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Portfolio concentration and performance of institutional investors worldwide☆

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ABSTRACT

Using data on security holdings for 10,771 institutional investors from 72 countries, we test whether concentrated investment strategies result in excess risk-adjusted returns. We examine several measures of portfolio concentration with respect to countries and industries and find that portfolio concentration is directly related to risk-adjusted returns for institutional investors worldwide. Results suggest, in contrast to traditional asset pricing theory and in support of information advantage theory, that concentrated investment strategies in international markets can be optimal.

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1. Introduction

In contrast to the traditional asset pricing theory, in which optimal portfolios are well diversified across international markets and securities, theories based on information advantage predict that portfolios concentrated in a few markets and securities can be optimal.[1] Many empirical studies show that investors' portfolios are much less diversified across international markets than one could expect if efficient portfolio diversification was the preeminent motivation in forming portfolios. Investors' portfolios are home-biased (i.e., overweighed in the home market) and concentrated only in a few foreign markets.[2] The

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[1] Merton (1987), Gehrig (1993), Levy and Livingston (1995), and, more recently, Van Nieuwerburgh and Veldkamp (2009, 2010) model investors' portfolio choices conditioning on information advantage.

[2] French and Poterba (1991), Chan, Covrig, and Ng (2005), Lewis (1999), and Karolyi and Stulz (2003) review the literature on home bias.

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existing literature has not resolved whether the observed portfolio concentration patterns emerge from some behavioral bias (e.g., Huberman, 2001; Cohen, 2009; Morse and Shive, 2011) or from a rational portfolio optimization implied by the information advantage theory.

In this paper, we examine whether the observed portfolio concentration in international markets is consistent with a rational decision-making process described in the information-based theory of home bias of Van Nieuwerburgh and Veldkamp (2009). These authors develop a model of rational investors, endowed with initial information advantage, making a choice of which assets to learn about prior to forming portfolios. In contrast to prior models, these authors show that investors can learn about foreign markets and unfamiliar firms, but they choose not to due to comparative advantage in the initial information asymmetry. As investors specialize and learn more about assets in which they have initial comparative information advantage, they hold more of these assets and the information asymmetry amplifies, leading to higher risk-adjusted returns. The pattern of information acquisition impacts portfolio allocation by tilting investors' asset holdings from the world market portfolio toward the assets in which the investors have an initial comparative information advantage. The main purpose of our paper is to test whether this tilt, captured by our empirical measures of portfolio concentration, is associated with higher risk-adjusted returns. We reason that if an investor's deviation from the world portfolio is in fact a rational choice driven by information advantage, then a positive relation should exist between portfolio concentration and the investor's risk-adjusted performance.

Van Nieuwerburgh and Veldkamp (2009) also argue that the benefits of an initial information advantage can be amplified with learning, limited by the investor's capacity to learn. Ultimately, learning is directed toward assets about which the average investor is most uncertain, and the investor's capacity to learn regulates how much an investor can learn about a given asset. We test whether investors with a higher capacity to learn (i.e., more skilled investors) hold more concentrated portfolios because they are able to exploit information advantage more effectively through learning and specializing than average investors. We also test whether investors in more uncertain home markets hold more home-biased portfolios because these investors gain more from learning about an abundant risk factor about which the average investor is uncertain.

To perform the analyses, we use data containing security holdings of 10,771 institutional investor portfolios of various types (e.g., mutual funds, hedge funds, insurance companies) domiciled in 72 countries. We calculate several measures of portfolio concentration in international markets, such as investors' home bias, concentration of investors' foreign country holdings, and industry concentration of the investors' holdings. The data allow us to study the link between portfolio concentration and performance as well as investment choices in which there are initial information advantages and learning opportunities, investors with different capacities to learn, and a number of markets with varying degrees of home risk factors. To our knowledge, we provide novel tests of the information advantage theory relative to home bias and portfolio allocation models across international markets.

Three findings provide strong support for portfolio concentration being driven by rational portfolio optimization consistent with the Van Nieuwerburgh and Veldkamp (2009) model. First, portfolio concentration in foreign and home markets and portfolio industry concentration are positively related to the investors' risk-adjusted performance. This suggests that institutional investors effectively concentrate holdings in their home market and in selected foreign markets and industries as if they possess an information advantage in these assets. We perform several risk-adjustment analyses to ensure that this relation is not driven by higher risk characteristics of more concentrated portfolios. Second, institutional investors with higher learning capacity (i.e., more skilled investors) form more concentrated portfolios, especially in foreign markets and industries. Third, the degree of home bias is positively related to the level of home market uncertainty. It appears that home investors in more uncertain markets have proportionately less initial uncertainty (hence, more initial information advantage) about asset payoffs in home markets relative to that of the average investor. Also, this relation is amplified by the investor's learning capacity.

Our study makes the following contribution to the existing literature. By examining the impact of deviations from the optimal portfolio on investor-level performance, we provide evidence that unconditional mean-variance inefficiency in international portfolios does not necessarily imply suboptimality in cases in which some investors are information-advantaged. Prior studies that demonstrate the benefits of international diversification do so by constructing efficient international portfolios or showing that investors deviate from the optimal world market portfolio, or both, but these studies do not examine the impact of that deviation on investor-level performance, which is the task we undertake here.[3] So far, prior studies that focus on information advantage in international markets examine the difference in performance between domestic and foreign investors and show that domestic investors demonstrate an advantage relative to foreign investors (e.g., Dvořák, 2005; Choe, Kho, and Stulz, 2005; Shukla and van Inwegen, 1995; Ferreira, Matos, Pereira, and Pires, 2015). Instead of examining the performance relative to another investor group, we consider performance against the optimal diversified world market portfolio. Prior studies, which show that portfolio concentration enhances investors' performance, conduct the analysis in a single-country setting, mainly in the United States.[4] In contrast, our study is the first to analyze the performance consequences of portfolio under-diversification relative to the value-weighted world portfolio. Finally, we examine whether the degree of portfolio concentration is

[3] See, for example, Levy and Sarnat (1970), Solnik (1974), Huberman and Kandel (1987), Harvey (1995), Bekaert and Urias (1996), and Li, Sarkar, and Wang (2003).

[4] These papers show, for example, that local market concentration as well as industry and sector concentration enhance investors' performance (e.g., Coval and Moskowitz, 2001; Kacperczyk, Sialm, and Zheng, 2005; Ivković, Sialm, and Weisbenner, 2008).

consistent with the implications of the information-based Van Nieuwerburgh and Veldkamp (2009) model. Namely, we examine whether home bias prevails in more uncertain home markets and is higher for the investors with higher capacity to learn—something that has not been examined in the prior literature.

The remainder of the paper is organized as follows. Section 2 reviews the information advantage theory and develops hypotheses. Sections 3 and 4 discuss our data and methodology, respectively. Section 5 presents empirical results, and Section 6 presents our conclusions.

2. Information advantage theory and hypotheses development

The traditional asset pricing theory implies that the perfectly diversified world market portfolio is the optimal investor's portfolio because of substantial benefits from international diversification.[5] Alternatively, other theories suggest that deviations from the world market portfolio are optimal for some investors because of information advantage. Our hypotheses development follows closely the information-based theory of home bias of Van Nieuwerburgh and Veldkamp (2009).

According to Van Nieuwerburgh and Veldkamp (2009), in equilibrium, the expected asset holdings vector q can be expressed as a tilt, B, relative to the perfectly diversified portfolio of home and foreign assets (i.e., the world market portfolio, $\bar{x}$), $E[q] = B\bar{x}$. Without learning and without initial advantage, there is no tilt and the expected asset holdings equal the world market portfolio, $E[q] = \bar{x}$. However, information advantage and learning reduce the conditional variance (i.e., risk or uncertainty) of the asset without reducing its return and, hence, providing excess risk-adjusted returns.

To show how this result is driven by learning, Van Nieuwerburgh and Veldkamp (2009) decompose the unconditional variance-covariance matrix of world securities $\Sigma = \Gamma\Lambda\Gamma'$, where Γ represents the asset risk factor sensitivities and Λ is a diagonal matrix of factor variances. For tractability, Van Nieuwerburgh and Veldkamp restrict learning to the risk factor variances, with no chance of improving on the precision of the factor sensitivities. For the investor who learns, the variance matrix results in the posterior variance-covariance matrix, denoted by $\hat{\Sigma} = \Gamma\hat{\Lambda}\Gamma'$, which measures the investor's uncertainty about asset payoffs after incorporating what she learned. This variance is contrasted with the posterior variance-covariance matrix of a hypothetical average investor, $\hat{\Sigma}^a = \Gamma\hat{\Lambda}^a\Gamma'$. (If the average investor does not learn, the (diagonal) risk factor variance matrix is simply $\hat{\Lambda}^a = \Lambda$). These variance-covariance matrices are then used to express the optimal expected portfolio allocation with information acquisition as $E[q] = \Gamma\hat{\Lambda}^{-1}\hat{\Lambda}^a\Gamma'\bar{x}$ (see Eq. 10 in Van Nieuwerburgh and Veldkamp, 2009).

