Unexploited Gains from International Diversification?

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Abstract

Using unique micro data on U.S. institutional investors' portfolios, this paper studies how capital, meant to be invested globally, is actually diversified internationally. We show that although the mutual fund industry has moved toward funds that have more flexibility to invest across countries and regions (global funds), mutual funds invest in a finite, rather small number of firms, almost independently of the set of available instruments. The number of mutual fund holdings in stocks and countries from a given region declines as funds become more global. This restricted investment practice has a cost: there are unexploited gains from international diversification. Mutual funds could achieve better returns by broadening their investment scope to include stocks held by specialized funds within the same fund family. This investment pattern is neither explained by the lack of available instruments or information nor by a better ability of global funds to minimize risk.

JEL Classification Codes: F30, F36, G11, G15, G23

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I.   Introduction

Financial globalization has advanced substantially since the early 1990s. In fact, the degree of financial globalization achieved in the last decade has been unprecedented.[1] One of the key drivers of the increase in international gross flows has been the potential gains from international diversification. On the supply side of funds, investors can reduce risk for a given level of expected returns (or increase returns for a given level of risk) by investing internationally.[2] For example, Harvey (1995) provides evidence that the standard deviation of the global portfolio could be reduced by 6% if the minimum variance frontier including emerging markets is calculated from 1986 to 1992. This is especially important nowadays as investors around the world save for retirement by investing in capital markets through institutional investors. On the demand side, governments and firms can reduce the cost of capital by tapping international investors, as well as they can reduce the exposure of their balance sheet to movements in the real exchange rate and other macro shocks.[3]

Despite these potential benefits from globalization and the sharp increase in the level of international financial integration, still it is the case that investors are not nearly diversified enough.[4] The evidence on this lack of international diversification has mostly concentrated on aggregate measures and has only recently begun to be exploit firm-level data more widely.[5] Several factors that might explain this insufficient diversification

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[1] See Obstfeld and Taylor (2002), and Frankel (2000). See Eichengreen (2001), Prasad et al. (2003), and Kose et al. (2006) for surveys on the financial globalization and financial integration literature. See Stulz (2005) for more on the limits of financial globalization.

[2] See Kose et al. (2007) for more on the effects of financial globalization on risk-sharing.

[3] See Rajan and Zingales (1998), Stulz (1999), and Bekaert and Harvey (2000) for more on the reduction of the cost of external finance to firms. Other effects of financial globalization and integration, such as the effect on firm and industry growth, on total factor productivity, and on transparency and accountability are studied by Mishkin (2007), Beck et al. (2000), and Stulz (1999), respectively.

[4] There is a large literature on home bias suggesting that investors are not nearly as internationally diversified as their consumption and income paths would imply. See Lewis (1999) and Karolyi and Stulz (2003) for comprehensive surveys of the home bias literature.

[5] Initially, the home bias literature analyzed accumulated capital flows and valuation adjustments, which led to greatly misestimate holdings. See, for example, Cooper and Kaplanis (1994), Tesar and Werner (1995), and Bekaert and Harvey (2000). Macroeconomic and country-level data have also been analyzed in Gelos and Wei (2005), Borensztein and Gelos (2003), Kaminsky et al. (2001), Froot et al. (2001), and Brennan and Cao (1997). However, Warnock and Cleaver (2003) show that capital flows data have deficiencies in estimating bilateral holdings.

have been identified in the literature: the role of non-tradable goods[6]; the existence of explicit barriers to international investment[7]; and the existence of implicit barriers, such as political or country risks, informational asymmetries, and "familiarity" effects.[8]

In this paper, we put together a unique micro dataset to shed light on the extent of international diversification. In particular, we analyze the actual portfolios of a group of institutional investors for which those portfolios can be constructed, those of U.S. mutual funds. Furthermore, we work with the universe of U.S. mutual funds established to purchase assets around the world. Given the regular reporting requirements for these types of investors, asset-level portfolios can be constructed and traced over time since their inception period. This characteristic of the mutual fund industry contrasts with other types of investors such as hedge funds, many pension funds, and individual international investors, for which data are not publicly available.

Two reasons motivate our emphasis on the U.S. mutual fund industry. First, it is extremely large (in 2005 there were 8,044 mutual funds with market capitalization of $8 trillion or 69% of U.S. GDP), they have a strong presence internationally (U.S. mutual funds represent more than 70 percent of the assets held worldwide by all mutual funds), they capture 24% of retirement savings, and they are relatively sophisticated investors. Second, and probably more importantly, several theories behind the lack of international diversification can be directly tested in this industry. For instance, we are able to analyze portfolios and the degree of international diversification for different types of funds within the same mutual fund family. That is, we study funds with different mandates to invest around the world. Some are specialized in some countries and regions (specialized funds), while others are supposed to invest more globally (global funds). Naturally, the

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[6] See, for example, Lewis (1999), Obstfeld and Rogoff (2001), Pesenti and van Wincoop (2002), and Engel and Matsumoto (2005). Moreover, Baxter and Jermann (1997) show that as long as non-tradables are more highly correlated with the domestic market than with the foreign market, as in the case of human capital, this explanation is not sufficient to elucidate the home bias puzzle.

[7] Explicit barriers include foreign exchange control, withholding taxes, and other directly observable obstacles. See Black (1974), Stulz (1981), Eun and Janakiramanan (1986), Errunza and Losq (1985) for different ways of modeling these direct barriers and the implications for portfolio and asset pricing. Stulz and Wasserfallen (1995) analyze the impact of the removal of barriers to international investment for a specific stock, while Bekaert and Harvey (2000) and Henry (2000) analyze the impact of lifting global investment barriers in emerging markets.

[8] Arguments in favor of the need to focus on implicit barriers can be found in French and Poterba (1991), Cooper and Kaplanis (1994), and Tesar and Werner (1995). For informational asymmetries and familiarity effects see Merton (1987), Coval and Moskowitz (1999), Huberman (2001), Bertaut and Kole (2004), Chan et al. (2005), and Portes and Rey (2005).

ones with a wider scope of investment have a-priori a wider set of instruments (firms from more countries) they can hold. This within-family comparison is particularly interesting because knowing that a fund within a family holds some stocks is an indication that those stocks are available for trading and are indeed desirable, at least by other fund managers within the same family. Moreover, information about those stocks has already been collected at the firm level, and in principle, is available to all managers of the same mutual fund company. Therefore, asymmetric information and transaction costs can be tested directly by comparing portfolios across different funds within the same family.

The dataset we collect for this paper has two parts: one on holdings and one on returns. The data on holdings contain asset-level annual portfolios between 1991 and 2005. We work with a total of 505 fund families and 3,651 funds, covering most of the U.S. mutual fund industry. We concentrate only on those funds that are already investing internationally. The total number of fund-year observations is 8,547 and the total number of asset level holdings for all funds and all years is 1,359,750. The portfolio holdings have been matched such that we can identify the country to which each stock belongs. Moreover, we track the assets over time, constructing a panel dataset. For returns, we use returns at the fund level on a daily basis between September 1989 and June 2006, for 36 fund families. We work with a total of 722,885 daily observations, composed of all returns for all funds.

The analysis in the paper is divided in three parts. The first one studies the degree of international diversification of mutual funds. We first explore the lack of diversification within mutual fund firms that invest internationally. The second part of the paper focuses on the reasons behind an apparent lack of international diversification. It focuses on whether the availability of instruments constraints the asset allocation of mutual funds. We also analyze where the variation in the number of stocks held by mutual funds comes from; in particular, we study to what extent it is driven by information asymmetry stories and family effects. Lastly, the third part investigates whether there are unexploited gains from diversification.

Regarding international diversification we find six main results: First, we find an increasing importance of global funds relative to specialized funds. Although the U.S.

mutual fund industry investing internationally has expanded sharply since the early 1990s, with significant increases in the number of both global and specialized funds, global funds have become significantly larger than specialized funds. For example, if assets under management are considered, global funds are increasingly more important. Global funds managed 787 billion of assets in 2005, whereas specialized funds had only 162 billion in assets under management.

Second, we find that the mutual fund industry as a whole hold a small number of assets in their portfolios. Moreover, if specific types of funds are considered, the same pattern arises. For example, individual mutual funds held on average 170 stocks in their portfolios in 2004 when there were over 39,000 stocks available for investment. More importantly, the number of portfolio holdings seems to be independent of the investment scope. It does not tend to increase for global funds compared to specialized funds within the same family. For example, global funds from AIM family of funds held on average 100 stocks in 2005, whereas specialized funds within this family of funds held 104 stocks.

Third, consistent with the observation that the number of holdings does not increase as the investment scope rises, we find that global funds hold fewer assets in fewer countries than specialized funds within each region of exposure, specially in emerging countries. For example, if holdings in Latin America are considered, the median specialized fund holds 41 stocks. Emerging market and global funds hold 34% and 94% less assets than the specialized fund within its mutual fund family. Furthermore, world and foreign funds also invest, respectively, in 71% and 75% fewer countries than their specialized counterparts.

Fourth, the patterns we observe regarding mutual fund holdings do not seem to be driven by the inability of funds to hold more companies across countries. For example, we show that, on average, mutual funds hold a very small fraction of market capitalization: both global fund and specialized fund investments each account for 0.12% of firms' market capitalization. Therefore, if funds wanted to increase their exposure, they could probably do so without major difficulties.

Fifth, we show that the limited number of stocks is explained by strong family effects. The number of holdings across mutual funds is largely explained by the family to

which the fund belongs. For example, funds in the Templeton Group held on average 129 stocks in 2005, significantly smaller than the 517 stocks held on average by funds in the Vanguard Group. In fact, family effects explain almost 50 percent of the variation.

Lastly, we find that information asymmetries, both costly information gathering and processing, are not enough to explain our stylized facts. Mutual funds hold portfolios that are not very similar. For example, global and specialized funds (the ones with a more limited scope of investment) share only 16% of their holdings (or, on average, 36% of net asset value of investments). Thus, costly information gathering cannot be an important explanation given that some of the funds within the family have already invested in acquiring information on those assets. Moreover, the number of managers and other measures related to the ability of funds to obtain and manage information have only a limited explanatory power on the number of stocks funds invest on. In sum, informational asymmetries alone cannot explain this apparent lack of international diversification as

These six facts imply that there is lack of international diversification even within mutual fund families. Of course, these facts are only relevant if we show that the lack of holdings is actually translated into return losses or excessive variance. In other words, does the fact that global funds do not tend to hold more stocks than specialized funds imply a diversification loss? If assets within and across countries are correlated, it might be possible for global funds to obtain the same degree of diversification benefits by simply holding fewer stocks, in possibly fewer countries. In that case, return correlations would account for the patterns observed in the data.

To address whether there are diversification losses, we ask whether a global fund can improve its performance simply by investing in specialized funds within the same family. In other words, we compare the performance of global funds with that of a portfolio of specialized funds and the global fund itself. Note that this is, by design, a very restrictive exercise. We are not asking a global fund to invest in any possible stock available to a specialized fund; we are restricting global funds to invest in a portfolio held already by another fund within the same company. This guarantees that the stocks are available for investment (that we are considering a feasible set), that they are at least attractive to another manager in the same firm, and that information about the stocks was already collected and analyzed by someone close to the global fund manager. If the gains

were negligible, the additional stocks in the specialized fund would not be necessarily useful for global funds, not at least in the proportions they enter the specialized fund portfolios.

Importantly, we do not allow short selling within the same family, but only portfolios that imply buy and hold. When we perform this exercise, we find that there are potential gains from diversification. Global funds could obtain better returns for a given level of risk if they invested in portfolios similar to those of specialized funds. In other words, by not increasing the number of stocks as funds expand their investment scope, global funds forgo the benefits that broader international diversification provides. The results are robust to many types of estimation methods that take into account expected returns, variances, and several benchmarks to which a fund is compared. For example, we find that the average return of world funds can be increased by 4.6% p.y. if their strategies were to minimize risks given a certain level of return. Alternatively, the average return can improve by 1.6% p.y. if they were to maximize expected returns given a specific level of riskiness for their portfolios. These numbers would be 3.9% and 2.5%, respectively, if benchmark indexes are considered. To the extent that funds hold similar portfolios than typical stock market indexes, these results also imply that holding a portfolio of sub-indexes dominates holding broader ones.

These findings have important implications to the literature. The fact that funds supposed to invest around the world are not enough diversified, even when there are potential gains to doing so, represents a significant puzzle. The experiment in this paper shows that global funds would gain by investing in stocks that specialized funds within the same company already hold. This casts doubts to the idea that asymmetric information drives the lack of international diversification – at least in the dimensions highlighted here. Global fund managers should at least have access to the same information that specialized fund managers have, especially to the ones that other managers within the same mutual fund company do. Moreover, the fact that each individual fund is small relative to the market size suggests that the lack of diversification is not driven by the inability of global funds to purchase the securities that specialized funds hold; that is, it is not driven by transaction costs. Although global funds are larger than specialized funds, at the minimum they could invest a similar fraction than the

specialized funds do in the securities that global funds do not hold. The finding that the number of holdings across mutual funds is significantly explained by family effects and does not vary much across fund types within families suggests that the way the financial industry is organized is an important factor in determining the degree of international diversification. Finally, to the extent that global funds continue growing relative to specialized funds, the findings in this paper suggest that there will be foregone diversification gains to investors. Also, several countries and firms will not benefit from tapping international investors, with the associated reduction in the cost of financing.

Our paper is closely related to the recent literature using micro data to study home bias. The initial studies that used firm-level data analyzed the portfolio of domestic and foreign investors in developed countries, such as Falkenstein (1996), Kang and Stulz (1997), and Dahlquist and Robertsson (2001), who studied the U.S., Japan, and Sweden, respectively. Ahearne et al. (2004) and Ammer et al. (2006) analyzed an alternative data source: the March 1994 and December 1997 comprehensive security-level surveys of U.S. residents' holdings in non-U.S. companies. Recent studies that also use firm-level data include Chan et al. (2005), who use a dataset equity holdings of 20,000 mutual funds from 26 developed and developing countries investing in 48 stock markets for the years 1999 and 2000; and Aggarwal et al. (2005), who analyze a snapshot of 114 U.S. mutual funds holdings in 1,280 firms across 30 emerging markets in February 2002. Therefore, studies usually analyze a limited period of time and/or one specific type of investor or portfolio. Our study stands out from previous papers in that we consider a longer period of time (1991-2005) and that we compare mutual funds with different mandates to infer conclusions related to the home bias and the unexploited gains from the low degree of international diversification.

The rest of the paper is organized as follows. Section 2 describes the dataset analyzed. Section 3 studies the extent of international diversification of U.S. mutual funds. Section 4 analyzes the reasons behind a lack of international diversification. Section 5 studies whether there are potential gains from further international diversification. Section 6 concludes.

II.   Data

In this paper, we use data on U.S. equity mutual funds that are established to purchase assets around the world.[9] We use two types of data in our empirical analysis: mutual fund holdings data and mutual fund price data.

Mutual fund holdings data are available from Morningstar International Equity Mutual Funds, a private company that collects mutual fund data. We analyze monthly Morningstar reports from March 1992 (when they became available) until June 2006. However, mutual funds do not disclose their holdings as frequently. They do so, at most, on a quarterly basis, and typically bi-annually (coinciding with SEC reporting). Given this heterogeneity in the release of new information, we construct our database with the last reported portfolio information for each fund on any given year. For example, our sample of mutual fund holdings for 2005 contains portfolio data for the Fidelity Worldwide Fund as of October 2005 and portfolio data for the Scudder Global Fund as of December 2005. In sum, we collect end-of-year detailed information on portfolio holdings between 1991 and 2005. Specifically, we collect stock names, amount invested in each stock by each fund, and country of origin of these holdings.

A difficulty in constructing the holdings database is that mutual funds report their asset allocation in separate reports over time. In other words, their holdings are not linked across reports; we had to link them. This is not a simple task because stock identifiers are rarely available and, if so, are not always unique. We do match these holdings across mutual funds over time based on the country of origin and the stock name for each security holding. We can thus determine whether the same stocks appear in different mutual fund portfolios over time, across and within fund families. Since the country of origin is available for the 1997-2005 period only, we do not attempt any matching of holdings for the pre-1997 period.

