **-0.165** | **-0.486***** | **-0.316**** | **-0.356**** | **-0.260**** | **-0.370**** |
| | **(-4.39)** | **(-1.94)** | **(-0.92)** | **(-3.84)** | **(-2.35)** | **(-2.13)** | **(-1.98)** | **(-2.22)** |
| **Top Ranked $Perf_{t-1}$ × MS $Passive_{t-1}$** | **-2.916***** | **-0.383** | **0.161** | **-2.262***** | **-1.341**** | **-1.516**** | **-0.791** | **-1.847***** |
| | **(-3.87)** | **(-0.80)** | **(0.28)** | **(-3.95)** | **(-2.39)** | **(-2.15)** | **(-1.48)** | **(-2.74)** |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 43,984 | 42,117 | 16,408 | 62,188 | 41,353 | 44,729 | 43,191 | 39,866 |
| Adjusted R-squared | 0.249 | 0.242 | 0.215 | 0.256 | 0.217 | 0.265 | 0.230 | 0.254 |
| Fixed Effects | Country × Year, Benchmark | Country × Year, Benchmark | Country x Year, Benchmark | Country × Year, Benchmark | Country × Year, Benchmark | Country × Year, Benchmark | Country × Year, Benchmark | Country × Year, Benchmark |

## Table 7: Cross-section of Funds

This table reports the results from OLS regressions of *Flow* on *MS Passive* (which is the market share of passive funds in the country and benchmark where the actively managed fund is available for sale), the fractional performance rank (measured as raw performance defined from 0 (worst) to 1 (best) by country and year), the interaction between the fractional performance rank and *MS Passive* (which measures the change in sensitivity of performance on flows due to the market share of passive funds), and fund characteristics as control variables for fund-level sub samples based on Institutional / Retail fund, the median of *total expense ratio*, and the median of *fund size*. The coefficients on fractional performance ranks are estimated using a piecewise linear regression framework over five quintiles. These performance quintiles are grouped in *Low Ranked Performance* (bottom quintile), *Mid Ranked Performance* (2nd to 4th quintile) and *Top Ranked Performance* (top quintile). *Flow* is the yearly growth rate of an actively managed mutual fund's total net assets due to inflows of new capital. *MS Passive* is the sum of total net assets of index funds divided by the sum of total net assets of actively managed funds and index funds by country and benchmark for a given year. All variables are defined in Appendix A. Robust t-statistics (in parentheses) are based on standard errors clustered by fund. All specifications include country times year and benchmark fixed effects. Control variables as in specification (3) and (4) of Table 2. ***, **, * denote statistical significance at the 1%, 5% and 10% level, respectively.

| Dependent variables | **$Flow_t$** | | | | | |
|---|---|---|---|---|---|---|
| | Institutional | Retail | High Fee | Low Fee | Large | Small |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Low Ranked $Performance_{t-1}$ | 0.319** | 0.105 | 0.004 | 0.424*** | 0.245*** | 0.042 |
| | (2.03) | (1.06) | (0.04) | (3.54) | (4.25) | (0.31) |
| Mid Ranked $Performance_{t-1}$ | 0.225*** | 0.256*** | 0.255*** | 0.245*** | 0.218*** | 0.279*** |
| | (6.51) | (12.02) | (9.74) | (10.06) | (15.87) | (9.02) |
| Top Ranked $Performance_{t-1}$ | 0.776*** | 0.419*** | 0.477*** | 0.618*** | 0.418*** | 0.653*** |
| | (4.28) | (3.62) | (3.56) | (4.40) | (5.60) | (3.98) |
| MS $Passive_{t-1}$ | 0.093 | -0.079 | -0.176* | 0.173* | 0.208*** | -0.224** |
| | (0.73) | (-0.99) | (-1.82) | (1.77) | (3.27) | (-2.18) |
| **Low Ranked $Perf_{t-1}$ × MS $Passive_{t-1}$** | **0.792** | **1.594*** ** | **1.939*** ** | **-0.055** | **-0.399** | **2.437*** ** |
| | **(1.09)** | **(3.00)** | **(2.99)** | **(-0.09)** | **(-1.20)** | **(3.65)** |
| **Mid Ranked $Perf_{t-1}$ × MS $Passive_{t-1}$** | **-0.076** | **-0.501*** ** | **-0.566*** ** | **-0.229*** | **-0.275*** ** | **-0.549*** ** |
| | **(-0.39)** | **(-4.29)** | **(-3.50)** | **(-1.88)** | **(-4.00)** | **(-3.53)** |
| **Top Ranked $Perf_{t-1}$ × MS $Passive_{t-1}$** | **-0.794** | **-1.828*** ** | **-1.961*** ** | **-0.413** | **-0.519** | **-1.874*** ** |
| | **(-1.01)** | **(-3.29)** | **(-2.92)** | **(-0.74)** | **(-1.55)** | **(-2.68)** |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 24,594 | 62,534 | 44,623 | 42,430 | 42,417 | 44,633 |
| Adjusted R-squared | 0.271 | 0.237 | 0.247 | 0.252 | 0.184 | 0.280 |
| Fixed Effects | Country × Year, Benchmark | Country × Year, Benchmark | Country × Year, Benchmark | Country × Year, Benchmark | Country × Year, Benchmark | Country × Year, Benchmark |