Intuitively, each investor constructs an optimal portfolio by tilting the perfectly diversified world portfolio $\bar{x}$ toward the assets for which the investor has the information advantage relative to the average investor. The term $\hat{\Lambda}^{-1}\hat{\Lambda}^a$ determines the magnitude of this tilt. The more the investor knows about a given risk factor relative to the average investor, the higher the tilt toward assets that load heavily on that factor. If the investor does not learn or initially know more about the asset relative to the average investor, the term $\hat{\Lambda}^{-1}\hat{\Lambda}^a$ simply reduces to an identity matrix, and the optimal expected portfolio reduces to the perfectly diversified world market portfolio: $E[q] = \Gamma I\Gamma\bar{x}$ or $E[q] = \bar{x}$. Furthermore, the model implies that concentration is stronger for assets with lower initial uncertainty for a given group of investors. Hence, investors with a prior information advantage about a given risk factor rationally choose to specialize in learning even more about that risk factor. The resulting portfolios can therefore be concentrated but optimal.

We formulate three hypotheses based on the Van Nieuwerburgh and Veldkamp (2009) model concerning portfolio concentration strategies and performance of institutional investors worldwide. We begin by testing whether concentrated investment strategies earn higher risk-adjusted returns compared to diversified investment strategies. Formally, our main hypothesis H1 is as follows.

H1. *(Performance hypothesis): An investor's risk-adjusted returns are positively related to portfolio concentration.*

After establishing the link between performance and concentration, we can use additional implications of the model to better understand what drives portfolio concentration. Hypotheses H2 and H3 focus on testing which investors hold more concentrated portfolios and what market characteristics relate to varying degrees of portfolio concentration.

One of the key features of the model is that learning amplifies the initial information asymmetry. The theoretical framework incorporates the investor's capacity to learn, which regulates how much an investor can learn about a given asset or, specifically, how much an investor can reduce the posterior variance estimate for a given asset through learning. The model implies that higher capacity to learn amplifies the reduction in posterior variance through learning. Hence, the tilt from the perfectly diversified portfolio increases with capacity to learn.

H2. *(Learning capacity hypothesis): Portfolio concentration is positively related to an investor's capacity to learn.*

According to the model, some risk factors are more attractive to learn about than others. Three characteristics that attract the attention of a skilled investor are (1) information has increasing returns to scale and, therefore, investors gain more from learning about an abundant risk factor, (2) investors gain more from learning about a risk factor about which the average investor is uncertain, that is, the risk factor has a high posterior variance for the average investor, and (3) investors should learn about a risk factor for which they have less initial uncertainty relative to the average investor, symbolically, for some factor i, $\Lambda_i < \hat{\Lambda}_i^a$.

[5] A large number of studies on the topic include Grubel (1968), Levy and Sarnat (1970), Solnik (1974), Huberman and Kandel (1987), Grauer and Hakansson (1987), Harvey (1995), Bekaert and Urias (1996), and Li, Sarkar, and Wang (2003).

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One could reasonably posit that information asymmetry between foreign and domestic investors is higher for countries with greater market uncertainty. If home investors in markets with greater uncertainty enjoy a higher level of initial information advantage and if those same investors capitalize on higher initial comparative advantage by learning and investing more in domestic assets, then the degree of home bias increases with market uncertainty.

H3. *(Uncertainty hypothesis): Portfolio concentration in the home market is positively related to home market uncertainty.*

3. Data

We use quarterly institutional holdings data from the FactSet (formerly LionShares) ownership database, which contains detailed information for approximately 13 thousand institutional investors from 110 countries. Using various publicly available sources of information, FactSet collects holdings data on institutional investors with greater than 10% of total net assets invested in listed equities. The database covers companies with a market capitalization of more than $50 million and accounts for all institutional holdings equal to or larger than 0.1% of the company's issued shares.

To compile a complete holdings' profile for each institutional investor, FactSet contacts mutual fund associations and regulatory authorities in each country. For example, for equities traded in the United States, it uses various mandatory reports (e.g., 13-F, N-Q, N-CSR, and 485BPOS) to collect ownership data, when regulatory filings fall short, it obtains portfolio reports either from the fund's website or by direct contact with the fund company or its distributors. For equities traded outside of the United States, FactSet gathers data from similar regulatory filings, company reports and announcements, and industry directories. The database provides information on the institutions as well as the securities held by the institutions. For each institution, in any given quarter, we obtain the number of shares and the market value of each security in the investor's portfolio. In addition, FactSet contains data on the investor's domicile country and the style and the type of investor. For each security, we have the security's country of exchange, standard industry classification (SIC), closing price, return data, and accounting data such as book value of equity and earnings.[6]

We use quarterly filings of institutional holdings from the last quarter of 1999 to the first quarter of 2010. Following FactSet's classification, we use the location of the institution's main operations to define the institution's domicile country, which we refer to as its "home country". We define institutional holdings as "domestic" if the institution's home country is the same as the security's country of exchange. We define institutional holdings as "foreign" if the institution's domicile country is different from the security's country of exchange.[7]

We limit our analysis to institutions that own at least one foreign security in their portfolio for a given quarter, which eliminates institutions restricted from owning assets in foreign markets and reasonably eliminates institutions with mandates that do not include foreign securities. In addition, we include in our sample only those institutions with at least 50% of their holdings in equities. We then merge the security-level holdings data with the security's price data in FactSet. FactSet's holdings data are reported at the aggregate firm level and, where applicable, at the portfolio level inside each firm. We analyze portfolio holdings, not aggregate holdings, of the investment firm. We refer to these portfolios as "institutions" or "institutional investors".

Table 1 presents the sample distribution by the investor's home country (Panel A) and by the country of securities' exchange (hereafter, target country) (Panel B). Panel A shows that our sample covers all parts of the world with wide representation from developed and emerging markets. The sample contains 10,771 institutional investors from 72 countries. About 40% of the sample, 4,262 institutions, are institutional investors from the United States, followed by 890 institutions from the United Kingdom and 889 from Canada. Other, less researched countries are also represented in the sample. For example, 251 institutions from South Africa, 183 from India, 130 from Taiwan, and 57 from Brazil. Panel A also shows the time series median of the total market value of assets under management (in $ billions) by all institutional investors domiciled in each country. The total market value of assets of US institutional investors is $8.607 trillion, which is the highest among all institutions in our sample, followed by $1.313 trillion for UK investors and by $375 billion for Canadian investors.

Panel B shows each target country's average share of the world market capitalization during the time period of our study. The percentage of float shares is calculated by dividing the total market value of investable, or float shares of each country by the aggregate market value of float shares from our sample countries. The percentage of total shares is calculated by dividing the total market capitalization of each country by the aggregate market capitalization of every country in our sample. Total market value and total float share values are from WorldScope as of the end of 2010. Panel B shows that about 40% of the investable world market capitalization consists of the securities listed in the US market, followed by almost 9% in the United Kingdom (8.68%), 8.39% in Japan, and 7.23% in China.

4. Methodology

To test H1, the performance hypothesis, we compute, for each institutional investor, several portfolio concentration measures that indicate the degree of deviation from the perfectly diversified world market portfolio at the

[6] Prior studies, e.g., Li, Moshirian, Pham, and Zein (2006), Ferreira and Matos (2008), and Ferreira, Matos, Pereira, and Peris (2015), use a subset of FactSet data that we study here. Ferreira and Matos (2008) provide an extensive set of summary statistics and explain in detail the comprehensiveness and limitations of the database.

[7] We also use the security's country of domicile as an alternative way to define "home country." The results are unaffected by the definition.

Table 1
Sample distribution by investor home country and target country.

This table reports sample distribution by the institutional investor's home country (Panel A) and by the target country (Panel B). The sample consists of 10,771 institutions from 72 countries with allocations in 40,374 securities traded in 54 countries. Panel A reports the number of institutional investors, the percentage relative to the total number of institutions in our sample, and the time series median of total market values of all institutions' holdings in each home country in billions of US dollars. Panel B reports the percentage of investable, or float, market share and the percentage of total market share of each target market relative to the total market capitalization of all countries in our sample. Home country is the location of the institution's main operation, and Target country is the security's country of exchange. Data are from the FactSet institutional quarterly holdings database from the last quarter of 1999 to the first quarter of 2010. Total shares and float shares are from WorldScope as of the end of 2010.