Table 1 describes our datasets. We collect data on 8,547 fund-year portfolio holdings over the period 1991 to 2005, covering 505 different families (companies) of mutual funds, and a total of 3,651 funds. Each mutual fund family has on average six

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[9] Funds that focus on both debt and equity are excluded from the analysis, even though they do invest a significant share of their portfolios in foreign stocks.

different mutual funds. Some families sell the same portfolio to investors under different names depending on their fee structure and minimum investment requirements. In our calculations, we count these different funds only once; i.e., we do not treat them as separate funds as MorningStar does.[10] The total number of asset-level observations in our dataset is 1,359,750, counting each stock-level allocation across all funds over time.

The U.S. mutual fund industry is organized by splitting funds according to their investment scope. In particular, funds are classified into five distinct categories: world funds, foreign funds, emerging market funds, regional funds, and country funds. Regional funds are divided into: Asia (and Pacific) funds, Europe funds, Latin America (and the Caribbean) funds, and Middle East and Africa funds.[11] World funds invest all over the world including the U.S., while foreign funds invest around the world excluding assets in the United States. Emerging market funds invest only on emerging market assets.[12] Regional and country funds invest only in a particular region or country, respectively, being developed or developing. For ease of exposition, we group funds into two categories: "global funds" and "specialized funds." Global funds encompass world funds and foreign funds. All other types of funds are called "specialized funds." The latter invest in a subset of assets that can be held by global funds. This organization of the mutual fund industry is displayed, as an example, in Figure 1. Naturally, funds with a wider (more global) investment scope can invest in the stocks held by more specialized funds.

The other dataset collected in this paper is the time series of return/price data on mutual funds themselves. Since these are open-ended funds, the value of each fund each day reflects the value of the underlying holdings or the net asset value (NAV). We thus use returns at the fund level on a daily basis between September 1989 and June 2006, for 36 fund families and 371 funds, as reported in Table 1.[13] We work with a total of 722,885

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[10] For example, Fidelity Advisors Funds contain the following Latin America funds with the same portfolio: Fidelity Advisors Latin America A, Fidelity Advisors Latin America B, and Fidelity Latin America T.

[11] Asia funds can actually invest in countries located in both Asia and Pacific regions. Latin America funds can also invest in countries in the Caribbean. Some Europe funds also tend to invest in countries in Africa, such as South Africa.

[12] Emerging markets are typically middle-income countries. However, these funds might invest a small proportion of their portfolios in low-income countries as well.

[13] The list of mutual fund families as well as the sample periods covered are reported in Appendix Table 1.

daily observations, composed of all returns for all funds. We include all funds within a given family of funds. On average, each family has 10 different mutual funds.[14] We work with a restricted number of mutual fund families, focusing on the larger families. This dataset allows us to assess issues related to the gains from international diversification by holding different types of mutual funds.

III. How Diversified Are Mutual Fund Holdings?

The U.S. mutual fund industry investing internationally has expanded sharply since the early 1990s. For example, in 1991 there were less than 200 mutual funds established to invest in international equity, while in 2005, there were almost 700 funds. This marked increase is not restricted to a specific type of mutual fund. Figure 2 shows the number of funds between 1991 and 2005; both the number of global and specialized funds increased significantly. However, while the number of global funds had increased steadily, that of specialized funds increased until 1998 and then declined. This is likely driven by the Asian and Russian crises that might have generated a desire to hold funds that can invest more freely around the world. At the end of 2005, there were 499 global funds and 191 specialized funds. In terms of assets under management, the differences are even starker. Global (specialized) funds managed 29 (7) billion U.S. dollars in 1991 and 787 (162) billion U.S. dollars in 2005. Although the number of global funds has stagnated since the early 2000s, their assets rose sharply. This pattern is broader than global versus specialized funds.[15] For instance, foreign funds are the ones with the most noticeable increase: from 61 funds in 1991 to 388 in 2005. In sum, the data show a clear trend in the U.S. mutual fund industry toward funds with a wider investment scope (global funds) over funds that invest in specific regions or countries (specialized funds).

Given the increasing importance of global funds, a natural question is to what extent their portfolio differs from the ones held by specialized funds and how much diversification they provide. To study this, we explore to what degree mutual fund

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[14] See Appendix Table 1 for a detailed description of the sample coverage of the price/returns data for each mutual fund family.

[15] Appendix Figure 1 shows similar plots but disaggregated by world, foreign, emerging market, regional, and country funds

holdings vary across different fund types within families. In principle, as the investment scope increases, funds should be able to hold more assets across countries and diversify risk better.

Figure 3 shows the median number of holdings for different mutual fund types from 1991 to 2005. The top panel reports these medians for world funds (with and without U.S. holdings), foreign funds, emerging market funds, and regional funds. The bottom panel displays the number of stocks held by Asia funds, Europe funds, Latin America funds, and country funds. The median number of holdings is surprisingly stable over the 15-year sample period and similar across fund types. The median world fund holds on average 106 stocks and 76 when excluding the U.S., with no clear time trend. The median foreign fund holds on average 106 stocks, while the median emerging market funds holds 121 stocks. Europe funds and country funds hold on average 70 and 63 stocks, respectively, while Asia and Latin America funds hold 64 and 56 stocks, respectively. These median values are lower for more specialized funds. However, across fund categories there is no clear time pattern. The only apparent exception is foreign funds, which have increased the number of holdings in the last few years. In sum, the evidence suggests that mutual fund managers tend to invest in a finite, number of stocks that does not increase significantly as the scope of investment widens.

Given that the number of stocks held by global funds does not increase significantly relative to specialized funds, and global funds have a broader scope of investment, a natural question is whether global funds hold fewer assets than specialized funds within each region of exposure. The evidence presented in Table 2 confirms that this is indeed the case. If holdings in Latin America are considered, the median specialized fund holds 41 stocks. Emerging market funds hold 34% less assets than the specialized fund within its mutual fund family. The drop in the number of holdings is even more striking for global funds, it falls 94% for either world or foreign funds. Furthermore, world and foreign funds also invest, respectively, in 71% and 75% fewer countries than their specialized counterparts. For Asia, the numbers suggest a similar pattern. The median foreign and world funds hold 35 and 19 assets, implying a drop of 42% and 69% relative to their specialized counterpart. If the number of countries is considered, a global fund also holds a significantly fewer countries than an Asia fund in

the same mutual fund family. Emerging market funds also invest in a smaller number of countries and assets than regional funds, 10% and 33% less respectively. Similarly, in Europe, global funds also hold fewer assets and fewer countries than specialized funds. Although, if emerging countries in Europe are considered, emerging market funds tend to invest in more stocks and countries than a Europe fund. This can be explained by the fact that Europe funds tend to focus their holdings in developed Europe.

In sum, as their scope of investment becomes broader, mutual funds invest a growing amount of funds in fewer stocks and fewer countries within each region of exposure, especially in emerging countries. In principle, if assets are not redundant, this behavior seems surprising.

However, several reasons could rationalize this pattern. First, the existence of transaction costs. It is possible that global funds are relatively large, and thus, are unable to buy and hold some of the smaller stocks in emerging markets without incurring in large transaction costs. Second, information gathering and processing by fund managers can be costly. If there is any communication at all within mutual fund families, however, information gathering cannot be the case. Lastly, it is also possible that there are actually no benefits to further diversification; the assets are indeed redundant. This is the theme of the following two sections.

IV. What Factors Might Explain the Investment Patterns?

In this section, we explore several reasons that might be behind the investment in a limited number of stocks. First, we study to what extent the availability of instruments constraints the asset allocation of mutual funds. Second, we analyze where the variation in the number of stocks held by mutual funds comes from; in particular, to what degree it is driven by information asymmetry stories and family effects.

A.   Share of total assets

A first step to understand the extent of international diversification by mutual funds is to analyze the universe of assets that can be held by the sample of mutual funds analyzed in this paper. Table 3 reports the size of the universe of stocks in which funds can invest in

1997 and 2004.[16],[17] It shows the total number of listed stocks across different regions for both developed and emerging countries. These potential holdings are larger in emerging countries than in developed countries; however, the difference has fallen over time. The number of stocks has grown 40% during the period in developed countries, and 20% in emerging countries – mostly concentrated in developing Europe.

Of the universe of potential holdings, mutual funds only invest in a fraction of these assets. Table 3 reports the actual number of mutual fund holdings and the fraction of holdings relative to the number of listed companies. It does so for all mutual funds and, separately, for global funds. In 1997, mutual funds invested in around 9,000 different firms. In developed countries, they held around 6,800 firms, an average of 50% of the available assets. However, in emerging countries, these numbers are much smaller: they held only 2,271 firms, or 13% of the available stocks. A similar, though more pronounced pattern emerges when focusing on global funds only, the mutual fund type that has become very large over the sample period. In 1997, they held 4,953 different firms in developed countries, which constitute 38% of the number of potential stocks available. In emerging economies, global funds held only 8% of the available shares.

Table 3 also shows that, although the universe of listed companies has increased between 1997 and 2004, there has been a considerable fall in the number of mutual fund holdings during this period. In 2004, mutual funds held 5,204 in developed countries and 1,085 different firms in emerging countries. This decline in holdings has not been concentrated in any particular region, but has been more accentuated in emerging countries – a fall of 52% is observed, evenly spread across the different regions. In developed countries, the number of holdings declined 24%. Moreover, at the same time that increased their assets substantially between 1997 and 2004, they reduced number of holdings. In 2004, their holdings have decreased to 4,799 firms in developed countries, only 26% of the available assets. In developing countries, the number of holdings fell

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[16] Assets in the U.S. and Canada have been excluded from this table as we focus on the international holdings of mutual funds. Offshore centers have also been excluded from this table as firms usually only have offices in these centers, but their main operations are somewhere else.

[17] This number is an underestimation of the true universe of assets that can be purchased by mutual funds. First, mutual funds occasionally hold assets that are not listed in stock exchanges and therefore would not show up in these aggregate numbers. And second, there are a number of firms, especially from developing countries, with headquarters and operations in one country but with stock exchange listings in another, usually in financial centers such as London, U.K, and Hong Kong. These companies have been "relocated" to the country in which main operations take place.

approximately 46%, from 1,314 to 711 firms, or equivalently, from 8% to only 3% of the number of available stocks. Notice that even though the "number" of firms might be affected by mergers and acquisitions, the share as of the total available firms is not.

Although the number of mutual holdings has been falling between 1997 and 2004, the amount invested in these stocks has grown significantly, in both developed and emerging countries. Investments in developed countries have increased from $204 billion in 1997 to $446 billion in 2004, a 119% increase. In emerging countries, investments have increased from $30 billion in 1997 to $62 billion in 2004, a 106% increase. Thus, a growing amount of funds is being invested in fewer firms, and more significantly so in emerging countries.

One concern about mutual fund investment across countries is that institutional investors tend to be large; therefore, the amount they invest in different assets might be determined by their ability to invest in them. For example, if specialized funds held a large fraction of the available shares, global funds would find it difficult to invest in them without affecting prices. To investigate whether there are restrictions coming from the supply side of instruments, Table 4 shows the size of each mutual fund holdings by fund type relative to firms' market capitalization. The table shows that, on average, mutual funds hold a very small fraction of market capitalization. For example, both global fund and specialized fund investments each account for 0.12% of firms' market capitalization. Therefore, if funds wanted to increase their exposure, they could probably do so without major price impact. For example, if global funds invested all of their assets in specialized funds, each fund would still capture a small fraction of market capitalization, around 0.36%. Even if one aggregates all mutual fund holdings, the fraction of market capitalization remains small. The sum of all global fund holdings accounts on average for 2.8% of firms' market capitalization and that of specialized funds accounts for 1.3% of market capitalization. Therefore, the patterns we observe regarding mutual fund holdings do not seem to be driven by the inability of funds to hold more companies across countries.

To complement the evidence that mutual fund investments are concentrated in few companies and not evenly distributed across regions, Figure 4 illustrates to what extent mutual funds invest differently across countries. The figure plots the ratio of the

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number of companies held in mutual fund portfolios to the total number of listed companies. These ratios are computed on a yearly basis and reported according to their averages over the 1997-2004 period.[18] Countries are sorted by the extent of mutual fund investment and divided in five equally-sized groups (quintiles). Reinforcing the previous evidence, this figure shows that mutual fund holdings are not evenly spread across countries. For around half of the countries in the sample, mutual funds invest in at most 20% of the listed companies. In no country do mutual funds exhaust the available stocks. Moreover, only developed countries appear in the highest quintile. Among emerging countries, Mexico is the one with the largest ratio (44%), whereas among developed countries, Netherlands has the largest ratio (77%). In the bottom two percentiles, there are 24 developing countries but only four developed countries. In other words, mutual funds tend to hold a larger fraction of listed firms from developed countries than from emerging countries.

B.   Family versus Fund type effects

The second part of this section analyzes what drives the variation in the number of stocks held by mutual funds. Figure 3 already shows that the number of stocks held by mutual funds is relatively constant over time and does not vary significantly by fund type. Here we study these effects more formally and measure, in particular, the relevance of family characteristics.

Figure 5 (top panel) shows the distribution of the number of holdings for all fund-year observations. The median number of holdings is 95, while 95% of the observations are below 450. Although there is some dispersion, with some funds holding many stocks in some years, 74% of the observations imply holdings below 150 stocks and 88%, holdings below 250 stocks. The bottom part of Figure 5 shows the average number of stocks per family, sorted from lowest to highest number of holdings. This panel suggests that the dispersion in the number of stocks found in the fund-year observations is linked to the dispersion in the average number of stocks held per family. Mutual fund families differ substantially in the number of stocks they hold. For example, GAM Funds and

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[18] The reported numbers are an upper bound of the true values. As mentioned before, firms that have operations in one country and listed in another are assigned to the country in which operations occur. Hence, the number of available assets for investment is reduced in the listing country.

Oppenheimer Funds, hold on average substantially less than 200 stocks, while others (such as Dreyfus Founders and Vanguard Group) hold at least two times more. The mean of the fist quintile is 40 stocks, while the mean of the fifth quintile is 353. While there are extreme cases, with one family holding on average 1,142 stocks, most families hold a limited number of stocks, with the mean of the fourth quintile being 139 stocks.

We now compare how important family effects are versus time and fund type effects to explain the number of holdings across mutual funds over time. Table 5 reports regressions of the number of holdings, as the dependent variable, on year, fund type, and family dummies. The dummy coefficients are not reported, although they are usually significant at 1% confidence level. Seven different specifications are reported. In the first specification only year dummies are considered. In this case, less than 1% of the variance in these mutual fund holdings can be explained. Column 2 reports a regression with fund type dummies alone. Again, a small percentage (only 3%) of the variance of the dependent variable is explained by these dummies. The specification in column 3 includes family dummies. In this case, 46% of the variance in the number of holdings across funds over time is explained, a much greater percentage than what was explained by fund type and year effects alone. The next three reported regressions include a combination of these three types of dummies: family dummies, fund type dummies, and year dummies. In all these cases, the R-squared is relatively high when family dummies are included. Lastly, we report a specification with all dummies together (column 7). In this case, there is only a slight increase in the R-squared in comparison to the other regressions with family dummies. Therefore, family effects indeed seem to be the relevant ones to explain mutual fund holdings.

C.   Informational Costs

Finally, we explore what might explain the importance of family effects on the number of holdings. Our hypothesis is related to information asymmetries, to which degree can vary across mutual fund families as institutional practices might differ. We address both costly information gathering and processing. To the extent that information is costly to obtain and the managers of specialized funds have already decided the asset allocation, global funds within the same mutual fund company could benefit from this stock selection and choose among the stocks selected by the managers of specialized funds. Thus a natural

question is whether global funds hold only a subset of the assets held by specialized funds within the same family. Moreover, we also analyze the extent to which the number of managers and other measures related to the ability of funds to obtain and manage information might influence on how many stocks each fund invest on.