## Table 8: Fund Performance-Liquidation Sensitivity

This table reports the results of regressions estimating a linear probability model (LPM) of *Liquidation* on *High MS Passive* (which is an indicator variable that equals one if *MS Passive* takes values larger than its sample median), *Ranked Performance* (which is the fractional performance rank, measured as raw performance (Panel A) and Jensen's alpha (Panel B) defined from 0 (worst) to 1 (best) by country and year), the interaction between *Ranked Performance* and *High MS Passive* (which measures the change in sensitivity of performance on liquidation due to the market share of passive funds), and fund characteristics as control variables. *Liquidation* is an indicator variable that is equal to one if the fund is liquidated in period t. *MS Passive* is the sum of total net assets of index funds divided by the sum of total net assets of actively managed funds and index funds by country and benchmark for a given year. All variables are defined in Appendix A. Robust t-statistics (in parentheses) are based on standard errors clustered by fund. Specification (1) – (3) include country, year and benchmark fixed effects. Specification (4) includes country times year and benchmark fixed effects. ***, **, * denote statistical significance at the 1%, 5% and 10% level, respectively.

**Panel A: Raw return**

| Dependent variables | **Liquidation** | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Ranked Performance$_{t-1}$ | -0.004*** | -0.003** | -0.004** | -0.003** |
| | (-2.87) | (-2.43) | (-2.53) | (-2.23) |
| High MS Passive$_{t-1}$ | 0.003* | 0.003* | 0.004** | 0.003* |
| | (1.75) | (1.96) | (2.23) | (1.86) |
| **Ranked Perf$_{t-1}$ × High MS Passive$_{t-1}$** | **-0.007*** ** | **-0.008*** ** | **-0.007*** ** | **-0.007*** ** |
| | **(-3.23)** | **(-3.58)** | **(-3.14)** | **(-2.95)** |
| Fund size$_{t-1}$ | -0.005*** | -0.005*** | -0.005*** | -0.005*** |
| | (-21.15) | (-19.20) | (-17.96) | (-17.73) |
| Flow$_{t-1}$ | -0.001*** | -0.001*** | -0.001*** | -0.001*** |
| | (-7.30) | (-6.91) | (-6.45) | (-6.12) |
| Expenses$_{t-1}$ | -0.273*** | -0.287*** | -0.326*** | -0.326*** |
| | (-4.48) | (-4.68) | (-5.09) | (-4.94) |
| Risk$_{t-1}$ | | 0.020 | 0.011 | 0.053* |
| | | (0.74) | (0.40) | (1.84) |
| Volatility Flow$_{t-1}$ | | -0.020*** | -0.021*** | -0.024*** |
| | | (-2.88) | (-2.89) | (-3.29) |
| Log Fund Age$_{t-1}$ | | -0.001** | -0.002*** | -0.002*** |
| | | (-2.15) | (-2.72) | (-2.83) |
| Institutional Fund Dummy$_{t-1}$ | | 0.001* | 0.001 | 0.001 |
| | | (1.66) | (1.19) | (1.26) |
| Team Dummy | | | 0.000 | 0.001 |
| | | | (0.56) | (0.75) |
| Observations | 97,162 | 95,176 | 87,504 | 87,475 |
| Adjusted R-squared | 0.042 | 0.048 | 0.051 | 0.056 |
| Fixed Effects | Country, Year, Benchmark | Country, Year, Benchmark | Country, Year, Benchmark | Country × Year, Benchmark |