Panel A: Distribution by investor's home country

Home country	Number of institutions	Percent of total	Total market value (billions of US dollars)
Argentina	2	0.02	0.03
Australia	171	1.59	162.36
Austria	59	0.55	6.96
Belgium	55	0.51	46.48
Bermuda	1	0.01	0.02
Botswana	1	0.01	0.03
Brazil	57	0.53	3.97
Bulgaria	2	0.02	0.01
Canada	889	8.25	374.94
Chile	15	0.14	4.10
China	28	0.26	6.17
Colombia	2	0.02	0.10
Croatia	14	0.13	0.13
Cyprus	1	0.01	0.00
Czech Republic	10	0.09	0.57
Denmark	80	0.74	38.72
Egypt	4	0.04	0.41
Estonia	6	0.06	0.41
Finland	110	1.02	28.32
France	489	4.54	204.88
Germany	376	3.49	207.83
Greece	47	0.44	2.02
Hong Kong	198	1.84	59.95
Hungary	10	0.09	0.66
Iceland	4	0.04	0.12
India	183	1.70	28.23
Indonesia	1	0.01	0.01
Ireland	57	0.53	50.61
Israel	245	2.27	0.58
Italy	183	1.70	36.87
Japan	89	0.83	140.86
Jordan	2	0.02	0.72
Kuwait	5	0.05	13.00
Latvia	1	0.01	0.03
Lithuania	6	0.06	0.03
Luxembourg	23	0.21	10.35
Malaysia	59	0.55	29.39
Mauritius	1	0.01	0.01
Mexico	5	0.05	0.77
Morocco	2	0.02	1.26
Namibia	6	0.06	0.13
Netherlands	88	0.82	74.11
New Zealand	14	0.13	5.75
Norway	79	0.73	108.16
Oman	2	0.02	0.03
Pakistan	17	0.16	0.11
Peru	1	0.01	0.88
Philippines	4	0.04	0.56
Poland	158	1.47	6.32
Portugal	91	0.84	4.26
Qatar	1	0.01	7.13
Romania	11	0.10	0.27
Russia	4	0.04	0.18
Saudi Arabia	5	0.05	1.01
Singapore	130	1.21	80.21
Slovakia	1	0.01	0.00
Slovenia	28	0.26	1.66
South Africa	251	2.33	59.57
South Korea	21	0.19	15.83

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Table 1 (continued)

Panel A: Distribution by investor's home country

Home country	Number of institutions	Percent of total	Total market value (billions of US dollars)
Spain	515	4.78	30.82
Sweden	163	1.51	155.64
Switzerland	336	3.12	83.29
Taiwan	130	1.21	0.42
Thailand	37	0.34	1.27
Trinidad and Tobago	1	0.01	0.02
Turkey	6	0.06	0.07
Ukraine	2	0.02	0.00
United Arab Emirates	20	0.19	7.58
United Kingdom	890	8.26	1,313.46
United States	4,262	39.57	8,607.65
Vietnam	3	0.03	0.05
Zimbabwe	1	0.01	0.07
Total	10,771	100.00	12,028.44

Panel B: Percentage market capitalization by target country

Target country	Percent of float shares	Percent of total shares
Argentina	0.06	0.12
Australia	3.59	3.56
Austria	0.20	0.29
Belgium	0.39	0.52
Brazil	0.97	1.47
Bulgaria	0.00	0.01
Canada	1.72	1.30
Chile	0.35	0.69
China	7.23	11.94
Colombia	0.02	0.03
Czech Republic	0.05	0.10
Denmark	0.48	0.51
Egypt	0.01	0.03
Estonia	0.00	0.01
Finland	0.57	0.50
France	2.94	3.29
Germany	2.31	2.60
Greece	0.11	0.30
Hong Kong	2.22	3.85
Hungary	0.04	0.04
India	2.05	3.38
Indonesia	0.37	0.78
Ireland	0.65	0.49
Israel	0.32	0.32
Italy	0.43	0.50
Japan	8.39	8.23
Jordan	0.01	0.03
Lithuania	0.00	0.01
Malaysia	0.61	0.73
Mexico	0.36	0.46
Morocco	0.03	0.06
Netherlands	1.17	1.01
New Zealand	0.05	0.07
Norway	0.41	0.60
Pakistan	0.03	0.07
Peru	0.07	0.23
Philippines	0.06	0.28
Poland	0.19	0.32
Portugal	0.10	0.16
Russia	0.32	0.60
Singapore	0.73	1.05
Slovenia	0.02	0.02
South Africa	1.23	1.34
South Korea	1.41	1.49
Spain	0.92	1.13
Sweden	1.43	1.35
Switzerland	3.50	2.91
Taiwan	2.27	2.13
Thailand	0.35	0.49
Turkey	0.26	0.59

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Table 1 (continued)

Panel B: Percentage market capitalization by target country

Target country	Percent of float shares	Percent of total shares
United Arab Emirates	0.03	0.05
United Kingdom	8.68	6.87
United States	40.3	31.07
Vietnam	0.01	0.02
Total	100.00	100.00

country (home and foreign) and industry level. Using the data on security returns, we then examine the relation between the institutional investor's portfolio concentration and performance. We analyze this relation in two different ways. We test (1) whether country (home and foreign) and global industry concentrations enhance the investor's aggregate portfolio performance benchmarked to the world's systematic risk and (2) whether country and industry concentrations in a given market enhance the performance in that target market benchmarked to that market's systematic risk. Section 4.1 defines the portfolio concentration measures and Section 4.2 defines the performance measures.

To test H2, the learning capacity hypothesis, we estimate the relation between portfolio concentration measures and the investor's capacity to learn. We cannot directly observe the learning capacity of the investors, but, as Van Nieuwerburgh and Veldkamp (2009) suggest, the capacity to learn can be inferred from the estimates of portfolio outperformance. Consequently, we define the investors with the highest performance on a risk-adjusted basis as high-capacity or highly skilled investors.

Using only performance as a proxy for skill makes it difficult to separate information advantage from learning capacity. Ideally, we would like a nonperformance-based proxy for learning capacity to include in our analysis. Learning capacity can come from the inherent skill of the portfolio manager or from resources the portfolio manager can use to acquire information. Portfolio size is an important variable to consider when assessing learning capacity. Portfolio size (at least for mutual funds and hedge funds) is directly related to investor skill, as shown in Berk and Green (2004). Larger portfolios also have economies of scale to acquire information. However, we want to test how skill relates to portfolio concentration. As skilled managers experience inflows, concentration necessarily falls as liquidity constraints and regulatory holding limits force managers to diversify their holdings more than they otherwise would. For our purposes, these opposing forces make portfolio size a dubious proxy, at best, for a measure of investor skill. We can still capture the intuition of the portfolio size to skill relation by considering the compensation structure prevalent among various institutional investor types (e.g., hedge funds, mutual funds, pensions and endowments, and banks and insurance companies). We appeal to labor market efficiency to conclude that, among different types of institutions, hedge funds and mutual funds (as opposed to pension funds and endowments or banks and insurance companies) attract the top talent as their portfolio managers. This is evident in the compensation structure prevalent among various institutional investor types. According to French (2008), the fees and compensation of the hedge fund managers are on average the highest, followed by mutual fund managers and then other institutions. Thus, we include the indicators for the investor type, so that hedge funds are assumed to have the highest learning capacity and skill level, followed by mutual funds, pensions and endowments, and banks and insurance.[8]

To test H3, the uncertainty hypothesis, we estimate the relation between the investor's home bias and home market uncertainty. We use several measures of home market uncertainty. First, for each country we compute the market's volatility measure, *Variance*, as the unconditional variance of the market's returns based on a year of historical data, leading up to the measuring period. West (1988), among others, argues that more firm-specific volatility is associated with less information in prices. Thus, more country-level volatility in stock returns is, arguably, associated with a higher level of uncertainty and greater noise in the market.

In addition, we construct a *Market uncertainty* variable by using principal component analysis of five uncertainty proxies. The first proxy is the unconditional variance of the assets' returns, as explained above. The second proxy is the size of the financial sector, measured by the World Bank market capitalization and scaled by the gross domestic product (GDP) of each country in each year.[9] The third proxy is the number of financial analysts in each market from Institutional Brokers' Estimate System (I/B/E/S), scaled by the number of firms in that market. Our fourth uncertainty proxy is the informativeness of asset prices, constructed for each home market following the methodology in Durnev, Morck, Yeung, and Zarowin (2003) (median R^2 (and adjusted R^2 as a robustness check) from stock-specific regressions of annual earnings per share in year y on annual stock returns and earnings per share in year y-1 for all available securities in each home country). The fifth uncertainty proxy is the functional efficiency of each home market, constructed as in Morck, Yeung, and Yu (2000) [annually collected median R^2 (and adjusted R^2 as a robustness check) from a market model of monthly returns against a country-specific value-weighted benchmark]. Roll (1988),

[8] Others impute skill to investor type. Lerner, Schoar, and Wongsunwai (2007) examine the relative skill of investor types in investing in private equity and conclude that differences in ability appear with banks performing poorly relative to other investors. They conclude that some investor types are less able to use information to their advantage.