To asses the portfolio similarity we ask: what is the likelihood that a stock held by a specialized fund also belongs to the portfolio of global funds, within the same family of funds? The within family comparison is important given the large heterogeneity in holdings across mutual fund families and the hypothesis of interest, that is, whether fund managers in the same company make similar stock picks. To answer this question, we compute frequency counts in our sample. In other words, we take two types of funds (global and specialized) within a mutual fund family and count the number of observations for which a stock is held by one of these two types of funds, with each of the close to 400,000 observations being a family-year-stock observation. Then we compute the fraction of the total observations that a stock is held by a certain fund type but not held by the other, a stock is held by both the fund types, and a stock is held by the global fund but there is no specialized fund within the same family that could hold that stock.[19] We make these comparisons for the same year; for example, we compare a stock held by a specialized fund at time *t* with the stocks held by the corresponding global fund also at time *t*. No observations fall into the case that there is no global fund that could not hold a stock held by a specialized fund; that is, for every specialized fund there is always a global fund within the family.[20] Moreover, by construction, there are no observations for which a stock is held by neither the global fund nor the specialized fund (or for which a specialized fund does not exist). We repeat this exercise just for holdings in emerging markets and by breaking global funds into world funds and foreign funds.

The basic results are shown in Table 6 for total holdings and those on emerging markets (Appendix Table 2 shows the results splitting global funds into world and foreign funds). Each cell represents the relative frequency of the observations, that is, the joint probability that the global and specialized funds hold/do not hold a particular stock.

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[19] U.S. assets are excluded from the analysis here.

[20] We exclude all family-year-stock observations for which mutual fund families that do not have either one of the fund types considered in that given year.

Conditional probabilities can be obtained by looking at a particular row or column. The evidence from Table 6 suggests that global funds and specialized funds do not hold many stocks in common. When considering all holdings, only 16% of actual holdings are shared by both fund types; in emerging markets, that fraction is 13%. Moreover, 32% of the stocks are held by a specialized fund but not by a global fund. When considering only asset holdings in emerging countries, that number increases to 76%. In other words, a mere 24% of emerging market stocks in our sample is held by global funds. Of the global fund holdings, 25% are not shared by specialized funds (when there is one fund that could invest on it within the family) and for 27% of the observations there is no specialized fund within the family that could be investing in those stocks. When considering emerging market holdings, the number drops substantially. Of the global fund holdings, only 10% of the observations are not held specialized funds. And in very rare occasions (2% of the observations) do global funds hold assets for which there is no specialized fund that could invest on them.

The results from Table 6 suggest that the vast majority of mutual fund holdings in emerging countries are done through specialized funds, not through global funds. Moreover, the number of global fund holdings not shared by their specialized counterparts is small in developing countries. This suggests that in developing countries, global funds tend to hold a subset of what specialized funds hold. For example, conditional on being held by a specialized fund, there is only 15% probability that an emerging market stock is held by a global fund. This evidence also implies that the results on all holdings are being driven by holdings in developed countries. In other words, global funds seem to be holding a larger set of firms in developed countries than specialized funds, but mostly because there are not many specialized funds within families covering these countries.

Appendix Table 2 splits global funds into world funds and foreign funds and compares them with specialized funds. The results suggest that there is no significant difference on portfolio holdings across global funds: specialized funds invest in a wider set of assets than both world funds and foreign funds (when specialized funds are available). World funds and specialized funds share only 10% of their holdings. This percentage increases to 15% if foreign funds are considered. In other words, the

intersection of portfolio holdings between specialized funds and foreign funds is significantly larger than with world funds. This last result is being driven by the larger number of holdings of foreign funds relative to world funds. In sum, the results presented so far suggest that global funds hold a fraction of specialized fund holdings in emerging countries, but in developed countries, they actually hold a different set of assets.

The frequency counts shown in Table 6 and Appendix Table 2 measure to what degree mutual funds with different investment scopes invest in the same stocks; however, that evidence does not take into account the size of the mutual fund investments across stocks. In other words, the results do not take into account the loadings in each stock. It might be possible that though the range of stocks in which mutual funds invest differs, global and specialized mutual fund portfolios have a large loading on the stocks that are common to their portfolios. Therefore, the portfolios could actually be more similar than they appear with the evidence presented above. The reverse could also be true. To address this issue, we study entropy or similarity/commonality measures that analyze how alike mutual fund investments actually are.

The entropy measure is constructed as follows:

$$Entropy_{f,t} = \frac{\sum\limits_{s,i} NAV_{s,i,f,t} + \sum\limits_{s,j} NAV_{s,j,f,t}}{\sum\limits_{i} NAV_{i,f,t} + \sum\limits_{j} NAV_{j,f,t}}, \tag{1}$$

where $Entropy_{f,t}$ is the entropy measure for a pair of fund types (i and j) within family f, at time t. $i, j \in \{\text{global fund, specialized fund}\}$. $NAV_{s,i,t}$ ($NAV_{s,j,t}$) is the net asset value of the investments by fund type i (j) in stock s held by types i and j. $NAV_{i,t}$ ($NAV_{j,t}$) is the total net asset value of investments by fund type i (j). As above, global funds are then split into world funds and foreign funds. In words, for a given pair of different types within the same fund family, the entropy measure is the ratio of the sum of the mutual fund dollar investment in stocks common to the portfolio of these two fund types over the total net assets of the same funds. It should be noted that this entropy measure overestimates the commonality between any pair of individual funds as it aggregates funds according to their types. The measure is calculated for every year. Moreover, this

measure is constructed within families, given the large family effects on the number of holdings.

The entropy measures indicate that mutual funds do indeed hold a more similar portfolio than what frequency counts suggest, however, mutual funds still invest in quite different portfolios. For example, when comparing global and specialized funds, the entropy measure shows that, on average, 36% of the value of their holdings is in common assets. In contrast, as mentioned for the case of Table 6, 16% of the number of their holdings is in the same stocks. The entropy measure is slightly higher in the case of emerging economies, reaching on average 42%, compared to the 13% obtained for the frequency count of Table 6. As shown in Figure 6, the entropy measure is stable over the sample period, and if anything it decreases since 2002 (and since 1999 for the case of emerging economies), suggesting that there is no rise in commonality over time. Similar patterns are obtained when splitting global funds. As Appendix Figure 2 shows, funds have been investing a smaller share of their portfolios in assets that are common across fund types. On average, the entropy measure is 26% when comparing the holdings of world funds and specialized funds and 28% when comparing those of foreign funds and specialized funds.

Thus, to the extent that funds tend to hold portfolios that are not very similar, information acquisition does not seem to be the explanation for the family effects. We now turn to the extent to which the number of managers and other measures related to the ability of funds to obtain and manage information might influence on how many stocks each fund invest. The results are shown in Table 7. Column 1 shows that the number of stocks is positively associated with the number of managers; however, the marginal effect is low. For example, funds with one manager hold, on average, 132 stocks, while funds with two managers hold 135 stocks, and funds with six managers hold 197 stocks. In all other specifications, we consider the number of managers as a single count variable in order to summarize its results. Columns 2 and 3 add manager tenure and fund age to the regressions. The effects of those variables are also positive and statistically significant, although the variable fund expenses becomes insignificant when including year and fund family dummies. The number of managers has a significant positive effect on the number of fund holdings. Nevertheless, the proportion of the total variance explained by these

variables is small, between 3% and 5%. When adding family effects, the proportion rises to 49%. We repeat these regressions but adding fund expenses instead of the variable for the number of managers. While the variable fund expenses is positively associated with the number of holdings, the effect reverses when we control for fund size. Moreover, if family dummies are added, both fund expenses and fund size become insignificant. We also report two specifications including a variable for the number of managers, the variables for fund expenses, and another one for fund size. The results are similar the ones obtained in the other specifications. In sum, although the variables related to the ability of funds to collect and manage information are positively associated with the number of holdings, their impact seems small relative to the explanatory power of family dummies.

In sum, the results presented in this section suggest that the number of holdings cannot be explained by lack of available instruments or the costly gathering and processing of information. Then, the next obvious reason to explore is whether there gains to further diversification.

V.   Measuring the Cost of Lack of Diversification

This section analyzes mutual fund returns to shed light on whether they explain the finding that global funds do not have a substantially larger number of holdings relative to specialized funds and, indeed, tend to hold a lower number of stocks and countries within regions of exposure. These facts on investment patterns might be explained by the lack of diversification gains and/or by the desire of investors to minimize risk.

To analyze these hypotheses, we first study if there are potential gains from further international diversification by global funds. It could be that global funds do not need to hold many stocks because returns are correlated and, therefore, they achieve as much diversification as specialized funds do. We also test whether benchmark effects can justify the portfolio choice of global funds, since managers are generally evaluated on their performance relative to benchmark indexes. Consequently, portfolio decisions should incorporate these managerial incentives.

A.   Standard Portfolio Model

To evaluate the potential cost of the lack of diversification by global funds, we compare the returns of global funds to those of a simulated portfolio of specialized funds and the global fund itself. In particular, we allow global funds to invest in a portfolio that replicates specialized fund holdings within the same mutual fund family. Namely, we are not asking global funds to design their own strategies; we ask them to just follow the portfolio that specialized funds in the same mutual fund company hold.

There is an important advantage in constructing these simulated portfolios at the family level. One can easily argue that the cost of collecting information has already been paid. In other words, if there is a cost to collecting information about a particular country, or about a particular stock, then the fact that one mutual fund within the family of funds is already holding the asset is an indication that at least someone in the company has already paid for those costs. Moreover, the fact that other funds are investing in those stocks is a clear indication that they are within the subset of investable assets. In other words, from the asset manager's perspective there are no restrictions to investing in those assets; transaction costs should not be very high. Finally, this is a conservative strategy to evaluate the gains from international diversification. We are not using all the stocks in the investment universe of a fund to construct alternative portfolios, which might include assets that are hard to reach, but would apparently yield substantially higher returns.

To construct the simulated portfolios we impose the following restrictions: (i) portfolios can be constructed for a specific global fund type using the respective fund itself and specialized funds within the same mutual fund family; (ii) strategies can only be buy and hold; (iii) funds cannot be shorted; (iv) the performance evaluation is always conducted out-of-sample; and (v) the portfolio is optimized on a daily basis.

Assume that there is a global fund whose return history G we observe. Assume that this global fund is comprised of several specialized funds, whose returns are denoted by S_i. We can then construct a portfolio P, which puts non-negative weights on all specialized funds and on the global fund itself. This portfolio P is the optimal portfolio that minimizes its own variance but it is constrained at achieving at least the same expected return as the global fund itself. In other words, we compare and evaluate funds

along two dimensions, returns and variances, once administrative fees and their investment objective has been determined.

The optimization problem is described by (2) and (3).

$$\underset{x}{Min} \; \mathrm{var}(P) = x'\Sigma x , \tag{2}$$

such that:
$$E(P) \geq E(G)$$
$$0 \leq x_i \leq 1 \tag{3}$$
$$\sum_i x_i < 1$$
$$P = \left(1 - \sum_i x_i\right) * G + \sum_i x_i * S_i.$$

Since this portfolio is constructed and evaluated out of sample, portfolio shares are computed at time t and held for the next period. We call this simulation approach our active strategy because portfolio weights are re-optimized every period.

In the previous exercise, we keep the return "constant" (i.e. with the same objective) and try to find a better portfolio in terms of its volatility. As an alternative, we keep the variance "constant" and maximize expected returns. This active strategy is described as follows.

$$\underset{x}{Max} \; \mathrm{E}(P), \tag{4}$$

such that:
$$\mathrm{var}(P) \leq \mathrm{var}(G)$$
$$0 \leq x_i \leq 1 \tag{5}$$
$$\sum_i x_i < 1$$
$$P = \left(1 - \sum_i x_i\right) * G + \sum_i x_i * S_i.$$

We perform these exercises for several types of global funds. We compare world funds and specialized funds, foreign funds and specialized funds, a portfolio of world funds and specialized funds, and a portfolio of foreign funds and specialized funds. Portfolios of either world or foreign funds exist when more than one fund in a mutual fund family is classified as a global fund. This might take place because funds have different objectives such as value, growth, or blend strategies. Therefore, these funds aim at different sets of assets than "plain" global funds. On the contrary, specialized funds

usually do not clearly state these investment strategies. We are thus trying to make a fairer comparison by putting together these global funds.

An important benefit of these strategies is that we do not need to identify the exact stocks dropped across different mutual funds. In other words, the only information we need to perform this exercise is mutual fund returns and fund characteristics, i.e., the type of investments they are supposed to follow. This allows us to extend the time horizon of the data to start in the late 1980s.

The summary statistics of these simulated portfolios and the comparisons with global funds are shown in two tables. Table 8 reports the "best simulation" for each global fund. Where "best" is because it typically includes the largest possible number of specialized funds, but generally do not have a very long time span due to data availability on mutual fund returns. On the other hand, Table 9 reports the longest simulation for each global fund. In this case, fewer specialized funds are typically available for comparison, but a longer time span is covered. The tables present the following statistics: the annualized returns for both the global fund and the constructed portfolio (called "active strategy"), the annualized improvement in returns if the constructed portfolio is compared with the global fund, daily standard deviation of returns, and the number of simulations. We report averages across mutual fund families.

The top panel of these tables report the summary statistics of portfolios constructed based on equations (2) and (3). The tables with the best simulations show that using our active strategy the average annualized return of the portfolio increases by 509 basis points per year for the world funds, by 404 basis points for the foreign funds, and by 1,159 and 397 basis points for the portfolio of world and foreign funds, respectively. With these increases in expected returns, it would be difficult to argue that there are no potential gains from international diversification, even when investing in stocks that other funds within the same family hold. Moreover, the daily standard deviation of the constructed portfolio returns is also smaller than the one on the global fund. It falls by 9 basis points for the world funds, by 6 basis points for the foreign funds, and by 8 and 6 basis points for the portfolio of world and foreign funds, respectively. Although this

number seems small, it is important to remember that this is the reduction in the daily standard deviation.[21]

If the longest possible simulations are considered, the results still hold. For example, the average improvement in returns is around 289 basis points per year and the improvement in the daily standard deviation of returns is 7 basis points. The results are more modest though than the ones reported on Table 8. The reason is that fewer specialized funds are available when the longest simulations are considered. This implies that there is less scope for improvement than in the other case.

The bottom parts of Tables 8 and 9 report the summary statistics of portfolios constructed based on equations (4) and (5), i.e., maximizing the portfolio of expected return holding its variance constant. Considering the simulations with the greater number of specialized funds, the improvements in annualized returns are around 161 basis points, whereas the improvement in the daily standard deviation is almost negligible at less than 1 basis point. If the longest simulations are considered, the improvement in returns is around 80 basis points and the improvement in the daily standard deviation is at 1 basis point, on average. [22]

In sum, the results from these simulations allow us to reject the hypothesis that there are no costs from dropping stocks. To the contrary, although there is some heterogeneity in the results depending on the strategy used, there are gains from further diversification in terms of return and volatility.[23]

B.   Benchmarking

The optimization strategies described above are perhaps somewhat unrestricted because the objective of most mutual funds is not necessarily to minimize the variance given some expected return, or to maximize returns given some variance. The performance of mutual funds is actually evaluated in comparison to benchmark indexes. Moreover,

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[21] We computed these tables at the family level as well. The results are shown in Appendix Table 3A for the best simulations, and in Appendix Table 3B for the longest simulation for each mutual fund. As expected, there is a lot of heterogeneity among them.

[22] The results at the mutual fund family level are reported on Appendix Tables 4A and 4B. There is a lot of heterogeneity in the results across mutual fund families.

[23] For robustness purposes, we try these simulations with a more restricted sample. We use rolling windows of 240 business days. The results are robust to this change. They are reported in Appendix Tables 5A and 5B.

managers are usually compensated according to this relative performance. Thus, portfolio decisions should incorporate these managerial incentives. We test whether these benchmark effects would justify the portfolio choice of global funds. In other words, we assess whether this extra constraint is sufficient to eliminate the gains from further diversification found in the previous exercise.