**Panel B: Jensen alpha**

| Dependent variables | Liquidation | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Ranked alpha$_{t-1}$ | -0.003** | -0.003* | -0.003* | -0.002 |
| | (-2.01) | (-1.72) | (-1.88) | (-1.58) |
| High MS Passive$_{t-1}$ | 0.002 | 0.002 | 0.003* | 0.003* |
| | (1.29) | (1.36) | (1.81) | (1.79) |
| **Ranked alpha$_{t-1}$ × High MS Passive$_{t-1}$** | **-0.006*** ** | **-0.007*** ** | **-0.007*** ** | **-0.007*** ** |
| | **(-2.82)** | **(-3.11)** | **(-2.97)** | **(-3.05)** |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 83,499 | 82,714 | 76,100 | 76,081 |
| Adjusted R-squared | 0.037 | 0.038 | 0.039 | 0.044 |
| Fixed Effects | Country, Year, Benchmark | Country, Year, Benchmark | Country, Year, Benchmark | Country × Year, Benchmark |

# Appendices

## Appendix A: Variable description

If not stated otherwise, the data source is Lipper.

| Variable | Description |
|---|---|
| **Dependent variables** | |
| Flow | $Flow_{i,c,t} = \frac{TNA_{i,c,t} - TNA_{i,c,t-1}(1+R_{i,c,t})}{TNA_{i,c,t-1}}$. |
| Liquidation | Dummy variable equal to 1 if fund is liquidated in period t, else 0. |
| **Main independent variables** | |
| MS passive | Market share of passive index funds, measured as: sum of total net assets of index funds divided by the sum of total net assets of actively managed and index funds by country, year and benchmark: $MS_{c,bm,t} = \frac{\sum TNA^{p}_{c,bm,t}}{\sum TNA^{a}_{c,bm,t} + TNA^{p}_{c,bm,t}}$. |
| High MS passive | Dummy variable equal to 1 if value of MS passive is larger than the median of MS passive, else 0. |
| Ranked Performance$_t$ | Relative fund performance measured in raw returns (0 to 1) per country and year. |
| Ranked alpha | Relative fund performance measured in Jensen's alpha (0 to 1) per country and year. |
| Low Ranked Performance | $Low_{i,c,t} = min(0.2, Rank_{i,c,t})$, where Rank is measured as ranked performance or ranked alpha. |
| Mid Ranked Performance | $Mid_{i,c,t} = min(0.6, Rank_{i,c,t} - Low_{i,c,t})$, where Rank is measured as ranked performance and ranked alpha. |
| Top Ranked Performance | $Top_{i,c,t} = Rank_{i,c,t} - (Low_{i,c,t} + Mid_{i,c,t})$, where Rank is measured as ranked return and ranked alpha. |
| **Control variables** | |
| Fund size | Natural logarithm of fund's total net assets (in US$) in period t. |
| Expenses | Fund's annual total expense ratio in period t. |
| Risk | Fund's standard deviation of monthly returns in period t. |

| | |
|---|---|
| Volatility Flow | Fund's standard deviation of monthly flows in period t. |
| Log Fund Age | Natural logarithm of fund's age since inception date in period t. |
| Institutional Fund Dummy | Dummy variable that equals 1 if fund offers institutional investor share class in period t, else 0. |
| Team Dummy | Dummy variable that equals 1 if fund is team managed, else 0. |
| High Fee (Low Fee) | Dummy variable equal to 1 if value of expenses is larger (smaller) than the median of Expenses, else 0. |
| Large (Small) | Dummy variable equal to 1 if the fund size is larger (smaller) than the median fund size, else 0. |
| # actively managed funds/GDP | Number of actively managed equity mutual funds divided by GDP in period t (Source: Lipper and World Bank). |
| Pop. owning shares | Percentage of the population that owns shares in the equity market (Source: Grout, Megginson, and Zalewska, 2009). |
| GDP/capita | Gross Domestic Product per Capita (Source: World Bank). |
| Governance index | Country-level governance index based on World Governance Indicators (WGI) (Source: World Bank). |