[9] The World Bank does not include Taiwan. We supplement the data for market capitalization from the Taiwanese stock exchange and for GDP from National Statistics of China (Taiwan). Both figures are in US dollars.

among others, argues that a low R^2 statistic for a firm from the market model can signal that firm price movements track fundamentals more closely.

4.1. Portfolio concentration measures

This subsection describes portfolio concentration measures computed quarterly for each institutional investor: *Home bias, Foreign bias, Foreign concentration, Global industry concentration*, and *Country industry concentration*. We first introduce the notation and then describe the construction of each measure. The numerical examples of each measure are provided in the Appendix.

In the equations that follow, we denote investors by $i \in I$; countries by $c \in C$, where c_i is the home country of investor i; and securities by $j \in J$ with some key subsets. J_c contains the securities domiciled only in country c; J_i is the set of securities in investor i's portfolio; and J_{ic} is the set of securities in investor i's portfolio domiciled in country c. SIC industries are indicated by $s \in S$; J_s contains all securities in industry s; J_{is} is the set of securities in investor i's portfolio in industry s; J_{cs} contains all securities in country c's industry s; and J_{ics} refers to securities only in investor i's portfolio in country c's industry s. In all equations, p_j is the market value of security j. All variables are computed quarterly, and the time index is suppressed for simplicity.

For each institutional investor's portfolio, we calculate *Home bias* as the difference between the home weight, which is the actual portfolio weight of the institution's holdings in the home country, and the home country market capitalization weight in the global market portfolio based on the home country's share of the world market capitalization reported by WorldScope.[10] We calculate *Home bias* for institutional investor i as

$$Home\ bias_i = \frac{\sum_{j\in J_{ic}} p_j}{\sum_{j\in J_i} p_j} - \frac{\sum_{j\in J_c} p_j}{\sum_{j\in J} p_j}. \quad (1)$$

Home bias captures the weighting of institution i's home country relative to the share of the country in the aggregate world market portfolio. A positive (negative) value of *Home bias* shows that the investor's portfolio is overweighted (underweighted) in the investor's home country.

Analogous to *Home bias,* for each institutional investor we compute the portfolio *Foreign concentration* from the *Foreign bias* in each country as

$$Foreign\ bias_{ic} = \frac{\sum_{j\in J_{ic}} p_j}{\sum_{c\in(C_i - c_i)} \sum_{j\in J_{ic}} p_j} - \frac{\sum_{j\in J_c} p_j}{\sum_{c\in(C_i - c_i)} \sum_{j\in J_c} p_j}. \quad (2)$$

Foreign bias measures whether the investor over- or underweights a foreign country relative to that country's share of the world market capitalization, excluding the investor's home country.[11] If the portfolio *Foreign bias* reaches its upper bound of one, then 100% of the institution's foreign holdings must be reallocated to achieve alignment with market capitalization weights.

Because the extant literature shows a large *Home bias* in the investors' portfolios, scaling by the total value of foreign holdings instead of by the total value of the overall portfolio captures more precisely the investor's concentration in the foreign markets. We believe that computing *Foreign bias* excluding the home market is an improvement over the typical approach, which includes the home market because it focuses on foreign country weights independently of the concentrations that are present in home country securities (e.g., Chan, Covrig, and Ng, 2005).[12]

To measure the degree of an investor's concentration in foreign markets, we calculate *Foreign concentration* by aggregating *Foreign bias* from Eq. (2) across all available foreign investments for institution i. The resulting *Foreign concentration* measure is

$$Foreign\ concentration_i = \frac{\sum_{c\in(C_i - c_i)} |Foreign\ bias_{ic}|}{2}. \quad (3)$$

This measure can be interpreted as the fraction of the institution's foreign holdings that should be reallocated across foreign countries to achieve perfect foreign diversification. A lower bound of zero is attained if a portfolio contains allocations in foreign countries exactly in proportion with country market capitalization weights. In contrast to *Home bias*, which indicates the relative weight of the institution's home country in the institution's aggregate portfolio, *Foreign concentration* indicates whether the investor's foreign share of the portfolio is well diversified across foreign markets.

As a practical matter, the upper bound of *Foreign concentration* can never be equal to one. In our sample, all target markets have nonzero market capitalization (the smallest float–based percentage share is 0.0017% for Bulgaria), so if all the holdings of an investor are in a very small market, that investor has a measure approaching one (e.g., an investor whose entire foreign portfolio is invested in Bulgaria needs to reallocate 99.9983% of his or her investment).

In addition to portfolio country concentration, we examine portfolio industry concentration. To measure portfolio industry concentration, we calculate the *Global industry concentration* from *Global industry bias;* that is,

[10] We use both the securities' total market capitalization and float-based or investable market capitalization to calculate the expected allocation. We report the results using float-based capitalizations, typically used in international studies.

[11] The *Foreign bias* measure is computed for all available foreign target markets, even if investor i's actual investment in country c is zero. We define the set of available target markets based on a positive float weight according to WorldScope. In addition, we require a presence of at least one foreign institutional investor before including target market c in our analysis.

[12] For robustness, we also compute *Global concentration*, which includes home country c_i and uses total portfolio weights. *Global concentration* is defined as half the sum of the absolute value of the country biases. See the Appendix for an example calculation. *Global concentration* is highly correlated with *Home bias* and produces results quantitatively similar to the *Home bias* results. Therefore, we omit *Global concentration* regressions from the paper for brevity.

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aggregated differences between the institution's actual and market capitalization weighted allocations to each SIC industry. The calculation mirrors that of the *Foreign concentration* measure. Initially, we calculate *Global industry bias* as

$$\textit{Global industry bias}_{is} = \frac{\sum_{j\in J_{is}} p_j}{\sum_{j\in J_i} p_j} - \frac{\sum_{j\in J_s} p_j}{\sum_{j\in J} p_j}. \quad (4)$$

Aggregating the absolute value of each industry bias for each institution yields the *Global industry concentration* measure:

$$\textit{Global industry concentration}_i = \frac{\sum_{s\in S} |\textit{Global industry bias}_{is}|}{2}. \quad (5)$$

This measure can be interpreted as the fraction of the institution's holdings required to be reallocated across industries to match the industry diversification of the global market portfolio. The range and interpretation of this measure are analogous to those of the *Foreign concentration* measure.

We require one final concentration measure, *Country industry concentration,* which captures the within-country, instead of global, industry concentration. This measure is calculated in the same manner as *Global industry concentration*, but at the country level instead of the entire global market portfolio level. It is calculated as

$$\textit{Country industry bias}_{ics} = \frac{\sum_{j\in J_{ics}} p_j}{\sum_{j\in J_{ic}} p_j} - \frac{\sum_{j\in J_{cs}} p_j}{\sum_{j\in J_c} p_j} \quad (6)$$

as an input to the corresponding concentration measure:

$$\textit{Country industry concentration}_{ic} = \frac{\sum_{s\in S_c} |\textit{Country industry bias}_{ics}|}{2}. \quad (7)$$

The interpretation of *Country industry concentration* is similar to that of *Global industry concentration* except that the industry diversification is measured within a particular country, not globally.

4.2. Performance measures

To test H1, the performance hypothesis, we first conduct the analysis at the institution's aggregate portfolio level, using portfolio excess return as a measure of performance. Portfolio excess return, R_{iq}, is calculated as the value-weighted return of the securities held by the institution over a given quarter less the global risk-free rate, obtained from Kenneth French's data library.[13] Value-weighted quarterly returns are compounded using split-adjusted monthly returns to securities for three consecutive months centered on the holdings reporting month. Our results are not sensitive to moving the centering month in the return calculation forward or backward by a month. The portfolio return is the return to the hypothetical portfolio that consists of the securities reported by the institution.

In addition to portfolio performance tests, we analyze whether the investor's concentration in a given country enhances the investor's performance in that country's securities. We examine whether higher portfolio weight or industry concentration in country *c* enhances institution *i*'s performance in country *c*'s securities. Following the same methodology we use for aggregate portfolio returns, we calculate the excess return in country *c*'s securities, R_{icq}, as the value-weighted return on the securities held by institution *i* in country *c* in quarter *q*, less the global risk-free rate over the same time period. This country-specific analysis addresses the possibility that an investor can achieve above-benchmark performance return in countries where holdings are concentrated, but the superior performance is masked when the concentrated holdings are in countries that under-perform the world market.