In the case of the first strategy, the variance minimization one, we modify the objective function to take into consideration a benchmark index. The benchmark is the appropriate MSCI index, specific for each global fund as described in the Morningstar database. Instead of minimizing the variance of the portfolio, we minimize the variance of the difference between the portfolio and the benchmark index. Thus, equation (6) replaces equation (2) for this strategy. The constraints of this problem are unchanged and remain as stated in (3):

$$\underset{x}{Min} \ \operatorname{var}(P - Bench) \tag{6}$$

For our second strategy, the maximization of expected returns, we impose an additional restriction: the variance of the difference between the portfolio and the benchmark index has to be at most the same as the variance of the difference between the Global fund and the benchmark index. Equation (7) states this additional restriction:

$$\operatorname{var}(P - G_{Bench}) \le \operatorname{var}(G - G_{Bench}) \tag{7}$$

The results of these new simulations are reported on Table 10 for simulations with the greatest number of specialized funds for each global fund, and on Table 11 for the longest simulations for each global fund, and thus fewer specialized funds. Once more, the tables report averages across mutual fund families.

For simulations that minimize the variance of the portfolio, the results are similar to the ones reported in the previous section. For simulations with the greatest number of specialized funds, reported on the top panel of Table 10, there is an improvement in annualized returns of 375 basis points for world funds, 397 basis points for foreign funds, 735 basis points for portfolio of world funds, and 334 for portfolios of foreign funds. Thus, even for this strategy with benchmarking considerations, the increase in expected returns is large and hard to justify the lack of diversification based on transaction costs. Improvements in the standard deviation are also observed. On average, the daily standard deviation falls 4 basis points. If the longest simulations are considered, as reported in the

top panel of Table 11, the results are consistently robust. There is an increase in annualized expected returns of 262 basis points on average across the different simulations, and a decrease in daily standard deviations of 3 basis points.

If the second strategy is considered, the results are even stronger than before. In Table 10, we report an improvement in annualized returns of 251 basis points on average across mutual fund families and an improvement in daily standard deviations of 4 basis points. In Table 11, where fewer specialized funds are included in portfolio simulations, the improvement in returns is 168 basis points, but reaches 544 basis points for the portfolio of World Stock funds. The improvement in daily standard deviations is also considerable: 10 basis points on average across mutual fund families.

Therefore, our results suggest that benchmark effects cannot explain the empirical evidence described on investment patterns. We find that even within the same fund company more aggregate funds are not nearly internationally diversified enough.

VI.   Conclusion

This paper studied whether there are unexploited gains from international diversification using a novel dataset of portfolio holdings of U.S. institutional investors. We take advantage of the fact that mutual funds belong to families, with each mutual fund company having several funds with different scopes for international investment. As the investment scope broadens, one would expect that risk is better diversified internationally and that funds would hold more securities, to the extent that assets are not perfectly correlated.

We find that mutual funds are not well diversified and could benefit from more international diversification. In particular, we find that mutual funds hold a rather small number of stocks. Moreover, as their investment scope widens, mutual funds invest in fewer stocks within each region of exposure and fewer countries. Furthermore, there are strong family effects. That is, the number of stocks held across fund types is similar within mutual fund companies but different across them. Importantly, holding few stocks has a cost to the mutual fund. Even within the same mutual fund company, global funds

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could substantially gain from further international diversification by simply replicating portfolios that are already held by other funds within the same company.[24]

Several conclusions can be drawn from these findings. First, the evidence we found does not seem consistent with the idea that the lack of diversification is driven by asymmetric information. Since we compare the potential diversification gains within mutual fund companies, one can argue that the cost of gathering information has been paid and that mutual fund managers could freely share that information. Second, our comparison also allows us to conclude that the lack of diversification is not driven by transaction costs, understood as barriers to purchase securities. Specialized funds have already purchased those assets, so they are available to global funds as well. Moreover, each fund is not very large relative to market capitalization; therefore the investment in few firms does not seem to be driven by the size of global funds. We evaluate whether or not the number of managers working in the fund could explain these differences – in line with theories based on limited capacity to process information. We find that while more managers tend to increase the number of stocks held by the fund, this effect is very small.

What remains for future research is why, given the potential gains, global funds are not more internationally diversified. Perhaps the remuneration scheme gives no incentives for the information gathered by specialized funds to be freely shared within each mutual fund company, with each fund manager collecting her own information. Given the differences in the performance of specialized funds relative to global funds, it is important to also understand why investors do not arbitrage these differences and favor specialized funds over global ones. These puzzles remain open in the literature, and what this paper has done is to cast some doubts over the standard explanations offered in the literature regarding them.

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[24] This departure from full diversification and from apparently optimal portfolios is consistent with evidence on pension funds. See Opazo, Raddatz, and Schmukler (2008) and Raddatz and Schmukler (2008).

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Figure 1. Structure of the U.S. Mutual Funds Industry
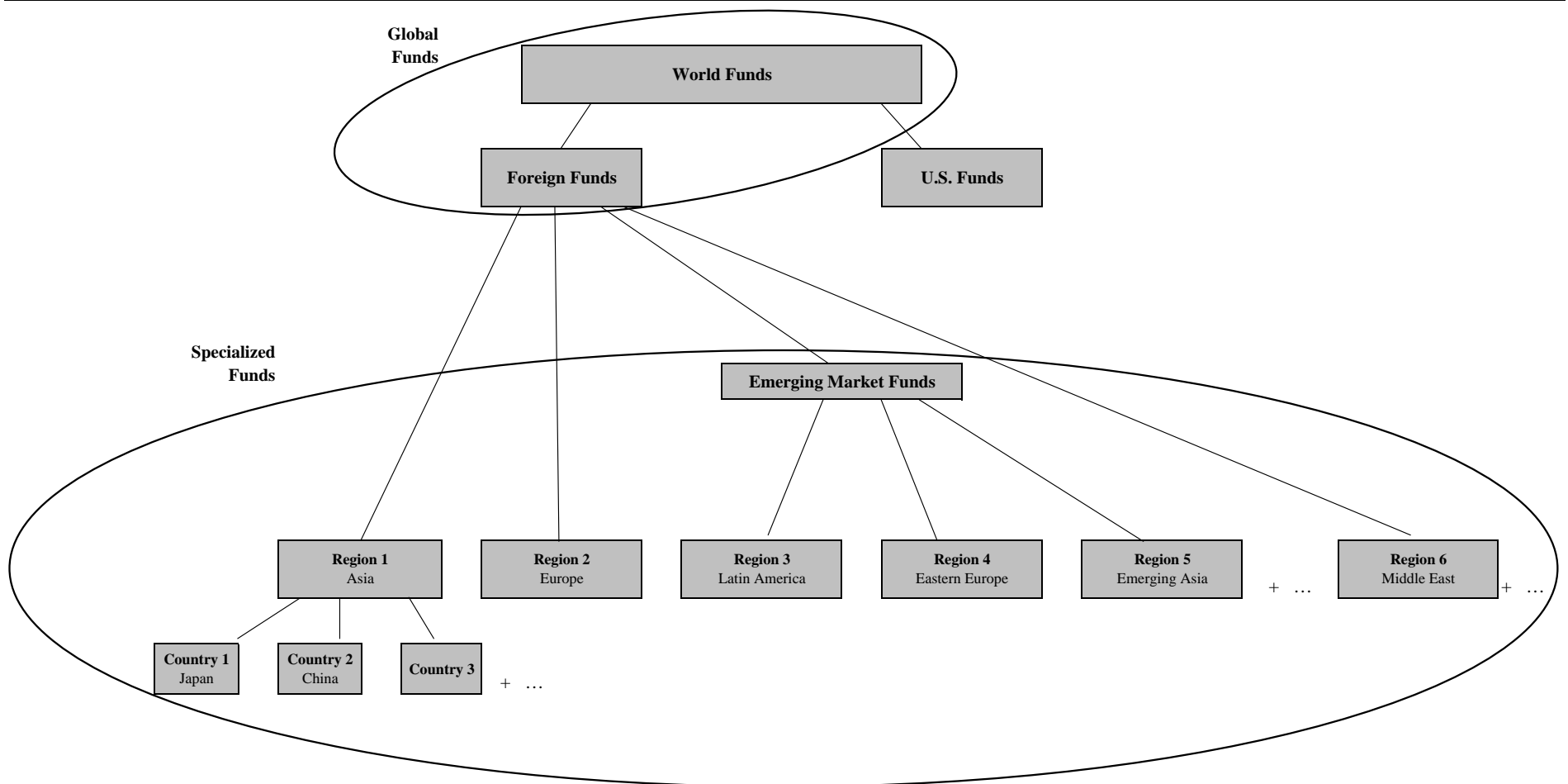
This figure characterizes the organization of U.S. mutual fund families that invest in foreign assets. See description in the main text for details. The figure also clarifies our classification between global and specialized funds. Global funds include both world and foreign funds. Specialized funds include: emerging market funds, regional funds, and country funds.

Figure 2. Total Number of Funds and Total Assets under Management by Fund Type
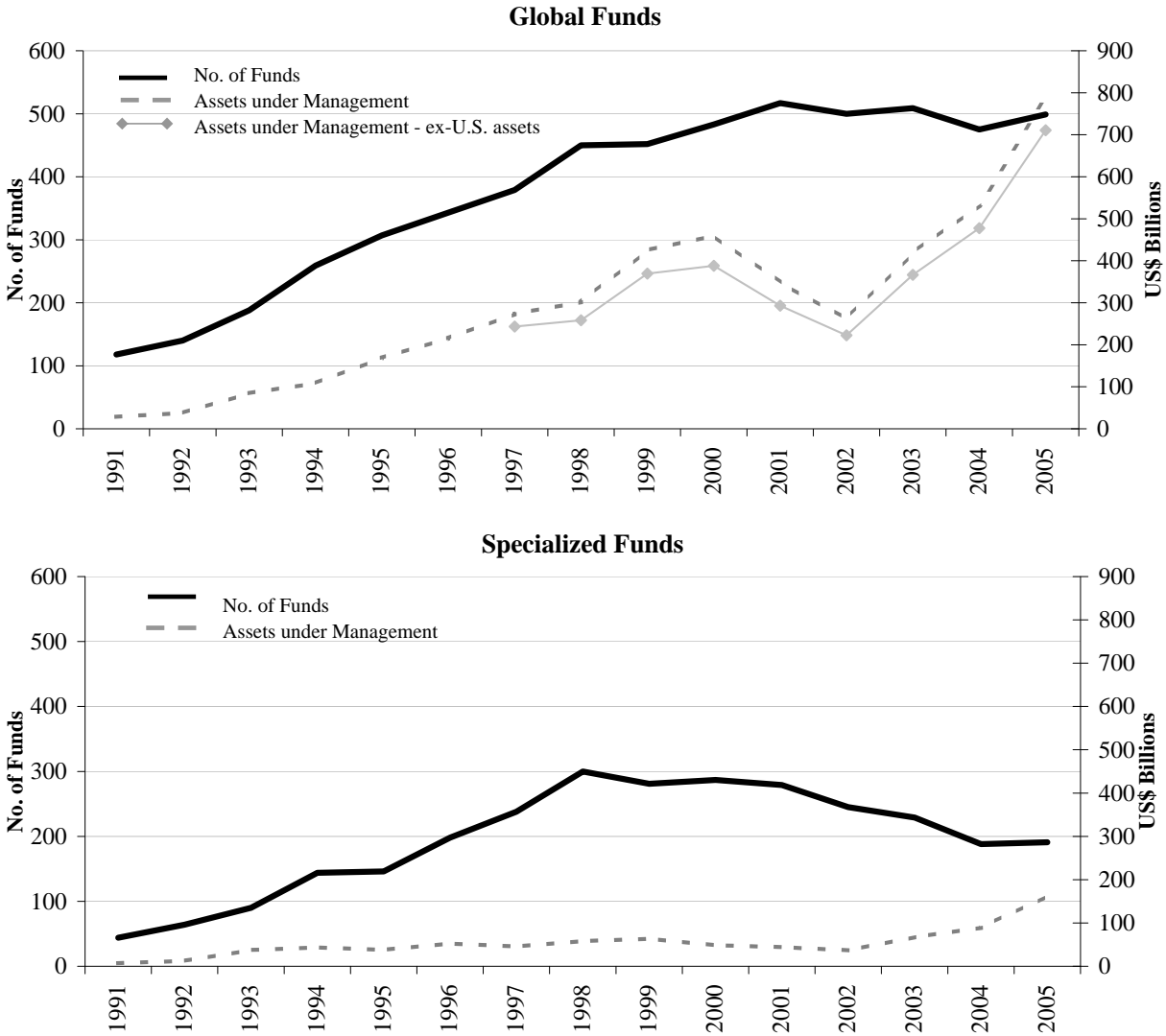
Global Funds

Specialized Funds

This figure shows the total number of mutual funds in our holdings database and their total assets under management by fund type from 1991 to 2005. Global funds include both world and foreign funds. Specialized funds include: emerging market funds, regional funds, and country funds. For global funds, the value of assets under management that are invested in non-U.S. assets is also shown (data available after 1997 only). Data on assets under management are in US$ billions. The data source is MorningStar International Equity Mutual Funds.

Figure 3. Median Number of Holdings by Fund Type

All Funds

World Funds | World Funds - Ex-U.S. Holdings
Foreign Funds | Emerging Market Funds
Regional Funds

Specialized Funds

Asia Funds | Europe Funds
Latin America Funds | Country Funds
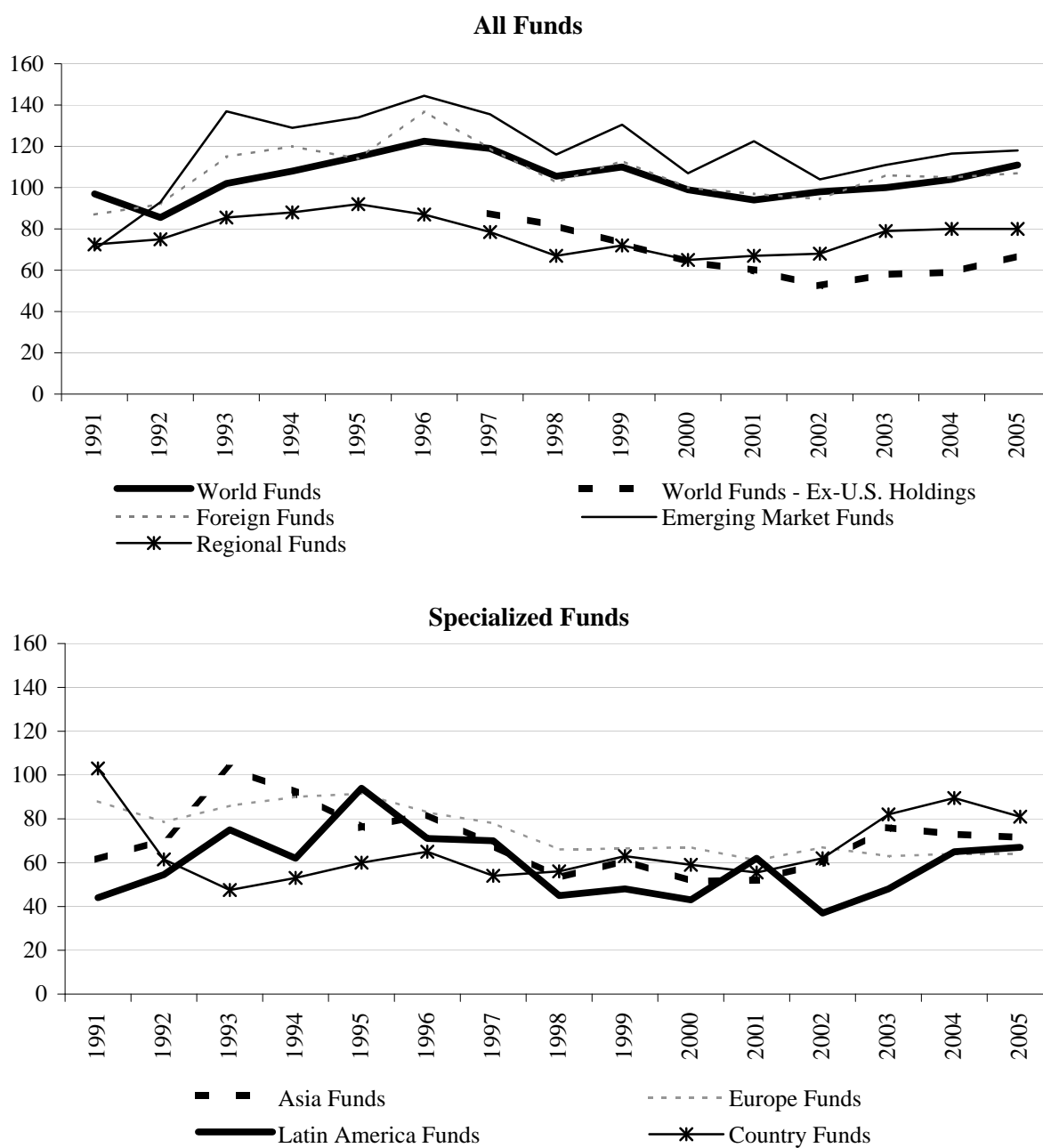
This figure shows the median number of holdings by mutual fund type between 1991 and 2005. The following mutual fund types are shown in the top panel of the figure: world, foreign, emerging market, and regional funds. The average number of foreign holdings of world funds is also shown. In the bottom panel, regional funds are divided into three different categories, namely: Latin America, Europe, and Asia funds. The average number of holdings for country funds is also reported in the bottom panel. The data source is MorningStar International Equity Mutual Funds.