# Appendix B: WLS

This table reports the results from WLS regressions of *Flow* on *MS Passive* (which is the market share of passive funds in the country and benchmark where the actively managed fund is available for sale), the fractional performance rank (measured as raw performance defined from 0 (worst) to 1 (best) by country and year), the interaction between the fractional performance rank and *MS Passive* (which measures the change in sensitivity of performance on flows due to the market share of passive funds), and fund characteristics as control variables (Panel A). In Panel B the coefficients on fractional performance ranks are estimated using a piecewise linear regression framework over five quintiles. These performance quintiles are grouped in *Low Ranked Performance* (bottom quintile), *Mid Ranked Performance* (2nd to 4th quintile) and *Top Ranked Performance* (top quintile). *Flow* is the yearly growth rate of an actively managed mutual fund's total net assets due to inflows of new capital. In Panel C the dependent variable is *Liquidation* (which is an indicator variable that is equal to one if the fund is liquidated in period t. *MS Passive* is the sum of total net assets of index funds divided by the sum of total net assets of actively managed and index funds by country and benchmark for a given year. Weights are dependent on the number of distinct funds per country-year. All variables are defined in Appendix A. Robust t-statistics (in parentheses) are based on standard errors clustered by fund. Specification (1) – (3) include country, year and benchmark fixed effects. Specification (4) includes country times year and benchmark fixed effects. ***, **, * denote statistical significance at the 1%, 5% and 10% level, respectively.

**Panel A: Sensitivity to past performance**

| Dependent variables | **$Flow_t$** | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $Ranked\ Performance_{t-1}$ | 0.322*** | 0.315*** | 0.328*** | 0.326*** |
| | (18.18) | (19.00) | (19.04) | (18.92) |
| $MS\ Passive_{t-1}$ | 0.364*** | 0.502*** | 0.534*** | 0.550*** |
| | (4.68) | (6.58) | (6.31) | (6.46) |
| **$Ranked\ Performance_{t-1}$ x $MS\ Passive_{t-1}$** | **-0.483*** ** | **-0.576*** ** | **-0.634*** ** | **-0.631*** ** |
| | **(-4.93)** | **(-6.06)** | **(-6.18)** | **(-6.14)** |
| $Fund\ size_{t-1}$ | -0.110*** | -0.044*** | -0.043*** | -0.043*** |
| | (-27.10) | (-14.38) | (-13.95) | (-13.80) |
| $Flow_{t-1}$ | 0.121*** | 0.072*** | 0.073*** | 0.073*** |
| | (20.86) | (12.51) | (12.34) | (12.25) |
| $Expenses_{t-1}$ | -8.306*** | -5.100*** | -5.617*** | -5.638*** |
| | (-8.54) | (-5.45) | (-5.51) | (-5.47) |
| $Risk_{t-1}$ | | -4.557*** | -4.655*** | -4.884*** |
| | | (-10.00) | (-9.96) | (-10.08) |
| $Volatility\ Flow_{t-1}$ | | 7.656*** | 7.610*** | 7.631*** |
| | | (23.23) | (22.74) | (22.69) |
| $Log\ Fund\ Age_{t-1}$ | | -0.053*** | -0.054*** | -0.055*** |
| | | (-8.54) | (-8.47) | (-8.57) |
| $Institutional\ Fund\ Dummy_{t-1}$ | | 0.015* | 0.019** | 0.020** |
| | | (1.68) | (2.05) | (2.08) |
| Team Dummy | | | -0.031*** | -0.031*** |
| | | | (-3.12) | (-3.15) |
| Observations | 96,817 | 94,876 | 87,215 | 87,186 |
| Adjusted R-squared | 0.108 | 0.235 | 0.234 | 0.233 |
| Fixed Effects | Country, Year, Benchmark | Country, Year, Benchmark | Country, Year, Benchmark | Country x Year, Benchmark |