The relation between portfolio concentration and excess returns must be net of any potential risk differences in more concentrated portfolios. To this end, we employ a variety of risk adjustments to appropriately benchmark portfolio performance. We utilize the global capital asset pricing model (CAPM) to control for the differences in systematic risk in institutions' excess returns.[14] When we estimate our risk measures, we do not have the benefit of the information available to skilled investors. We appeal to a result in Kacperczyk, Van Nieuwerburgh, and Veldkamp (2014), which shows that risk measures from an unconditional CAPM approach the model-implied conditional counterpart when idiosyncratic risk is small relative to aggregate risk. We also perform risk adjustments using the four Fama and French (2012) global risk factors; that is, in addition to the global market premium, we include size premium (SMB_q), value premium (HML_q), and momentum premium (UMD_q) factors in the regressions.[15] These factors have been used in prior studies to explain international stock returns (see, e.g., Fama and French (2010, 2012); Hou, Karolyi, and Kho (2011)). In the country-specific performance analysis, we compute country-specific market, size, value, and momentum premiums from monthly security return data, closely following Fama and French (1993). Firm return, size, and book value data are from WorldScope.

In all of our regressions, we control for the institution's portfolio size measured as the natural logarithm of the institution's market value of equity in the quarter. In addition, where appropriate, we include home country fixed effects to account for different country

[13] Kenneth French's data library is at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

[14] *Market premium* in CAPM is calculated as the market return less the global risk-free rate, both measured in quarter *q*. *Market return* equals the global market return obtained from Kenneth French's data library when evaluating aggregate portfolio performance, and it equals each country's value-weighted market return, based on securities' return data for that country when evaluating performance in the target country (home or foreign).

[15] SMB_q is the difference between the returns on a diversified portfolio of small and large stocks over quarter *q*, HML_q is the difference between the returns of value and growth stocks over quarter *q*, and UMD_q is the difference between the returns on winners and losers over quarter *q*. Data on the global factors are also from Kenneth French's data library.

Table 2
Sample characteristics, all institutions.
This table presents sample characteristics by institutional investor type (Panel A) and style (Panel B). The sample consists of 10,771 institutional investors from 72 countries with at least one investment outside of the institution's home country. Data are from the Factset institutional quarterly holdings database from the last quarter of 1999 to the first quarter of 2010. *Home bias* is the difference between the actual portfolio weight of the institution's holdings in the home country and the expected portfolio allocation to the home country (see Eq. (1)). *Foreign concentration* is calculated following Eq. (3) and indicates the fraction of the institution's foreign holdings that should be reallocated across foreign countries to achieve perfect foreign diversification. *Global industry concentration* is calculated following Eq. (5) and indicates the fraction of the institution's portfolio that should be reallocated across different industries to achieve perfect industry diversification.

Type	Number of institutions	Percent of total	*Home bias*	*Foreign concentration*	*Global industry concentration*
Panel A: Sample description by institution's type					
Banks	431	4.00	0.420	0.688	0.567
Hedge fund	567	5.26	0.409	0.637	0.810
Insurance	297	2.76	0.624	0.775	0.635
Investment adviser	1,970	18.29	0.480	0.688	0.670
Mutual fund	7,178	66.64	0.384	0.628	0.655
Pension fund and endowment	271	2.52	0.423	0.665	0.594
Other	57	0.53	0.404	0.747	0.618
(Total) average	(10,771)	(100.00)	0.412	0.648	0.660
Panel B: Sample description by institution's investment style					
Aggressive growth	286	2.66	0.556	0.794	0.788
Deep value	559	5.19	0.511	0.776	0.794
Growth at a Reasonable Price	3,028	28.11	0.385	0.588	0.627
Growth	2,163	20.08	0.383	0.619	0.662
Index	230	2.14	0.326	0.629	0.502
Value	2,772	25.74	0.383	0.640	0.613
Yield	1,665	15.46	0.499	0.735	0.743
Not specified	68	0.63	0.459	0.792	0.871
(Total) average	(10,771)	(100.00)	0.412	0.648	0.660

characteristics that affect investment behavior and portfolio characteristics. We also include fixed effects for investor type, to control for potential variation in learning capacity across different types of institutional investors, as well as investment style, to control for variation in different objectives and strategies.

5. Results

This section describes our main empirical results.

5.1. Portfolio concentration measures: summary statistics

Table 2 presents average values of *Home bias, Foreign concentration*, and *Global industry concentration* for the sample institutions. We separate institutions by type (Panel A) and investment style (Panel B) to examine heterogeneity in portfolio concentration decisions among institutional investors with different type and style characteristics. Panel A shows that mutual funds are the most represented category (66.64% of the sample), followed by investment advisers (18.29%) and hedge funds (5.26%). All types of institutions overweight the home market, with the average *Home bias* measure of 0.412 indicating that institutions, on average, overweight the home market by more than 40% relative to the home market's share in the aggregate world market capitalization. Insurance companies overweight the home market the most (*Home bias* = 0.624), and mutual funds overweight the home market the least (*Home bias* = 0.384). Similarly, all institutions are heavily concentrated in a few foreign markets. The average *Foreign concentration* measure of 0.648 indicates that almost 65% of institutions' foreign holdings should be reallocated across foreign markets to mimic a perfectly diversified portfolio. *Foreign concentration* ranges from 0.628 for mutual funds to 0.775 for insurance companies. All types of institutional investors are also heavily industry concentrated. The sample average *Global industry concentration* is 0.660 and ranges from 0.567 for banks to 0.810 for hedge funds. These magnitudes show that, on average, more than 60% of the institutions' portfolios worldwide should be reallocated across different industries to achieve perfect industry diversification.

Panel B breaks down the sample by institutions' investment style and shows that 28% of the institutions follow a growth at a reasonable price (GARP) investment style, almost 26% are value funds, and 20% follow a growth investment strategy. The *Home bias* value ranges from 0.326 for index funds to 0.556 for aggressive growth funds. *Foreign concentration* is also the highest for aggressive growth funds (0.794) and is the lowest for GARP funds (0.588). All investment style categories are heavily industry concentrated, so that the index funds have the lowest *Global industry concentration* measure (0.502) and deep value has the highest (0.794).

Overall, the sample description in Table 2 reveals that institutions of different types and investment styles are heavily concentrated in home market securities and in a few industries. The parts of the portfolios that are allocated to foreign countries are heavily concentrated in a few foreign countries. This univariate analysis, however, suggests that some heterogeneity exists in portfolio concentration measures among institutions of different types and investment styles. In our subsequent analysis, we examine the link between portfolio concentration measures and performance.

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Table 3
Portfolio concentration measures and institutional investors' portfolio excess returns.

This table presents the results of ordinary least squares (OLS) regressions of portfolio excess returns. The sample consists of 10,771 institutional investors from 72 countries with at least one investment outside of the institution's home country. The dependent variable is excess return, computed as the value-weighted return to each institution's securities in a given quarter less the global risk-free rate over the same quarter, obtained from Kenneth French's data library (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The value-weighted quarterly return is computed based on the consecutive three-month security returns surrounding the reporting period. *Home bias* is the difference between the actual portfolio weight of the institution's holdings in the home country and the expected portfolio allocation to the home country (see Eq. (1)). *Foreign concentration* is calculated following Eq. (3) and indicates the fraction of the institution's foreign holdings that should be reallocated across foreign countries to achieve perfect foreign diversification. *Global industry concentration* is calculated following Eq. (5) and indicates the fraction of the institution's holdings that should be reallocated across industries to achieve perfect global industry diversification. *Portfolio size* is the institution's total market value of equity in quarter *q*, in natural logarithm. *Market premium, SMB, HML,* and *UMD* are four global systematic risk factors, obtained from Kenneth French's data library. *Market premium* is the market return less the global risk-free rate. *SMB* is the difference between the returns on a diversified portfolio of small and large stocks. *HML* is the difference between the returns of value and growth stocks. *UMD* is the difference between the returns on winners and losers, all measured in quarter *q*. Fixed effects used are year, investors' home, style, and type. All regressions are run with institution-clustered standard errors. Robust *t*-statistics are reported in brackets with ***, **, and * indicating statistical significance at the 1%, 5%, and 10% level, respectively.