Figure 4. Mutual Fund Holdings as a Proportion of the Total No. of Listed Stocks
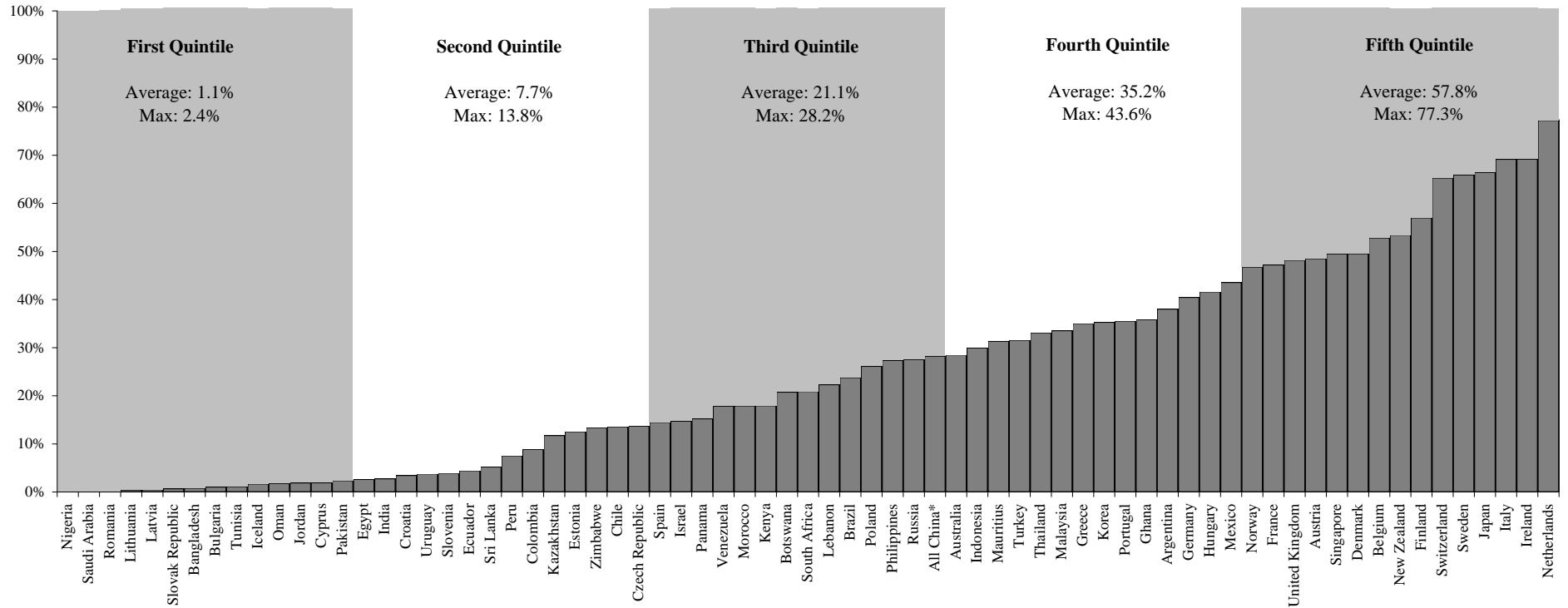
This figure shows the number of mutual fund holdings as a percentage of the total number of listed stocks by country. Countries are sorted according to their average ratio in the 1997-2004 period. Countries are divided into five equally-sized groups (quintiles); the average and maximum values for each quintile are reported. The United States and Canada were excluded from figure. The data sources are MorningStar International Equity Mutual Funds and Global Financial Database. * "All China" includes the following countries: China, Hong Kong, and Taiwan.

Figure 5. No. of Holdings: Dispersion and Family Effects

Histogram

Summary Statistics:

Average: 149 Stocks
Median: 95 Stocks
Std. Dev.: 186 Stocks

74% of obs. are below 150 holdings
88% of obs. are below 250 holdings
82% of obs. are below 350 holdings

y-axis: Frequency
x-axis: No. of Holdings

Family Averages

	First Quintile	Second Quintile	Third Quintile	Fourth Quintile	Fifth Quintile
Average:	40	72	97	139	353
Max:	59	83	112	180	1,142

y-axis: No. of Holdings
x-axis: Families

This figure shows two characteristics of mutual fund holdings. The top panel, shows the distribution of the number of holdings in the 1991-2005 period. The bottom panel reports the average number os holdings by mutual fund family. All funds in any given family are considered. Families are sorted according to their average number of holdings in the 1991-2005 period. Families are divided into five equaly-sized groups (quintiles); the average and maximum values for each quintile are reported.

Figure 6. Evolution of Entropy Measures

Total Holdings

Holdings in Emerging Countries Only
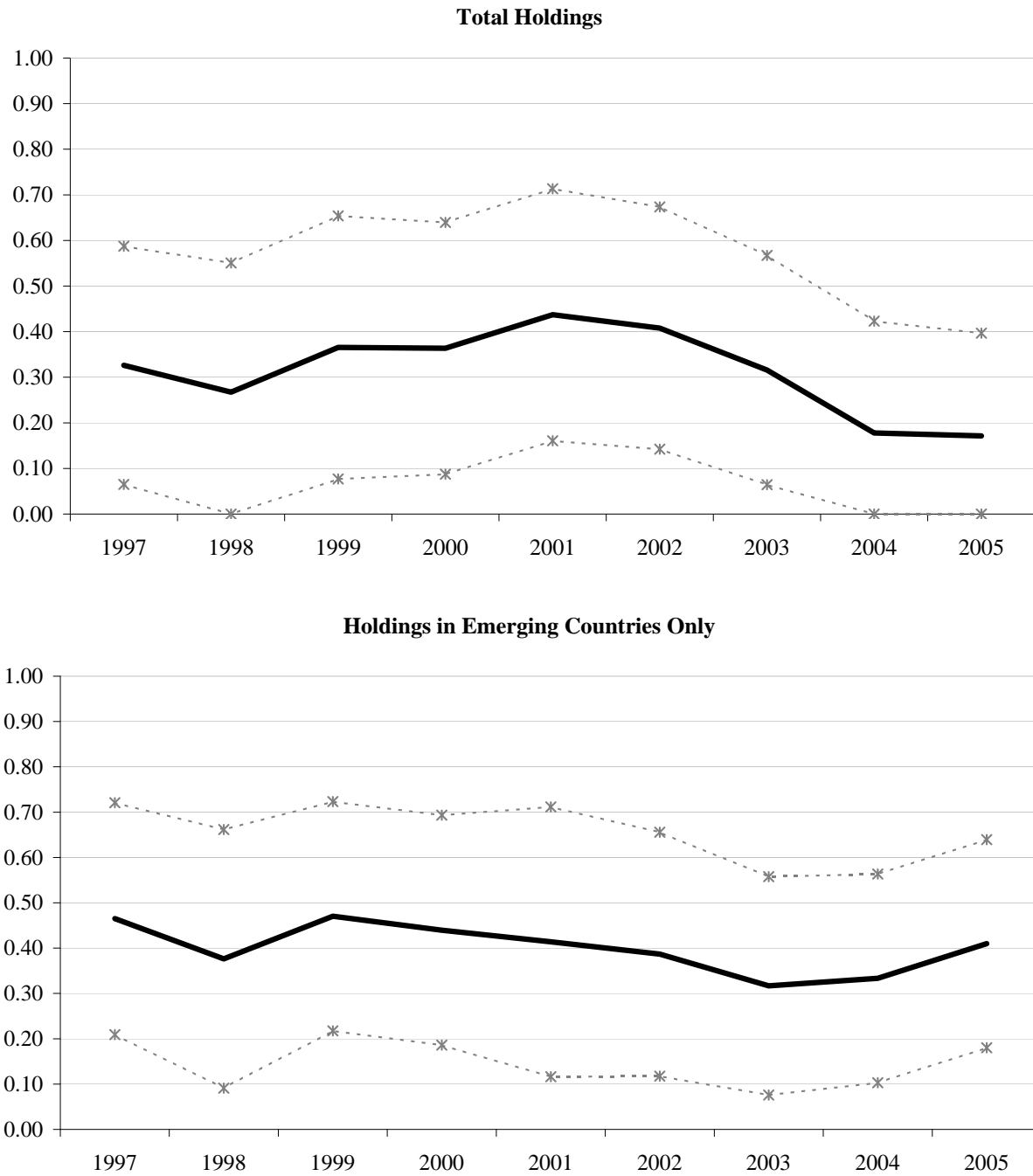
This figure shows the evolution of our entropy meaure from 1997 to 2005, in which stocks common to both global and specialized funds are considered. In the top panel, holdings in assets from all countries except the U.S. are considered, whereas in the bottom panel, only assets from emerging countries are analyzed. The thick line represents the median value across families in a given year. The figure also shows +/- one standard deviation from this median (dotted grey lines). Specialized funds include: emerging market, Latin America, Asia, Europe, and country funds. In each of these figures, if any given family on a given year does not have both types of funds being analyzed, it is excluded from the analysis.

Table 1. Data Coverage

Holdings Data

Sample	1991-2005
Frequency	Annual
No. of Families	505
Total Number of Funds	3,651

Price Data

Sample	September 1989 - June 2006
Frequency	Daily
No. of Families	36
Total Number of Funds	371

This table describes the two datasets analyzed in this paper. The source of the data on mutual fund holdings is MorningStar International Equity Mutual Funds. The source of the mutual fund price/return dataset is Bloomberg.

Table 2. Differences in Holdings Within Regions across Fund Types

No. of Holdings

Fund Type	Latin America	Asia	Europe	
			Developed Countries	Emerging Countries
Regional Funds				
Median No. of Holdings	41	60	62	1
Changes Relative to:				
Emerging Market Funds	-34%	-33%	-	283%
Foreign Funds	-94%	-42%	-5%	-69%
World Funds	-94%	-69%	-49%	-100%

No. of Countries

Fund Type	Latin America	Asia	Developed Countries	Emerging Countries
Regional Funds				
Median No. of Holdings	6	8	11	1
Changes Relative to:				
Emerging Market Funds	-17%	-10%	-	175%
Foreign Funds	-71%	-31%	0%	-53%
World Funds	-75%	-36%	-14%	-100%

This table reports differences in asset holdings across fund types within regions of exposure. These differences are expressed as a percentage change relative to the holdings of the appropriate regional fund. Median values are reported. The top panel shows the differences in the number of holings across fund types.The bottom panel shows the differences in the number of countries receiving investments from different fund types. The first row in each panel reports the median number of holdings or countries in a given region for the appropriate regional fund. The comparisons are made within mutual fund families. Families without the appropriate regional fund are excluded from the analysis. The sample period is from 1997 to 2005. Global funds are comprised of both world and foreign funds. Regional funds include the following fund types: Latin America funds, Asia funds, and Europe funds.

<div align="center">**Table 3. Mutual Fund Holdings**</div>

	No. Listed Companies	All Fund Holdings		Global Fund Holdings	
		No. of Holdings	As a Percentage of All Listed Stocks	No. of Holdings	As a Percentage of All Listed Stocks
1997					
Total	30,319	9,086	30%	6,267	21%
Developed Countries	12,987	6,815	52%	4,953	38%
Asia	5,760	3,249	56%	2,246	39%
Europe	6,392	3,459	54%	2,635	41%
Middle East	802	87	11%	54	7%
Emerging Countries	17,332	2,271	13%	1,314	8%
Asia	10,089	1,304	13%	693	7%
Europe	2,697	319	12%	167	6%
Latin America	2,196	399	18%	297	14%
Middle East & Africa	2,350	249	11%	157	7%
2004					
Total	39,061	6,289	16%	5,510	14%
Developed Countries	18,282	5,204	28%	4,799	26%
Asia	7,758	2,748	35%	2,429	31%
Europe	9,817	2,392	24%	2,315	24%
Middle East	686	45	7%	37	5%
Emerging Countries	20,779	1,085	5%	711	3%
Asia	10,444	566	5%	394	4%
Europe	6,279	184	3%	114	2%
Latin America	1,525	195	13%	141	9%
Middle East & Africa	2,531	140	6%	62	2%

This table shows the number of stocks that can be potentially held by U.S. mutual funds in 1997 (top panel) and in 2004 (bottom panel). The first column shows the total number of listed stocks in the main stock exchange in each country within each region. The data is from Claessens and Schmukler (2006) and from Global Financial Database. This is considered the universe of stocks that can be held by mutual funds. The second column shows the number of stocks actually held by all U.S. mutual funds in these regions, in absolute terms and as a percentage of the universe of stocks available. The third column reports the same numbers for global funds only. Developed countries include high-income countries and emerging countries are non-high-income countries, according to the World Bank classification of countries. The United States, Canada, and offshore centres are exlcuded from the analysis. The data source is MorningStar International Equity Mutual Funds.

Table 4. Size of Mutual Fund Holdings

	Holdings as a Percentage of Firms' Market Capitalization			Average Mutual Fund Size (US$ Million)
	Average	**Median**	**Std. Dev.**	
Fund Type:				
Global Funds	0.12%	0.01%	0.74%	894
World Funds	0.18%	0.01%	0.86%	1,315
Foreign Funds	0.11%	0.01%	0.72%	754
Specialized Funds	0.12%	0.02%	0.59%	272
Emerging Market Funds	0.15%	0.02%	0.70%	367
Asia Funds	0.12%	0.01%	0.53%	131
Europe Funds	0.08%	0.01%	0.35%	332
Latin America Funds	0.09%	0.02%	0.46%	146

This table shows the average, median, and standard deviation of mutual fund foreign holdings as a percentage of firms' market capitalization, by fund type. The average size of mutual funds is also reported. This data is in US$ millions. The sample period considered is from 1997 to 2005.

Table 5. No of Holdings: Importance of Year, Fund Type, and Family Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
R-squared	0.01	0.03	0.46	0.04	0.47	0.48	0.49
Independent Variables:							
Year Dummies	Yes	No	No	Yes	Yes	No	Yes
Fund Type Dummies	No	Yes	No	Yes	No	Yes	Yes
Family Dummies	No	No	Yes	No	Yes	Yes	Yes
No. of Observations	8,543	8,543	8,543	8,543	8,543	8,543	8,543

This table shows the R-squared of the regressions of the number of mutual fund holdings on year dummies, fund type dummies, and family dummies. Seven different specifications are shown. See the main text for a detailed description. The following fund types are considere in the analysis: world, foreign, emerging market, regional, and country funds. The sample period is from 1991 to 2005.