**Panel B: Convexity and performance-flow relation**

| Dependent variables | $Flow_t$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Low Ranked $Performance_{t-1}$ | -0.127 | 0.108 | 0.107 | 0.097 |
| | (-1.10) | (0.94) | (0.92) | (0.83) |
| Mid Ranked $Performance_{t-1}$ | 0.291*** | 0.294*** | 0.305*** | 0.303*** |
| | (11.30) | (12.30) | (12.16) | (12.05) |
| Top Ranked $Performance_{t-1}$ | 0.976*** | 0.646*** | 0.686*** | 0.699*** |
| | (6.79) | (4.84) | (4.95) | (5.03) |
| MS $Passive_{t-1}$ | 0.099 | 0.168* | 0.182* | 0.202* |
| | (1.00) | (1.73) | (1.76) | (1.96) |
| **Low Ranked $Perf_{t-1}$ x MS $Passive_{t-1}$** | **1.312**** | **1.603***** | **1.698***** | **1.670***** |
| | **(2.10)** | **(2.71)** | **(2.68)** | **(2.63)** |
| **Mid Ranked $Perf_{t-1}$ x MS $Passive_{t-1}$** | **-0.558***** | **-0.597***** | **-0.658***** | **-0.645***** |
| | **(-4.02)** | **(-4.44)** | **(-4.33)** | **(-4.23)** |
| **Top Ranked $Perf_{t-1}$ x MS $Passive_{t-1}$** | **-1.533**** | **-2.264***** | **-2.460***** | **-2.496***** |
| | **(-2.38)** | **(-3.63)** | **(-3.74)** | **(-3.80)** |
| Fund $size_{t-1}$ | -0.110*** | -0.043*** | -0.043*** | -0.043*** |
| | (-27.07) | (-14.39) | (-13.96) | (-13.80) |
| $Flow_{t-1}$ | 0.119*** | 0.072*** | 0.073*** | 0.073*** |
| | (20.58) | (12.46) | (12.29) | (12.19) |
| $Expenses_{t-1}$ | -8.554*** | -4.996*** | -5.507*** | -5.535*** |
| | (-8.80) | (-5.35) | (-5.40) | (-5.37) |
| $Risk_{t-1}$ | | -4.497*** | -4.592*** | -4.833*** |
| | | (-9.93) | (-9.89) | (-10.02) |
| Volatility $Flow_{t-1}$ | | 7.663*** | 7.617*** | 7.638*** |
| | | (23.29) | (22.81) | (22.76) |
| Log Fund $Age_{t-1}$ | | -0.053*** | -0.054*** | -0.055*** |
| | | (-8.50) | (-8.43) | (-8.53) |
| Institutional Fund $Dummy_{t-1}$ | | 0.015* | 0.019** | 0.020** |
| | | (1.67) | (2.04) | (2.07) |
| Team Dummy | | | -0.031*** | -0.031*** |
| | | | (-3.14) | (-3.17) |
| Observations | 96,817 | 94,876 | 87,215 | 87,186 |
| Adjusted R-squared | 0.109 | 0.235 | 0.235 | 0.234 |
| Fixed Effects | Country, Year, Benchmark | Country, Year, Benchmark | Country, Year, Benchmark | Country x Year, Benchmark |

**Panel C: Fund performance-liquidation sensitivity**

| Dependent variables | Liquidation | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Ranked Performance$_{t-1}$ | -0.006*** | -0.005** | -0.006** | -0.006** |
| | (-2.62) | (-2.32) | (-2.49) | (-2.53) |
| High MS Passive$_{t-1}$ | 0.005** | 0.005** | 0.005** | 0.005** |
| | (2.28) | (2.24) | (2.26) | (2.17) |
| **Ranked Perf$_{t-1}$x High MS Passive$_{t-1}$** | **-0.008*** ** | **-0.009*** ** | **-0.008** ** | **-0.008** ** |
| | **(-2.59)** | **(-2.77)** | **(-2.44)** | **(-2.32)** |
| Fund size$_{t-1}$ | -0.007*** | -0.007*** | -0.007*** | -0.007*** |
| | (-17.88) | (-15.98) | (-15.58) | (-15.52) |
| Flow$_{t-1}$ | -0.002*** | -0.002*** | -0.002*** | -0.002*** |
| | (-5.75) | (-5.77) | (-5.61) | (-5.48) |
| Expenses$_{t-1}$ | -0.693*** | -0.680*** | -0.720*** | -0.733*** |
| | (-6.57) | (-6.33) | (-6.22) | (-6.27) |
| Risk$_{t-1}$ | | 0.018 | 0.018 | 0.034 |
| | | (0.47) | (0.47) | (0.84) |
| Volatility Flow$_{t-1}$ | | -0.024** | -0.026** | -0.027** |
| | | (-2.04) | (-2.12) | (-2.28) |
| Log Fund Age$_{t-1}$ | | -0.002** | -0.002** | -0.002** |
| | | (-2.08) | (-2.11) | (-2.08) |
| Institutional Fund Dummy$_{t-1}$ | | 0.002 | 0.001 | 0.001 |
| | | (1.43) | (1.33) | (1.34) |
| Team Dummy | | | -0.000 | -0.000 |
| | | | (-0.18) | (-0.13) |
| Observations | 96,817 | 94,876 | 87,215 | 87,186 |
| Adjusted R-squared | 0.033 | 0.033 | 0.034 | 0.032 |
| Fixed Effects | Country, Year, Benchmark | Country, Year, Benchmark | Country, Year, Benchmark | Country x Year, Benchmark |

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