Independent variable	(1)	(2)	(3)	(4)	(5)
Home bias	0.0021*	0.0103***			0.0018
	[1.75]	[10.06]			[1.54]
Foreign concentration	0.0117***		0.0246***		0.0167***
	[4.84]		[11.26]		[7.01]
Global industry concentration	0.0288***			0.0354***	0.0293***
	[12.30]			[13.89]	[12.59]
Portfolio size	0.0007***	0.0001	0.0005***	0.0011***	0.0012***
	[5.04]	[0.81]	[4.36]	[8.58]	[8.55]
Market premium	0.7275***	0.7334***	0.7328***	0.7335***	0.7329***
	[172.67]	[173.97]	[174.59]	[173.90]	[174.59]
SMB		−0.3885***	−0.3873***	−0.3887***	−0.3869***
		[−31.15]	[−31.06]	[−31.21]	[−31.05]
HML		−1.0901***	−1.0917***	−1.0907***	−1.0922***
		[−78.41]	[−78.54]	[−78.50]	[−78.57]
UMD		−0.4694***	−0.4709***	−0.4693***	−0.4710***
		[−83.99]	[−84.13]	[−84.03]	[−84.20]
Number of observations	112,584	112,584	112,584	112,584	112,584
Adjusted R^2	0.4538	0.5275	0.5282	0.5288	0.5295

5.2. Portfolio-level performance

Table 3 presents the results of ordinary least squares (OLS) regressions of an institution's portfolio excess returns on portfolio concentration measures while including controls for systematic risk. Specification 1 examines the performance concentration relation using the market model, and Specifications 2–5 use the global Fama and French four-factor model. According to H1, the performance hypothesis, the coefficients on portfolio concentration measures, when regressed on excess returns, should have a positive sign. Institutional investors with more concentrated portfolios should outperform investors with more diversified portfolios.

Specification 1 in Table 3 includes all three portfolio concentration measures simultaneously and shows that the coefficients on all three measures are positive and significant. Institutional investors who concentrate their holdings in their home country and in a few foreign countries as well as industries achieve higher risk-adjusted returns. Specifications 2–4 present the results of regressions examining each concentration measure individually in the Fama and French model, and they show that each concentration measure is positive and statistically significant at the 1% level. Specification 5 reports the results with all three concentration measures included simultaneously in the Fama and French model and shows that coefficients on all three portfolio concentration measures remain positive, even though the statistical significance of the *Home bias* measure drops to just below the 10% level (*t*-statistic = 1.54). The coefficients on the portfolio concentration measures are also economically significant. For example, in Specifications 2–4, a one standard deviation increase in *Home bias, Foreign concentration*, and *Global industry concentration* corresponds, respectively, to 0.35%, 0.50%, and 0.65% average increase in quarterly portfolio excess returns.[16]

In addition to the analysis presented in Table 3, we examine the relation between portfolio concentration and returns by measuring each investor's abnormal return from the Fama and French (2012) four-factor model. We regress the institution's abnormal return on the three portfolio concentration measures, presenting the results in Table 4. In all regressions, we also control for portfolio size. The results in Specifications 1–3, examining each concentration measure individually, show that all three portfolio concentration measures are positive and statistically significant at the 1% level. The coefficient on *Home bias* is not statistically significant once all three concentration measures are examined simultaneously (Specification 4).

[16] The standard deviations of *Home bias, Foreign concentration*, and *Global industry concentration* are 0.34, 0.20, and 0.18, respectively.

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Table 4
Portfolio concentration measures and institutional investors' portfolio abnormal returns.

This table presents the results of ordinary least squares regressions of portfolio abnormal returns. The sample consists of 10,771 institutional investors from 72 countries with at least one investment outside of the institution's home country. The dependent variable is the portfolio's abnormal return based on the regression of portfolio excess returns on the four Fama and French (2012) global factors, from the following equation:

$$R_{iq} = \alpha_i + \beta_i MP_q + \chi_i SMB_q + \delta_i HML + \gamma_i UMD_q + \varepsilon_{iq},$$

where R_{iq} is the portfolio excess return as described in Section 4.2, MP_q is the global market premium, SMB_q is the global size factor, HML_q is the global book-to-market factor, and UMD_q is the global momentum factor, all obtained from Kenneth French's data library (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). *Home bias* is the difference between the actual portfolio weight of the institution's holdings in the home country and the expected portfolio allocation to the home country (Eq. (1)). *Foreign concentration* is calculated following Eq. (3) and indicates the fraction of the institution's foreign holdings that should be reallocated across foreign countries to achieve perfect foreign diversification. *Global industry concentration* is calculated following Eq. (5) and indicates the fraction of the institution's holdings that should be reallocated across industries to achieve perfect global industry diversification. *Portfolio size* is the institution's total market value of equity in quarter q, in natural logarithm. Fixed effects used are year, investors' home, style, and type. All regressions are run with institution-clustered standard errors. Robust t-statistics are reported in brackets, with ***, **, and * indicating statistical significance at the 1%, 5%, and 10% level, respectively.

Independent variable	(1)	(2)	(3)	(4)
Home bias	0.0091***			−0.0006
	[6.980]			[−0.382]
Foreign concentration		0.0270***		0.0240***
		[12.178]		[9.358]
Global industry concentration			0.0236***	0.0162***
			[9.118]	[6.087]
Portfolio size	−0.0002*	0.0002	0.0004***	0.0006***
	[−1.706]	[1.263]	[2.621]	[3.558]
Number of observations	111,467	111,467	111,467	111,467
Adjusted R^2	0.0105	0.0185	0.0128	0.0211

Our portfolio-level analysis confirms that concentrated investment strategies result in higher risk-adjusted returns to institutional investors worldwide. The positive relation between performance and concentration holds up under different methods for computing risk-adjusted returns. These findings support H1, the performance hypothesis, and suggest that investors have some information advantage when forming concentrated portfolios. These findings provide the first evidence that deviations from the world market portfolio can improve portfolio performance.

5.3. Performance in the target market

Next we examine the performance of the portion of the institutional investor's portfolio allocated to a given target market. This analysis extends our aggregate portfolio analysis and allows us to examine the performance implications of country-specific concentration in greater detail. We conjecture that if portfolio concentration is based on information advantage, then the investor's concentration in a given country should result in better performance in that country's securities (i.e., in the portion of the portfolio allocated to that country). Instead of the global factors used for risk adjustment in aggregate portfolio analysis, we include country-specific risk factors.

Table 5 reports the results of the performance analysis in the target market. The dependent variable is the quarterly return of the institution's securities in a target market in excess of the global risk-free rate. Panel A presents findings for the institution's performance in the institution's home market, in which the variable *Country bias* equals *Home bias* (Eq. (1)). Panel B presents the results for the institution's performance outside of the institution's home country, in which *Country bias* equals *Foreign bias* (Eq. (2)). Both panels also examine the relation between risk-adjusted returns and the country industry concentration variable (Eq. (7)). Similar to the analysis presented in Table 3, we perform OLS regressions of the market model (Specification 1), followed by the regressions of the Fama and French four-factor model (Specifications 2–4). We control for the size of the institutions' portfolios and include the institutional investor's home country, investor's style, type, and year fixed effects.

The country-specific results presented in Table 5 can be summarized as follows. *Country bias* is positive and highly significant in both Panels A and B, indicating that increasing portfolio weight in a given target market (either home or foreign), relative to the expected weight, results in better risk-adjusted performance in that target market. Furthermore, the coefficient on *Country industry concentration* is positive and significant in all specifications, suggesting that institutional investors who concentrate their holdings in industries in home (Panel A) and foreign (Panel B) countries, as opposed to diversifying across industries, generate higher risk-adjusted returns.

Overall, the performance results in a given target market reinforce our aggregate portfolio-level findings in support of H1, the performance hypothesis. In unreported analysis, we find that the results are similar in statistical significance to replacing the country-specific risk factors with the global risk factors used in the portfolio-level analysis. We also analyze the explanatory power of either the global or country-specific benchmarks on institutions' excess returns without institution-specific variables. The explanatory power of the country-specific risk factors on performance is higher than that of the global benchmark and produces an alpha coefficient that is not statistically significant from zero in the aggregate sample. As we anticipated, the analysis shows that the global factor benchmark produces a positive (negative) result on the

Table 5
Portfolio concentration measures and institutional investors' performance in the target market.