Table 6. Probabilities of Being Held by a Mutual Fund

Total Holdings

		Global Funds Probability of:		Total
		Not Being Held	Being Held	
Specialized Funds Probability of:	Not Being Held	0%	25%	25%
	Being Held	32%	16%	48%
No Specialized Fund		0%	27%	27%
Total		32%	68%	100% [399,281]

Holdings in Emerging Countries Only

		Global Funds Probability of:		Total
		Not Being Held	Being Held	
Specialized Funds Probability of:	Not Being Held	0%	10%	10%
	Being Held	76%	13%	89%
No Specialized Fund		0%	2%	2%
Total		76%	24%	100% [92,355]

This table shows frequency tables for mutual fund holdings from 1997 to 2005. It reports the probability of being held (or not) by certain types of mutual funds, given that a mutual fund family has both fund types. The top panel considers asset holdings in all countries except the U.S, whereas the bottom panel considers asset holdings in emerging countries only. Each observation is a family-year-stock observation. The total number of observations is reported in brackets in the "Total" column of each table. The cell percentage is reported. If in a given family-year observation, a global fund holds an asset in a country not covered by the specialized funds within that family in that year, then this observation is counted in the "No Specialized Fund" line. In each of these tables, if any given family in a given year does not have both types of funds being analyzed, it is dropped from the analysis.

Table 7. No of Holdings: Importance of No. of Managers and Fees

Independent Variables:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
No. of Managers		16.814***	15.612***	4.567**				16.075***	4.723**
		[1.681]	[1.653]	[1.886]				[1.774]	[2.024]
1	132.205***								
	[3.438]								
2	134.980***								
	[4.066]								
3	153.479***								
	[7.867]								
4	165.689***								
	[8.927]								
5	151.307***								
	[6.925]								
6	196.882***								
	[27.129]								
7 or More	216.827***								
	[9.570]								
Manager Tenure		2.319**	2.776***	2.068**	-1.42	-2.262**	1.505*	1.11	2.138**
		[0.976]	[0.967]	[0.878]	[1.051]	[1.063]	[0.854]	[0.993]	[0.884]
Fund Age		0.999***	0.28	-0.967**	0.45	0.851**	-1.203***	0.22	-1.232***
		[0.357]	[0.369]	[0.443]	[0.368]	[0.388]	[0.404]	[0.362]	[0.403]
Fund Expenses					0.655***	-2.175***	0.23	-2.228***	0.24
					[0.061]	[0.400]	[0.393]	[0.418]	[0.395]
Fund Size						0.028***	0.00	0.026***	0.00
						[0.004]	[0.004]	[0.004]	[0.004]
Year Dummies	No	No	Yes	Yes	No	No	Yes	Yes	Yes
Fund Type Dummies	No	No	Yes	Yes	No	No	Yes	Yes	Yes
Family Dummies	No	No	No	Yes	No	No	Yes	No	Yes
No. of Observations	6,419	6,170	6,170	6,170	5,733	5,732	5,732	5,726	5,726
R-squared	0.02	0.03	0.05	0.49	0.01	0.02	0.52	0.07	0.52

This table reports the regressions of the number of mutual fund holdings on dummies for the number of managers, manager's tenure, age of fund in years, fund expenses, and fund size. Depending on the specification, year, fund type, and/or family dummies are included in these regressions. The sample period is from 1997 to 2005. Fund expenses and fund size are in US$ millions. R-squared and total number of observations are reported in the bottom of the table. Standard deviation is shown in brackets. ***, **, and * indicate significance at one, five, or ten percent, respectively.

Table 8. Simulations: Best Result for Each Fund

Minimizing the Variance

Type of Global Fund	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
	Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
World Funds	6.05%	11.08%	4.87%	5.09%	0.89%	0.80%	60
Foreign Funds	6.40%	10.40%	3.88%	4.04%	0.96%	0.90%	72
Portfolio of World Funds	22.54%	36.41%	11.40%	11.59%	0.79%	0.71%	3
Portfolio of Foreign Funds	9.18%	13.22%	3.84%	3.97%	0.89%	0.83%	21
Total	6.92%	11.49%	4.40%	4.58%	0.92%	0.85%	156

Maximizing Expected Return

Type of Global Fund	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
	Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
World Funds	6.05%	7.93%	1.92%	1.91%	0.89%	0.89%	60
Foreign Funds	6.40%	6.85%	0.45%	0.46%	0.96%	0.96%	73
Portfolio of World Funds	22.54%	34.83%	10.14%	10.10%	0.79%	0.81%	3
Portfolio of Foreign Funds	9.18%	12.65%	3.46%	3.46%	0.89%	0.89%	20
Total	6.92%	8.51%	1.61%	1.61%	0.92%	0.92%	156

This table shows the results of the following simulations: minimization the variance of returns subject to restrictions on the expected returns (top panel) and maximization of expected returns subject a restiction on the variance of returns (bottom panel). The best simulation for each main fund in each family is considered. The main funds are world funds, foreign funds, portfolios of world funds, and portfolios of foreign funds. Portfolios of world funds are composed by several world funds within the same family but with different scopes, e.g. world value funds and world growth funds. Portfolios of foreign funds are similarly formed, e.g. foreign value funds and foreign growth funds. The strategy considered is an active one, in which portfolio weights are updated every day. Realized returns of the simulated portfolio are calculated out-of-sample, as described in the main text. Simulations use all previous data available at each point in time.

Table 9. Simulations: Longest Available Sample, But Fewer Regional Funds

Minimizing the Variance

Type of Global Fund	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
	Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
World Funds	8.05%	10.83%	2.65%	2.84%	1.15%	1.08%	60
Foreign Funds	5.52%	7.97%	2.41%	2.55%	0.97%	0.92%	73
Portfolio of World Funds	2.29%	12.35%	9.93%	10.37%	1.04%	0.88%	3
Portfolio of Foreign Funds	8.77%	11.91%	3.02%	3.15%	0.92%	0.86%	20
Total	6.84%	9.65%	2.73%	2.89%	1.04%	0.97%	156

Maximizing Expected Return

Type of Global Fund	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
	Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
World Funds	8.05%	8.14%	0.09%	0.08%	1.15%	1.15%	60
Foreign Funds	5.52%	5.77%	0.24%	0.24%	0.97%	0.97%	73
Portfolio of World Funds	2.29%	16.32%	13.86%	14.03%	1.04%	0.99%	3
Portfolio of Foreign Funds	8.77%	11.75%	3.01%	3.02%	0.92%	0.92%	20
Total	6.84%	7.63%	0.80%	0.80%	1.04%	1.03%	156

This table shows the results of the following simulations: minimization the variance of returns subject to restrictions on the expected returns (top panel) and maximization of expected returns subject a restriction on the variance of returns (bottom panel). The longest simulation for each main fund in each family is considered. The main funds are world funds, foreign funds, portfolios of world funds, and portfolios of foreign funds. Portfolios of world funds are composed by several world funds within the same family but with different scopes, e.g. world value funds and world growth funds. Portfolios of foreign funds are similarly formed, e.g. foreign value funds and foreign growth funds. The strategy considered is an active one, in which portfolio weights are updated every day. Realized returns of the simulated portfolio are calculated out-of-sample, as described in the main text. Simulations use all previous data available at each point in time.

Table 10. Benchmarking: Best Result for Each Fund

Minimizing the Variance

Type of Global Fund	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
	Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
World Funds	8.45%	12.24%	3.59%	3.75%	0.91%	0.86%	54
Foreign Funds	6.35%	10.36%	3.90%	3.97%	0.96%	0.94%	72
Portfolio of World Funds	22.54%	31.39%	7.26%	7.35%	0.79%	0.75%	3
Portfolio of Foreign Funds	9.00%	12.34%	3.25%	3.34%	0.90%	0.86%	20
Total	7.77%	11.69%	3.77%	3.87%	0.93%	0.89%	149

Maximizing Expected Return

Type of Global Fund	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
	Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
World Funds	8.45%	11.60%	3.00%	3.18%	0.91%	0.85%	54
Foreign Funds	6.35%	8.63%	2.22%	2.28%	0.96%	0.94%	72
Portfolio of World Funds	22.54%	24.44%	1.56%	1.59%	0.79%	0.78%	3
Portfolio of Foreign Funds	9.00%	10.74%	1.63%	1.66%	0.90%	0.88%	20
Total	7.77%	10.29%	2.41%	2.51%	0.93%	0.89%	149

This table shows the results of the following simulations: minimization the variance of returns subject to restrictions on the expected returns relative to a benchmark index (top panel) and maximization of expected returns subject a restiction on the variance of returns relative to a benchmark index (bottom panel). The best simulation for each main fund in each family is considered. For each simulation, we consider the appropriate benchmark indexes for the global fund as published by MorningStar. The main funds are world funds, foreign funds, portfolios of world funds, and portfolios of foreign funds. Portfolios of world funds are composed by several world funds within the same family but with different scopes, e.g. world value funds and world growth funds. Portfolios of foreign funds are similarly formed, e.g. foreign value funds and foreign growth funds. The strategy considered is an active one, in which portfolio weights are updated every day. Realized returns of the simulated portfolio are calculated out-of-sample, as described in the main text. Simulations use all previous data available at each point in time.

Table 11. Benchmarking: Simulations With The Longest Available Sample, But Fewer Regional Funds

Minimizing the Variance

Type of Global Fund	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
	Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
World Funds	9.04%	11.63%	2.46%	2.59%	1.15%	1.11%	60
Foreign Funds	5.49%	7.70%	2.19%	2.24%	0.97%	0.95%	73
Portfolio of World Funds	2.29%	11.68%	9.19%	9.51%	1.04%	0.93%	3
Portfolio of Foreign Funds	8.53%	11.58%	2.99%	3.08%	0.93%	0.89%	19
Total	7.16%	9.76%	2.53%	2.62%	1.03%	1.00%	155

Maximizing Expected Return

| Type of Global Fund	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
	Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
World Funds	9.04%	10.08%	1.20%	1.87%	1.15%	0.91%	60
Foreign Funds	5.49%	6.98%	1.45%	1.52%	0.97%	0.95%	73
Portfolio of World Funds	2.29%	7.56%	5.21%	5.44%	1.04%	0.96%	3
Portfolio of Foreign Funds	8.53%	9.67%	1.07%	1.11%	0.93%	0.91%	19
Total	7.16%	8.51%	1.38%	1.68%	1.03%	0.93%	155

This table shows the results of the following simulations: minimization the variance of returns subject to restrictions on the expected returns relative to a benchmark index (top panel) and maximization of expected returns subject a restiction on the variance of returns relative to a benchmark index (bottom panel). The longest simulation for each main fund in each family is considered. For each simulation, we consider the appropriate benchmark indexes for the global fund as published by MorningStar. The main funds are world funds, foreign funds, portfolios of world funds, and portfolios of foreign funds. Portfolios of world funds are composed by several world funds within the same family but with different scopes, e.g. world value funds and world growth funds. Portfolios of foreign funds are similarly formed, e.g. foreign value funds and foreign growth funds. The strategy considered is an active one, in which portfolio weights are updated every day. Realized returns of the simulated portfolio are calculated out-of-sample, as described in the main text. Simulations use all previous data available at each point in time.

Appendix Figure 1. Total Number of Funds and Total Assets under Management by Fund Type
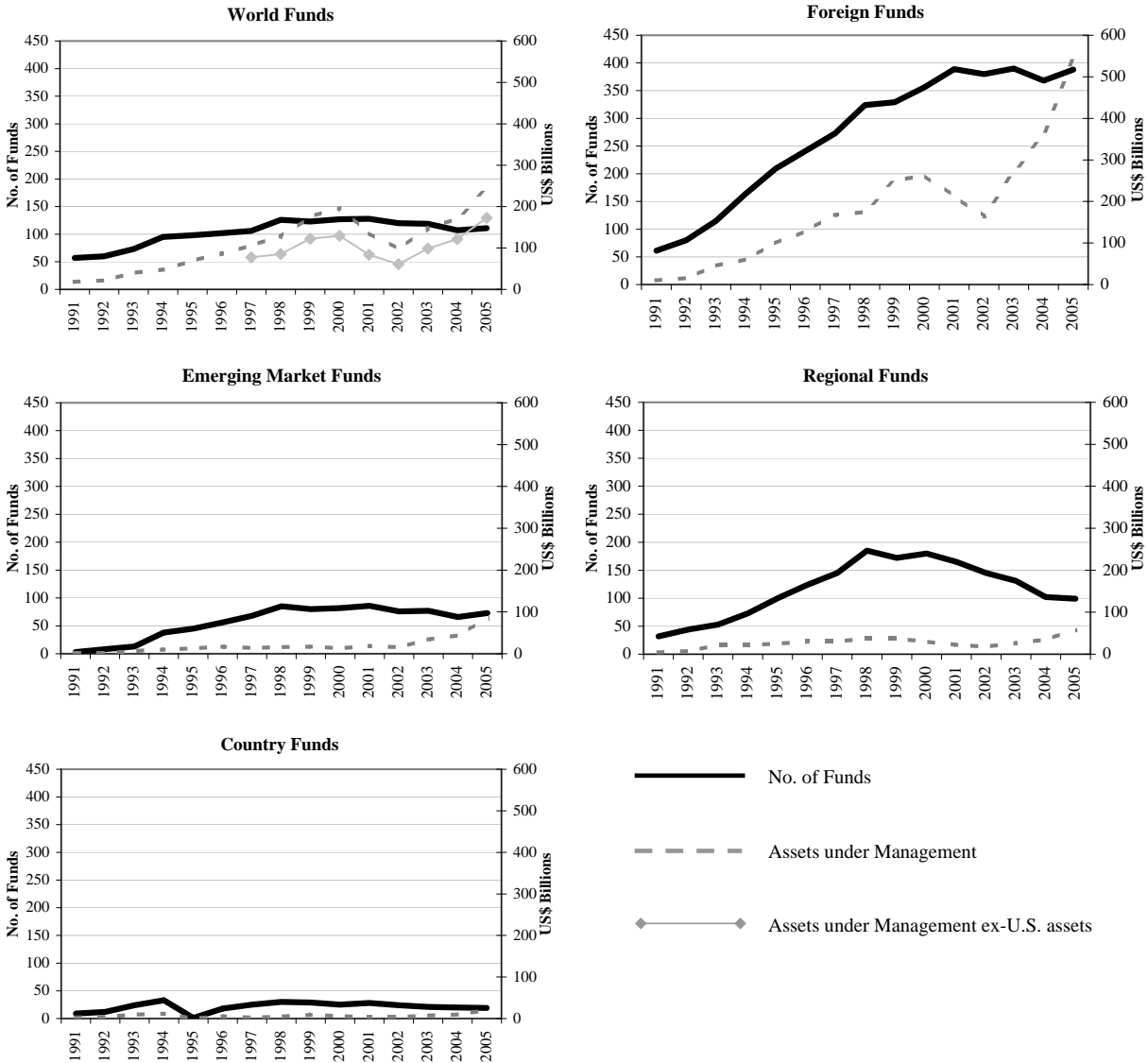
This figure shows the total number of mutual funds in our holdings database and their total assets under management by fund type from 1991 to 2005. World funds are allowed to invest anywhere in the world, foreign funds are also allowed to invest in all countries except the U.S., emerging market funds can invest in emerging countries, regional funds invest in specific regions, and country funds, in specific countries. For world funds, the value of assets under management for only non-U.S. assets is also shown (data available after 1997 only). Data on assets under management are in US$ billions. The data source is MorningStar International Equity Mutual Funds.