This table presents the results of ordinary least squares regressions examining institutional investors' performance in home (Panel A) and foreign (Panel B) target markets. The sample consists of 10,771 institutional investors from 72 countries with at least one investment outside of the institution's home country. The dependent variable is the quarterly value-weighted return of the institutional investor in its home market securities (Panel A) and foreign market securities (Panel B) in excess of the global risk-free rate over the same quarter, obtained from Kenneth French's data library (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The value-weighted quarterly return is computed based on the consecutive three-month security returns surrounding the reporting period ($R_{t-1,t+1}$). *Country bias* equals *Home bias* (Eq. (1)) in Panel A and equals *Foreign bias* (Eq. (2)) in Panel B. *Country industry concentration* is calculated following Eq. (7) and indicates the fraction of the institution's portfolio that should be reallocated in a given country (home country in Panel A; foreign country in Panel B) to achieve perfect industry diversification in that country. *Portfolio size* is the institution's total market value of equity in quarter *q*, in natural logarithm. *Market premium* is equal to the value-weighted market return of a target market less the global risk-free rate. *SMB*, *HML*, and *UMD* are country-specific systematic risk factors, generated for each target market. *SMB* is the difference between the returns on a diversified portfolio of small and large stocks. *HML* is the difference between the returns of value and growth stocks. *UMD* is the difference between the returns on winners and losers, all measured in quarter *q*. Fixed effects used are year, investors' home, style, and type. All regressions are run with institution-clustered standard errors. In unreported analysis, we find that the results are similar in statistical significance and somewhat larger in magnitude to including investor home country clustered errors (Panel A), and investor home country/target country pairwise clustered errors (Panel B). Robust *t*-statistics are reported in brackets, with ***, **, and * indicating statistical significance at the 1%, 5%, and 10% level, respectively.

Independent variable	(1)	(2)	(3)	(4)
Panel A: Home market performance				
Country bias	0.0033***	0.0024**		0.0043***
	[3.30]	[2.27]		[4.00]
Country industry concentration	0.0079***		0.0076***	0.0099***
	[6.03]		[5.53]	[7.30]
Portfolio size	−0.0009***	−0.0009***	−0.0007***	−0.0007***
	[−8.23]	[−8.99]	[−6.47]	[−6.00]
Market premium	0.7349***	0.7420***	0.7403***	0.7401***
	[183.19]	[173.71]	[177.23]	[177.03]
SMB		0.0767***	0.0824***	0.0826***
		[11.75]	[13.45]	[13.48]
HML		0.0871***	0.0863***	0.0864***
		[15.90]	[15.94]	[15.94]
UMD		−0.2117***	−0.2091***	−0.2093***
		[−49.23]	[−50.31]	[−50.38]
Number of observations	111,921	102,954	102,678	102,678
Adjusted R^2	0.5245	0.5456	0.5482	0.5483
Panel B: Foreign market performance				
Country bias	0.0026***	0.0036***		0.0053***
	[2.68]	[3.78]		[5.43]
Country industry concentration	0.0023***		0.0036***	0.0042***
	[4.55]		[6.88]	[7.86]
Portfolio size	−0.0125***	−0.0089***	−0.0077***	−0.0066***
	[−12.43]	[−8.87]	[−7.67]	[−6.47]
Market premium	0.7685***	0.7593***	0.7557***	0.7556***
	[480.44]	[473.81]	[476.49]	[476.49]
SMB		0.0052**	0.0145***	0.0145***
		[1.99]	[5.60]	[5.63]
HML		0.0143***	0.0188***	0.0188***
		[8.00]	[10.47]	[10.51]
UMD		−0.1073***	−0.0968***	−0.0970***
Number of observations	1,128,153	1,025,168	986,163	986,163
Adjusted R^2	0.4772	0.4735	0.4781	0.4781

country weight coefficient when the country significantly outperforms (under-performs) the global index. However, both the global risk adjustment and the country-specific risk adjustment produce quantitatively similar results on the industry concentration measure.

5.4. Performance of non-US institutional investors

We analyze whether the positive relation between portfolio concentration and investors' risk-adjusted performance is driven by US investors, who comprise 40% of the sample. We repeat the analyses presented in Tables 4 and 5, excluding the US investors from the sample. Table 6 reports the results for portfolio-level performance (Panel A) and for the performance in the home (Panel B) and foreign (Panel C) markets for non-US institutional investors. The results are similar to the results for the entire sample of institutional investors, confirming that portfolio concentration across countries and industries results in better performance of institutional investors worldwide.

5.5. Portfolio concentration and learning capacity

To test H2, the learning capacity hypothesis, we analyze the relation between the portfolio concentration measures and the investors' learning capacity. We conjecture

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Table 6
Portfolio concentration and performance of non-US institutional investors.

This table reports the results of ordinary lease squares regressions for non-US institutional investors. Panel A presents the results for portfolio-level performance, in which the dependent variable is excess return, computed as quarterly value-weighted return to each institution's securities less the global risk-free rate. Panels B and C examine performance in the home and foreign markets, respectively. The dependent variable is the quarterly, value-weighted return of the institutional investor in its home market securities (Panel B) and in the foreign market securities (Panel C) in excess of the global risk-free rate over the same quarter. *Home bias* is the difference between the actual portfolio weight of the institution's holdings in the home country and the expected portfolio allocation to the home country (see Eq. (1)). *Foreign concentration* is the fraction of the institution's foreign holdings that should be reallocated across foreign countries to achieve perfect foreign diversification (see Eq. (3)). *Global industry concentration* indicates the fraction of the institution's holdings that should be reallocated across industries to achieve perfect global industry diversification (see Eq. (5)). *Country bias* equals *Home bias* (Eq. (1)) in Panel B and equals *Foreign bias* (Eq. (2)) in Panel C. *Country industry concentration* is calculated following Eq. (7) and indicates the fraction of the institution's portfolio that should be reallocated in a given country (home country in Panel B; foreign country in Panel C) to achieve perfect industry diversification in that country. *Market premium* is the global market return, obtained from Kenneth French's data library (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html), when evaluating aggregate portfolio performance (Panel A) and calculated as the value-weighted market return of a target market less the global risk-free rate when evaluating the target market performance (Panels B and C). *SMB*, *HML*, and *UMD* are global factors in Panel A, obtained from Kenneth French's data library, and country-specific factors in Panels B and C, computed from the target country's security returns. *SMB* is the difference between the returns on a diversified portfolio of small and large stocks. *HML* is the difference between the returns of value and growth stocks. *UMD* is the difference between the returns on winners and losers, all measured in quarter *q*. Fixed effects used are year, investors' home, style, and type. Regressions are run with institution-clustered standard errors. Robust *t*-statistics are reported in brackets, with ***, **, and * indicating statistical significance at the 1%, 5%, and 10% level, respectively.

Independent variable	(1)	(2)	(3)	(4)	(5)
Panel A: Portfolio-level performance of non-US investors					
Home bias	0.0097***	0.0174***			0.0097***
	[5.19]	[11.86]			[5.18]
Foreign concentration	0.0031		0.0264***		0.0054*
	[0.98]		[9.86]		[1.71]
Global industry concentration	0.0393***			0.0492***	0.0399***
	[10.27]			[12.13]	[10.42]
Portfolio size	0.0016***	0.0010***	0.0012***	0.0022***	0.0021***
	[7.63]	[6.21]	[7.39]	[10.88]	[9.85]
Market premium	0.7480***	0.7049***	0.7041***	0.7047***	0.7047***
	[112.18]	[106.94]	[107.19]	[106.87]	[107.37]
SMB		−0.1535***	−0.1519***	−0.1553***	−0.1536***
		[−8.28]	[−8.21]	[−8.38]	[−8.29]
HML		−1.0744***	−1.0749***	−1.0751***	−1.0756***
		[−52.99]	[−53.05]	[−53.06]	[−53.07]
UMD		−0.3468***	−0.3472***	−0.3465***	−0.3474***
		[−45.35]	[−45.41]	[−45.28]	[−45.41]
Number of observations	69,265	69,265	69,265	69,265	69,265
Adjusted R^2	0.4230	0.4689	0.4686	0.4700	0.4708
Panel B: Home market performance					
Country bias	0.0030***		0.0045***		0.0033***
	[2.77]		[4.26]		[2.84]
Country industry concentration	0.0047**			0.0059***	0.0070***
	[2.52]			[2.98]	[3.48]
Size	−0.0007***		−0.0010***	−0.0007***	−0.0006***
	[−5.41]		[−8.56]	[−4.80]	[−4.47]
Market premium	0.6719***		0.6606***	0.6648***	0.6647***
	[154.57]		[147.87]	[148.85]	[148.72]
SMB			0.0967***	0.1078***	0.1078***
			[13.27]	[15.25]	[15.25]
HML			0.0566***	0.0558***	0.0558***
			[10.14]	[10.03]	[10.03]
UMD			−0.1599***	−0.1624***	−0.1625***
			[−30.87]	[−32.92]	[−32.95]
Number of observations	68,602		59,635	59,359	59,359
Adjusted R^2	0.5441		0.5471	0.5547	0.5547