Appendix Figure 2. Evolution of Entropy Measures

Total Holdings

Stocks Common to World and Specialized Funds
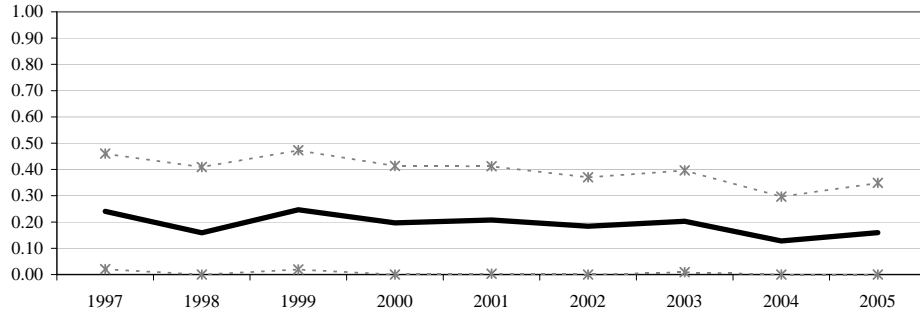
Stocks Common to Foreign and Specialized Funds
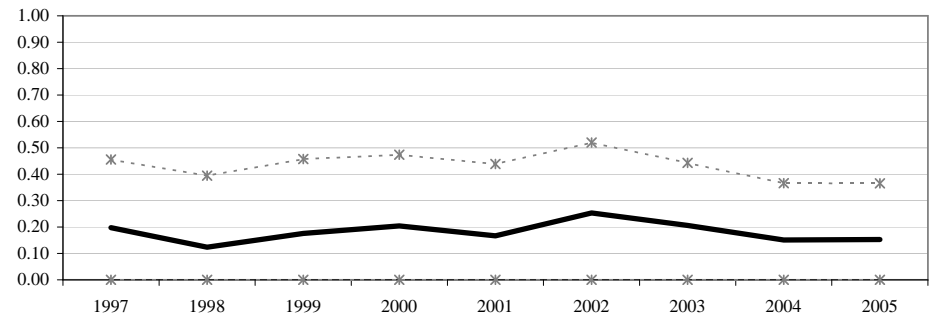
Holdings in Emerging Countries Only

Stocks Common to World and Specialized Funds
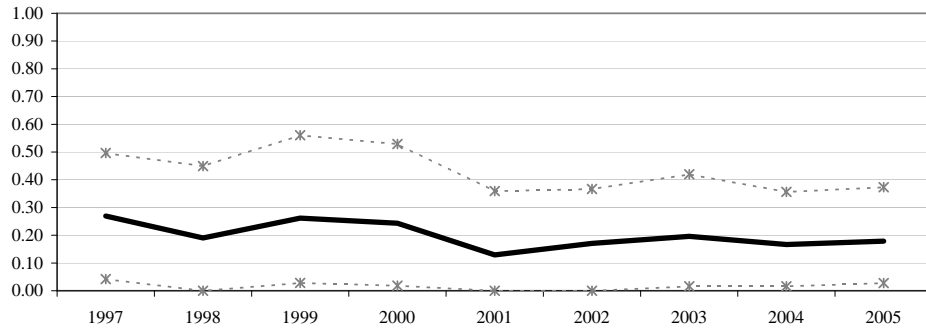
Stocks Common to Foreign and Specialized Funds
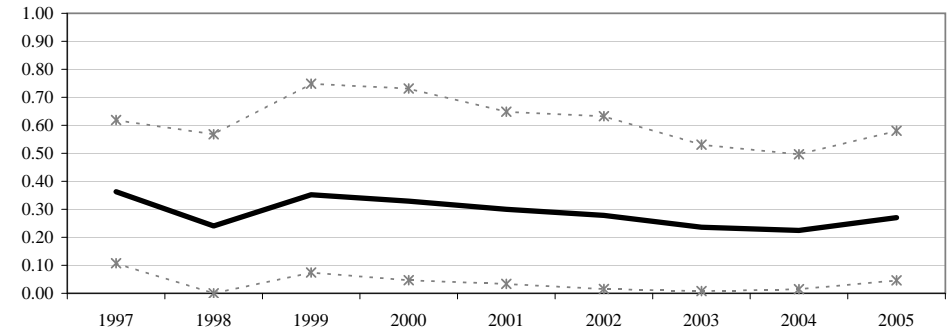
This figure shows the evolution of our entropy meaures from 1997 to 2005. Two different measures based on different pairs of mutual fund types are considered: stocks common to both world and specialized funds (left panels) and stocks common to both foreign and specialized funds (right panels). In the top panel, holdings in assets from all countries except the U.S. are considered, whereas in the bottom panel, only assets from emerging countries are analyzed. The thick line represents the median value across families in a given year. The figure also shows +/- one standard deviation from this median (dotted grey lines). Specialized funds include: emerging market, Latin America, Asia, Europe, and country funds. In each of these figures, if any given family on a given year does not have both types of funds being analyzed, it is excluded from the analysis.

Appendix Table 1. Price Data on Mutual Funds

	Family	No. Funds	Beginning	End
			Sample	
1	AIM Family of Funds	17	Apr-92	Jul-05
2	AllianceBernstein	10	Dec-99	Jun-06
3	Allianz Funds	4	Dec-04	Jul-05
4	American Funds Group	7	Mar-02	Jun-06
5	Columbia Funds	8	Oct-00	Jun-06
6	Credit Suisse	8	Dec-01	Jun-06
7	DFA Investment Dimensions Group	9	Mar-93	Jul-05
8	Dreyfus Founders	11	Jul-96	Jun-06
9	Eaton Vance Group	7	Sep-99	Jul-05
10	Evergreen Funds	5	Sep-94	Jun-06
11	Excelsior Funds	4	Sep-93	Jul-05
12	Fidelity Advisors Funds	14	Dec-00	Jun-06
13	Fidelity Group	18	Sep-89	Jul-05
14	GAM Funds	7	Jan-90	Jul-05
15	Gartmore	5	Jul-04	Jun-06
16	GMO LLC	17	Jan-99	Jul-05
17	Goldman Sachs Asset Management Group	11	Oct-98	Jul-05
18	Hartford Mutual Funds	10	May-01	Jun-06
19	ING Funds Trust	12	Nov-94	Jul-05
20	Ivy Mackenzie Management	9	May-99	Jul-05
21	J.P. Morgan Funds	10	Jul-02	Jun-06
22	Janus	12	Oct-98	Jun-06
23	Merrill Lynch Group	15	Nov-94	Jul-05
24	MFS Family of Funds	11	Jun-96	Jun-06
25	Morgan Stanley Funds	26	Oct-94	Jul-05
26	Oppenheimer Funds	9	Sep-04	Jun-06
27	Putnam Funds	6	Nov-91	Jul-05
28	RiverSource (former AXP)	9	Jul-90	Jul-05
29	Scudder Funds	18	Jun-98	Jul-05
30	Seligman Group	4	Jun-03	Jun-06
31	Smith Barney Group	6	Mar-98	Jun-06
32	T. Rowe Price Funds	14	Jun-92	Jul-05
33	Templeton Group	20	Nov-92	Jul-05
34	UBS Funds	6	Mar-01	Jun-06
35	Vanguard Group	11	Jul-00	Jun-06
36	Wells Fargo Advantage	5	Oct-97	Jul-05

This table describes mutual fund price data by fund families. It shows the number of funds in each family analyzed. It also shows the beginning and the end of our sample. The data source is Bloomberg.

Appendix Table 2. Probabilities of Being Held by a Mutual Fund

Total Holdings

		World Funds Probability of:		Total				Foreign Funds Probability of:		Total
		Not Being Held	Being Held					Not Being Held	Being Held	
Specialized Funds Probability of:	Not Being Held	0%	12%	12%		**Specialized Funds** Probability of:	Not Being Held	0%	23%	23%
	Being Held	52%	10%	62%			Being Held	34%	15%	49%
No Specialized Fund		15%	11%	26%		No Specialized Fund		2%	26%	28%
Total		67%	33%	100% [181,292]		Total		37%	63%	100% [382,591]

Holdings in Emerging Countries Only

		World Funds Probability of:		Total				Foreign Funds Probability of:		Total
		Not Being Held	Being Held					Not Being Held	Being Held	
Specialized Funds Probability of:	Not Being Held	0%	6%	6%		**Specialized Funds** Probability of:	Not Being Held	0%	8%	8%
	Being Held	83%	9%	92%			Being Held	79%	12%	91%
No Specialized Fund		1%	1%	3%		No Specialized Fund		0%	1%	2%
Total		85%	15%	100% [45,617]		Total		80%	20%	100% [89,260]

This table shows frequency tables for mutual fund holdings from 1997 to 2005. It reports the probability of being held (or not) by certain types of mutual funds, given that a mutual fund family has both fund types. The top panel considers asset holdings in all countries except the U.S, whereas the bottom panel considers asset holdings in emerging countries only. Each observation is a family-year-stock observation. The total number of observations is reported in brackets in the "Total" column of each table. The cell percentage is reported. If in a given family-year observation, a global fund holds an asset in a country not covered by the specialized funds within that family in that year, then this observation is counted in the "No Specialized Fund" line. In each of these tables, if any given family in a given year does not have both types of funds being analyzed, it is dropped from the analysis.

Appendix Table 3A. Simulations: Best Result for Each Fund

Minimizing the Variance

	Family	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
		Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
1	Allianz Funds	0.95%	-3.05%	-3.94%	-3.91%	0.66%	0.65%	2
2	AllianceBernstein	10.89%	14.76%	3.51%	3.59%	0.90%	0.86%	9
3	American Funds Group	10.57%	13.93%	3.06%	3.33%	0.87%	0.74%	4
4	AIM Family of Funds	8.37%	20.92%	11.71%	12.08%	0.95%	0.82%	10
5	Columbia Funds	17.52%	21.06%	3.14%	3.32%	0.85%	0.77%	3
6	Credit Suisse	8.46%	12.15%	3.40%	3.63%	0.95%	0.85%	2
7	DFA Investment Dimensions Group	3.15%	1.22%	-1.85%	-1.70%	0.91%	0.84%	4
8	Dreyfus Founders	4.75%	11.96%	6.99%	7.33%	0.95%	0.83%	6
9	Evergreen Funds	5.76%	5.56%	-0.19%	-0.21%	1.07%	1.08%	2
10	Eaton Vance Group	-0.75%	15.22%	16.10%	16.91%	1.08%	0.79%	2
11	Excelsior Funds	3.95%	7.15%	3.09%	3.13%	0.89%	0.87%	2
12	Fidelity Group	5.97%	9.42%	3.29%	3.59%	1.02%	0.91%	7
13	Fidelity Advisors Funds	7.76%	11.86%	3.84%	4.09%	0.87%	0.77%	6
14	GAM Funds	-1.42%	3.04%	4.53%	3.67%	1.04%	1.43%	2
15	Gartmore	22.30%	18.99%	-2.68%	-2.62%	0.81%	0.78%	3
16	GMO LLC	6.65%	8.05%	1.37%	1.36%	0.76%	0.77%	8
17	Goldman Sachs Asset Management Group	1.63%	6.80%	5.12%	5.42%	1.04%	0.94%	3
18	Hartford Mutual Funds	14.82%	18.72%	3.40%	3.50%	0.91%	0.86%	2
19	ING Funds Trust	-4.77%	0.10%	5.34%	5.71%	1.11%	1.01%	6
20	Ivy Mackenzie Management	-0.56%	4.80%	5.41%	5.73%	0.94%	0.81%	3
21	Janus	-7.01%	0.08%	7.65%	7.60%	0.67%	0.70%	5
22	J.P. Morgan Funds	22.11%	24.06%	1.60%	1.68%	0.90%	0.87%	4
23	MFS Family of Funds	20.70%	39.09%	15.78%	15.93%	0.88%	0.81%	3
24	Merrill Lynch Group	10.35%	13.01%	2.46%	2.64%	0.99%	0.93%	9
25	Morgan Stanley Funds	1.87%	6.83%	4.91%	5.28%	0.98%	0.84%	9
26	Oppenheimer Funds	10.45%	9.72%	-0.64%	-0.69%	0.82%	0.84%	3
27	Putnam Funds	4.86%	5.53%	0.65%	0.74%	1.08%	1.05%	5
28	RiverSource (former AXP)	13.45%	22.06%	7.63%	7.87%	0.84%	0.73%	2
29	Scudder Funds	6.31%	13.19%	6.49%	6.75%	1.00%	0.90%	6
30	Smith Barney Group	2.03%	2.35%	0.31%	0.30%	0.94%	0.94%	1
31	Seligman Group	14.45%	15.89%	1.26%	1.26%	0.82%	0.82%	2
32	Templeton Group	1.13%	2.46%	1.34%	1.55%	0.83%	0.73%	8
33	T. Rowe Price Funds	19.58%	32.17%	10.64%	10.71%	0.85%	0.82%	6
34	UBS Funds	4.41%	7.30%	2.77%	2.88%	0.89%	0.84%	1
35	Vanguard Group	7.77%	10.39%	2.43%	2.54%	0.96%	0.92%	4
36	Wells Fargo Advantage	5.22%	11.69%	6.16%	6.65%	0.98%	0.78%	2
	Total	6.92%	11.49%	4.40%	4.58%	0.92%	0.85%	156

This table shows the results of the following simulation: minimization the variance of returns subject to restrictions on the expected returns. The results are shown per family. The best simulation for each main fund in each family is considered. The main funds are world funds, foreign funds, portfolios of world funds, and portfolios of foreign funds. Portfolios of world funds are composed by several world funds within the same family but with different scopes, e.g. world value funds and world growth funds. Portfolios of foreign funds are similarly formed, e.g. foreign value funds and foreign growth funds. The strategy considered is an active one, in which portfolio weights are updated every day. Realized returns of the simulated portfolio are calculated out-of-sample, as described in the main text. Simulations use all previous data available at each point in time.

Appendix Table 3B. Simulations: Longest Available Sample, But Fewer Regional Funds

Minimizing the Variance

	Family	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
		Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
1	Allianz Funds	0.95%	-3.05%	-3.94%	-3.91%	0.66%	0.65%	2
2	AllianceBernstein	9.49%	13.26%	3.46%	3.54%	0.90%	0.87%	9
3	American Funds Group	10.57%	13.93%	3.06%	3.33%	0.87%	0.74%	4
4	AIM Family of Funds	9.43%	20.69%	10.47%	10.86%	0.99%	0.85%	10
5	Columbia Funds	14.11%	17.02%	2.64%	3.03%	0.92%	0.77%	3
6	Credit Suisse	8.46%	12.15%	3.40%	3.63%	0.95%	0.85%	2
7	DFA Investment Dimensions Group	3.15%	1.22%	-1.85%	-1.70%	0.91%	0.84%	4
8	Dreyfus Founders	4.71%	7.83%	3.05%	3.33%	1.02%	0.92%	6
9	Evergreen Funds	5.76%	5.56%	-0.19%	-0.21%	1.07%	1.08%	2
10	Eaton Vance Group	-4.98%	8.94%	14.69%	15.46%	1.13%	0.87%	2
11	Excelsior Funds	1.58%	1.67%	0.09%	0.10%	0.99%	0.99%	2
12	Fidelity Group	6.89%	8.09%	1.13%	1.36%	0.95%	0.86%	7
13	Fidelity Advisors Funds	7.40%	10.14%	2.59%	2.85%	0.93%	0.82%	6
14	GAM Funds	41.57%	45.05%	2.51%	1.43%	8.19%	8.66%	2
15	Gartmore	22.30%	18.99%	-2.68%	-2.62%	0.81%	0.78%	3
16	GMO LLC	6.65%	8.05%	1.37%	1.36%	0.76%	0.77%	8
17	Goldman Sachs Asset Management Group	1.63%	6.80%	5.12%	5.42%	1.04%	0.94%	3
18	Hartford Mutual Funds	6.10%	8.06%	1.85%	2.17%	1.04%	0.91%	2
19	ING Funds Trust	0.66%	4.26%	3.74%	4.09%	1.05%	0.94%	6
20	Ivy Mackenzie Management	0.89%	5.81%	4.91%	5.25%	0.99%	0.86%	3
21	Janus	4.97%	7.82%	2.78%	2.75%	0.88%	0.87%	5
22	J.P. Morgan Funds	22.11%	24.06%	1.60%	1.68%	0.90%	0.87%	4
23	MFS Family of Funds	12.47%	16.07%	3.22%	3.19%	0.80%	0.82%	3
24	Merrill Lynch Group	5.09%	6.49%	1.39%	1.57%	1.03%	0.96%	9
25	Morgan Stanley Funds	2.58%	5.83%	3.23%	3.49%	0.98%	0.88%	9
26	Oppenheimer Funds	12.61%	11.27%	-1.18%	-1.22%	0.79%	0.81%	3
27	Putnam Funds	4.86%	5.53%	0.65%	0.74%	1.08%	1.05%	5
28	RiverSource (former AXP)	3.46%	3.15%	-0.30%	-0.28%	1.14%	1.13%	2
29	Scudder Funds	3.78%	8.29%	4.37%	4.55%	1.01%	0.94%	6
30	Smith Barney Group	2.03%	2.35%	0.31%	0.30%	0.94%	0.94%	1
31	Seligman Group	14.45%	15.89%	1.26%	1.26%	0.82%	0.82%	2
32	Templeton Group	4.07%	4.14%	0.07%	0.21%	0.78%	0.71%	8
33	T. Rowe Price Funds	5.04%	10.10%	4.92%	5.07%	0.98%	0.92%	6
34	UBS Funds	4.41%	7.30%	2.77%	2.88%	0.89%	0.84%	1
35	Vanguard Group	5.40%	7.05%	1.58%	1.68%	0.99%	0.95%	4
36	Wells Fargo Advantage	6.44%	8.39%	1.87%	2.18%	1.01%	0.88%	2
	Total	6.84%	9.65%	2.73%	2.89%	1.04%	0.97%	156

This table shows the results of the following simulation: minimization the variance of returns subject to restrictions on the expected returns. The results are shown per family. The longest simulation for each main fund in each family is considered. The main funds are world funds, foreign funds, portfolios of world funds, and portfolios of foreign funds. Portfolios of world funds are composed by several world funds within the same family but with different scopes, e.g. world value funds and world growth funds. Portfolios of foreign funds are similarly formed, e.g. foreign value funds and foreign growth funds. The strategy considered is an active one, in which portfolio weights are updated every day. Realized returns of the simulated portfolio are calculated out-of-sample, as described in the main text. Simulations use all previous data available at each point in time.

Appendix Table 4A. Simulations: Best Result for Each Fund

Maximizing Expected Return

	Family	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
		Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
1	Allianz Funds	0.95%	0.95%	0.00%	0.00%	0.66%	0.66%	2
2	AllianceBernstein	10.89%	10.90%	0.01%	-0.01%	0.90%	0.90%	9
3	American Funds Group	10.57%	10.78%	0.19%	0.18%	0.87%	0.87%	4
4	AIM Family of Funds	8.37%	12.94%	4.46%	4.47%	0.95%	0.95%	10
5	Columbia Funds	17.52%	16.06%	-1.23%	-1.21%	0.85%	0.84%	3
6	Credit Suisse	8.46%	8.39%	-0.07%	-0.06%	0.95%	0.95%	2
7	DFA Investment Dimensions Group	3.15%	3.85%	0.69%	0.73%	0.91%	0.88%	4
8	Dreyfus Founders	4.75%	6.27%	1.51%	1.56%	0.95%	0.93%	6
9	Evergreen Funds	5.76%	5.76%	0.00%	0.00%	1.07%	1.07%	2
10	Eaton Vance Group	-0.75%	0.69%	1.45%	1.50%	1.08%	1.06%	2
11	Excelsior Funds	3.95%	3.95%	0.01%	0.01%	0.89%	0.89%	2
12	Fidelity Group	5.97%	6.10%	0.12%	0.11%	1.02%	1.03%	7
13	Fidelity Advisors Funds	7.76%	7.45%	-0.28%	-0.27%	0.87%	0.87%	6
14	GAM Funds	-1.42%	-2.18%	-0.76%	-0.72%	1.04%	1.03%	2
15	Gartmore	22.30%	22.30%	0.00%	0.00%	0.81%	0.81%	3
16	GMO LLC	6.65%	7.50%	0.81%	0.74%	0.76%	0.79%	8
17	Goldman Sachs Asset Management Group	1.63%	1.55%	-0.08%	-0.08%	1.04%	1.04%	3
18	Hartford Mutual Funds	14.82%	14.82%	0.00%	0.00%	0.91%	0.91%	2
19	ING Funds Trust	-4.77%	4.83%	10.70%	10.82%	1.11%	1.08%	6
20	Ivy Mackenzie Management	-0.56%	3.70%	4.31%	4.57%	0.94%	0.84%	3
21	Janus	-7.01%	11.09%	19.58%	19.43%	0.67%	0.74%	5
22	J.P. Morgan Funds	22.11%	21.52%	-0.48%	-0.48%	0.90%	0.90%	4
23	MFS Family of Funds	20.70%	20.40%	-0.25%	-0.25%	0.88%	0.88%	3
24	Merrill Lynch Group	10.35%	11.17%	0.75%	0.68%	0.99%	1.03%	9
25	Morgan Stanley Funds	1.87%	2.19%	0.32%	0.31%	0.98%	0.98%	9
26	Oppenheimer Funds	10.45%	9.70%	-0.67%	-0.68%	0.82%	0.82%	3
27	Putnam Funds	4.86%	4.96%	0.10%	0.11%	1.08%	1.08%	5
28	RiverSource (former AXP)	13.45%	13.45%	0.00%	0.00%	0.84%	0.84%	2
29	Scudder Funds	6.31%	7.83%	1.47%	1.45%	1.00%	1.01%	6
30	Smith Barney Group	2.03%	2.41%	0.37%	0.37%	0.94%	0.94%	1
31	Seligman Group	14.45%	14.44%	-0.01%	0.00%	0.82%	0.81%	2
32	Templeton Group	1.13%	1.06%	-0.06%	-0.08%	0.83%	0.83%	8
33	T. Rowe Price Funds	19.58%	19.77%	0.16%	0.16%	0.85%	0.85%	6
34	UBS Funds	4.41%	4.41%	0.00%	0.00%	0.89%	0.89%	1
35	Vanguard Group	7.77%	7.50%	-0.25%	-0.24%	0.96%	0.96%	4
36	Wells Fargo Advantage	5.22%	6.03%	0.78%	0.87%	0.98%	0.95%	2
	Total	6.92%	8.51%	1.61%	1.61%	0.92%	0.92%	156

This table shows the results of the following simulation: maximization of expected returns subject a restiction on the variance of returns. The results are shown per family. The best simulation for each main fund in each family is considered. The main funds are world funds, foreign funds, portfolios of world funds, and portfolios of foreign funds. Portfolios of world funds are composed by several world funds within the same family but with different scopes, e.g. world value funds and world growth funds. Portfolios of foreign funds are similarly formed, e.g. foreign value funds and foreign growth funds. The strategy considered is an active one, in which portfolio weights are updated every day. Realized returns of the simulated portfolio are calculated out-of-sample, as described in the main text. Simulations use all previous data available at each point in time.

Appendix Table 4B. Simulations: Longest Available Sample, But Fewer Regional Funds

Maximizing Expected Return

	Family	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
		Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
1	Allianz Funds	0.95%	0.95%	0.00%	0.00%	0.66%	0.66%	2
2	AllianceBernstein	9.49%	9.48%	-0.01%	-0.01%	0.90%	0.91%	9
3	American Funds Group	10.57%	10.78%	0.19%	0.18%	0.87%	0.87%	4
4	AIM Family of Funds	9.43%	15.72%	6.04%	6.07%	0.99%	0.98%	10
5	Columbia Funds	14.11%	12.69%	-1.24%	-1.21%	0.92%	0.91%	3
6	Credit Suisse	8.46%	8.39%	-0.07%	-0.06%	0.95%	0.95%	2
7	DFA Investment Dimensions Group	3.15%	3.85%	0.69%	0.73%	0.91%	0.88%	4
8	Dreyfus Founders	4.71%	4.84%	0.12%	0.13%	1.02%	1.02%	6
9	Evergreen Funds	5.76%	5.76%	0.00%	0.00%	1.07%	1.07%	2
10	Eaton Vance Group	-4.98%	-4.41%	0.59%	0.59%	1.13%	1.13%	2
11	Excelsior Funds	1.58%	1.54%	-0.05%	-0.05%	0.99%	0.99%	2
12	Fidelity Group	6.89%	6.85%	-0.04%	-0.04%	0.95%	0.95%	7
13	Fidelity Advisors Funds	7.40%	6.81%	-0.55%	-0.54%	0.93%	0.93%	6
14	GAM Funds	41.57%	40.49%	-0.76%	-0.72%	8.19%	8.17%	2
15	Gartmore	22.30%	22.30%	0.00%	0.00%	0.81%	0.81%	3
16	GMO LLC	6.65%	7.50%	0.81%	0.74%	0.76%	0.79%	8
17	Goldman Sachs Asset Management Group	1.63%	1.55%	-0.08%	-0.08%	1.04%	1.04%	3
18	Hartford Mutual Funds	6.10%	6.10%	0.00%	0.00%	1.04%	1.04%	2
19	ING Funds Trust	0.66%	5.36%	5.26%	5.32%	1.05%	1.03%	6
20	Ivy Mackenzie Management	0.89%	5.14%	4.24%	4.53%	0.99%	0.88%	3
21	Janus	4.97%	4.94%	0.00%	-0.05%	0.88%	0.88%	5
22	J.P. Morgan Funds	22.11%	21.52%	-0.48%	-0.48%	0.90%	0.90%	4
23	MFS Family of Funds	12.47%	12.18%	-0.26%	-0.26%	0.80%	0.80%	3
24	Merrill Lynch Group	5.09%	6.11%	0.99%	0.98%	1.03%	1.04%	9
25	Morgan Stanley Funds	2.58%	3.33%	0.74%	0.70%	0.98%	1.00%	9
26	Oppenheimer Funds	12.61%	11.85%	-0.67%	-0.67%	0.79%	0.80%	3
27	Putnam Funds	4.86%	4.96%	0.10%	0.11%	1.08%	1.08%	5
28	RiverSource (former AXP)	3.46%	3.46%	0.00%	0.00%	1.14%	1.14%	2
29	Scudder Funds	3.78%	4.88%	1.06%	1.03%	1.01%	1.02%	6
30	Smith Barney Group	2.03%	2.41%	0.37%	0.37%	0.94%	0.94%	1
31	Seligman Group	14.45%	14.44%	-0.01%	0.00%	0.82%	0.81%	2
32	Templeton Group	4.07%	4.08%	0.00%	0.00%	0.78%	0.78%	8
33	T. Rowe Price Funds	5.04%	5.20%	0.15%	0.15%	0.98%	0.98%	6
34	UBS Funds	4.41%	4.41%	0.00%	0.00%	0.89%	0.89%	1
35	Vanguard Group	5.40%	5.13%	-0.25%	-0.24%	0.99%	0.99%	4
36	Wells Fargo Advantage	6.44%	6.11%	-0.31%	-0.27%	1.01%	1.00%	2
	Total	6.84%	7.63%	0.80%	0.80%	1.04%	1.03%	156

This table shows the results of the following simulation: maximization of expected returns subject a restriction on the variance of returns. The results are shown per family. The longest simulation for each main fund in each family is considered. The main funds are world funds, foreign funds, portfolios of world funds, and portfolios of foreign funds. Portfolios of world funds are composed by several world funds within the same family but with different scopes, e.g. world value funds and world growth funds. Portfolios of foreign funds are similarly formed, e.g. foreign value funds and foreign growth funds. The strategy considered is an active one, in which portfolio weights are updated every day. Realized returns of the simulated portfolio are calculated out-of-sample, as described in the main text. Simulations use all previous data available at each point in time.

Appendix Tabble 5A. Simulations: Best Result for Each Fund

Minimizing the Variance (Rolling Windows: 240 Business Days)

Type of Global Fund	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
	Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
World Stock	8.86%	14.08%	5.10%	5.12%	0.88%	0.78%	53
Foreign Stock	6.53%	10.37%	3.69%	3.96%	0.96%	0.89%	70
Portfolio of World Stock Funds	14.77%	20.74%	6.60%	4.09%	0.71%	0.65%	3
Portfolio of Foreign Stock Fund	12.19%	13.70%	1.98%	1.37%	0.85%	0.78%	18
Total	8.25%	12.35%	4.06%	4.06%	0.91%	0.83%	144

Maximizing Expected Return (Rolling Windows: 240 Business Days)

Type of Global Fund	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
	Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
World Stock	8.86%	9.81%	1.03%	0.79%	0.88%	0.88%	53
Foreign Stock	6.53%	7.40%	0.85%	0.91%	0.96%	0.97%	70
Portfolio of World Stock Funds	14.77%	21.87%	8.32%	6.76%	0.71%	0.76%	3
Portfolio of Foreign Stock Fund	12.19%	12.08%	0.52%	-0.30%	0.85%	0.86%	18
Total	8.25%	9.15%	1.03%	0.84%	0.91%	0.92%	144

This table shows the results of the following simulations: minimization the variance of returns subject to restrictions on the expected returns (top panel) and maximization of expected returns subject a restiction on the variance of returns (bottom panel). The best simulation for each main fund in each family is considered. The main funds are world funds, foreign funds, portfolios of world funds, and portfolios of foreign funds. Portfolios of world funds are composed by several world funds within the same family but with different scopes, e.g. world value funds and world growth funds. Portfolios of foreign funds are similarly formed, e.g. foreign value funds and foreign growth funds. The strategy considered is an active one, in which portfolio weights are updated every day. Realized returns of the simulated portfolio are calculated out-of-sample, as described in the main text. Simulations use information based on the previous 240 business days only at each point in time.

Appendix Table 5B. Simulations: Longest Available Sample, But Fewer Regional Funds

Minimizing the Variance (Rolling Windows: 240 Business Days)

Type of Global Fund	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
	Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
World Stock	8.24%	10.82%	2.56%	2.65%	0.90%	0.81%	59
Foreign Stock	5.79%	8.44%	2.56%	2.78%	0.97%	0.91%	71
Portfolio of World Stock Funds	6.91%	17.38%	9.64%	10.51%	1.04%	0.83%	3
Portfolio of Foreign Stock Fund	11.92%	13.34%	1.90%	1.25%	0.87%	0.80%	18
Total	7.48%	10.11%	2.62%	2.70%	0.93%	0.86%	151

Maximizing Expected Return (Rolling Windows: 240 Business Days)

Type of Global Fund	Average Return (p.y.)		Improvement in Returns (p.y.)		Standard Deviation of Daily Returns		No. Sims.
	Global Fund	Active Strategy	Daily	Accumulated	Global Fund	Active Strategy	
World Stock	8.24%	8.45%	0.28%	0.14%	0.90%	0.90%	59
Foreign Stock	5.79%	6.06%	0.23%	0.28%	0.97%	0.98%	71
Portfolio of World Stock Funds	6.91%	15.83%	8.50%	8.87%	1.04%	0.96%	3
Portfolio of Foreign Stock Fund	11.92%	11.89%	0.59%	-0.29%	0.87%	0.88%	18
Total	7.48%	7.86%	0.46%	0.33%	0.93%	0.93%	151

This table shows the results of the following simulations: minimization the variance of returns subject to restrictions on the expected returns (top panel) and maximization of expected returns subject a restiction on the variance of returns (bottom panel). The longest simulation for each main fund in each family is considered. The main funds are world funds, foreign funds, portfolios of world funds, and portfolios of foreign funds. Portfolios of world funds are composed by several world funds within the same family but with different scopes, e.g. world value funds and world growth funds. Portfolios of foreign funds are similarly formed, e.g. foreign value funds and foreign growth funds. The strategy considered is an active one, in which portfolio weights are updated every day. Realized returns of the simulated portfolio are calculated out-of-sample, as described in the main text. Simulations use information based on the previous 240 business days only at each point in time.