(*continued on next page*)

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Table 6 (continued)

Panel C: Foreign market performance				
Country bias	0.0064***	0.0036***		0.0053***
	[4.10]	[3.78]		[5.43]
Country industry concentration	0.0061***		0.0036***	0.0042***
	[3.58]		[6.88]	[7.86]
Size	0.0007	−0.0089***	−0.0077***	−0.0066***
	[0.41]	[−8.87]	[−7.67]	[−6.47]
Market premium	0.9519***	0.7593***	0.7557***	0.7556***
	[66.34]	[473.81]	[476.49]	[476.49]
SMB		0.0052**	0.0145***	0.0145***
		[1.99]	[5.60]	[5.63]
HML		0.0143***	0.0188***	0.0188***
		[8.00]	[10.47]	[10.51]
UMD		−0.1073***	−0.0968***	−0.0970***
		[−56.37]	[−53.60]	[−53.65]
Number of observations	1,128,619	1,025,168	986,163	986,163
Adjusted R^2	0.5110	0.4735	0.4781	0.4781

that investors with higher learning capacity, which we associate with higher skill, hold more concentrated portfolios because they are better able to capitalize on and amplify their initial information advantage. We proxy for the investor's learning capacity with the *Skill* variable, which represents the decile of the investor's abnormal performance. The tenth decile represents the most skilled institutional investors; and the lowest decile, the least skilled investors. Furthermore, we include investor's type indicators, making banks and insurance the omitted category, conjecturing that hedge funds and mutual funds would hold more concentrated portfolios, compared with banks and insurance companies because the managers of these funds are likely to have higher learning capacities. We run the regressions of these learning capacity measures on the portfolio concentration measures at the country and industry levels. For each portfolio concentration measure we first examine the effect of the *Skill* variable, and then the effect of investor type indicators (*Hedge funds, Mutual funds*, and *Pensions and endowments*). We then include *Skill* and investor's type indicators simultaneously. We also control for portfolio size and include style and year fixed effects in all specifications.

Table 7 presents the results for the home market (Panel A) and foreign markets (Panel B). In Panel A, the dependent variable is *Home bias* (Eq. (1)) in Specifications 1–3. In Specifications 4–6, the dependent variable is *Home country industry concentration*, which is the country industry concentration (Eq. (7)) calculated for the investor's home country. In the regressions for *Home bias*, the coefficients on *Skill* and investor's type indicators are negative and significant at the 1% level, suggesting that institutional investors with higher capacity to learn hold less home-biased portfolios; that is, they are more likely to invest internationally. In contrast, the results for *Home country industry concentration* suggest that investors with higher capacity to learn hold more industry-concentrated portfolios in the home market. The coefficients on *Skill, Hedge funds*, and *Mutual funds* are positive and significant at the 1% level. Furthermore, the coefficients for the investor's type indicators are positive and decrease monotonically from *Hedge funds* to *Mutual funds* to *Pensions and endowments*, suggesting that investors with higher learning capacity (e.g., hedge funds) construct more industry concentrated portfolios in the home country.

In the analysis of the portfolio concentration in the foreign markets (Table 7, Panel B), the dependent variable is *Foreign bias* (Eq. (2)) in Specifications 1–3, and is *Foreign country industry concentration,* which is the *Country industry concentration* (Eq. (7)) calculated for each foreign market, in Specifications 4–6. The coefficients on *Skill* and investor type indicators are positive and highly significant in most specifications, suggesting that investors with higher capacity to learn hold more concentrated portfolios at the country and industry levels when investing in foreign countries. Furthermore, the magnitude of the coefficients on investor type indicators decreases monotonically from *Hedge funds* to *Mutual funds* to *Pensions and endowments* to *Banks and insurance* (omitted) in all specifications, suggesting that hedge funds construct the most concentrated portfolios with respect to country and industry weights as they invest in a given foreign target market, followed by mutual funds, pensions and endowments, and, finally, banks and insurance companies. Combined with the result that the *F*-statistic for the test of equality in coefficients across investor's type indicators is statistically significant in every specification, this finding provides further support for H2, the learning capacity hypothesis.

Overall, the results support the implication of the information advantage theory that investors with higher capacity to learn hold more concentrated portfolios. Furthermore, the results show that investors with higher capacity to learn are more likely to concentrate their holdings by industry and foreign market and are less likely to concentrate their holdings in home markets. Arguably, from the perspective of an average investor, the information advantage in foreign markets and industries is more difficult to attain and amplify compared with that of the home market. If that is the case, it is not surprising that more skilled investors are more likely to concentrate their learning efforts in more complicated sectors or assets, or both, and be rewarded with higher risk-adjusted returns.

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Table 7
Portfolio concentration and investor's learning capacity.

This table presents the results of ordinary least squares regressions of portfolio concentration of institutions' holdings in the home markets (Panel A) and in the foreign markets (Panel B) on investors' capacity to learn measures. In Panel A, the dependent variables are *Home bias* (Eq. (1)) in Specifications 13, and *Home country industry concentration*, which is the *Country industry concentration* (Eq. (7)) calculated for the investor's home country in Specifications 4–6. In Panel B, the dependent variables are *Foreign bias* (Eq. (3)) in Specifications 1–3, and *Foreign country industry concentration*, which is the *Country industry concentration* (Eq. (7)) calculated for each foreign market in specifications 4–6. The main independent variables are *Skill*, which is the decile of the investor's abnormal performance, measured by portfolio-level alpha (10 = most skilled, 1 = least skilled) and indicator variables for institutional investor type: *Banks and insurance* (omitted), *Hedge funds* (which includes hedge funds and arbitrage), *Mutual funds* (which includes mutual funds and advisors), and *Pensions and endowments* (which includes pension funds and endowments). *Portfolio size* is the institution's market value in quarter *q*, in natural logarithm. Fixed effects used are year and investors' style. The standard errors are clustered by institution. Robust *t*-statistics are reported in brackets. *F*-statistic that tests for equality in the institution's type coefficients is reported in the last row, if applicable. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Panel A: Home markets

Independent variable	Dependent variable: *Home bias*			*Home country industry concentration*		
	(1)	(2)	(3)	(4)	(5)	(6)
Skill	0.0022		0.0024*	0.0080***		0.0074***
	[1.60]		[1.75]	[10.04]		[9.50]
Hedge funds		−0.1711***	−0.1623***		0.1901***	0.1870***
		[−11.23]	[−10.53]		[19.51]	[19.01]
Mutual funds		−0.0677***	−0.0597***		0.0992***	0.0894***
		[−5.37]	[−4.71]		[12.73]	[11.46]
Pensions and endowments		−0.1178***	−0.1125***		0.0934***	0.0871***
		[−6.82]	[−6.45]		[8.90]	[8.30]
Portfolio size	0.0019	0.0011	0.0010	−0.0212***	−0.0190***	−0.0195***
	[1.43]	[0.79]	[0.75]	[−22.59]	[−20.04]	[−20.62]
Number of observations	115,023	118,401	115,023	114,383	117,695	114,383
Adjusted R^2	0.0371	0.0481	0.0511	0.2890	0.3054	0.3061
F-statistic (equality of type)		46.24***	44.98***		82.10***	91.08***

Panel B: Foreign markets

Independent variable	Dependent variable: *Foreign bias*			*Foreign country industry concentration*		
	(1)	(2)	(3)	(4)	(5)	(6)
Skill	0.0005***		0.0005***	0.0054***		0.0048***
	[3.21]		[3.17]	[8.36]		[7.62]
Hedge funds		0.0323***	0.0270***		0.0842***	0.0901***
		[13.92]	[13.07]		[10.75]	[10.77]
Mutual funds		0.0072***	0.0067***		0.0778***	0.0744***
		[5.73]	[6.24]		[12.53]	[11.71]
Pensions and endowments		0.0025	0.0052***		0.0607***	0.0586***
		[1.62]	[3.79]		[6.88]	[6.43]
Portfolio size	−0.0856***	−0.1083***	−0.0785***	−0.3352***	−0.2915***	−0.3042***
	[−31.18]	[−34.20]	[−28.03]	[−20.14]	[−19.03]	[−18.83]
Number of observations	1,115,135	1,219,977	1,115,135	1,061,148	1,161,415	1,061,148
Adjusted R^2	0.0136	0.0267	0.0166	0.1122	0.1254	0.1277
F-statistic (equality of type)		89.87***	62.90***		3.93**	5.99***

5.6. Home bias and market uncertainty

In this subsection we test H3, the uncertainty hypothesis, by examining the relation between the degree of the institution's home market portfolio concentration and the level of home market uncertainty. We expect the coefficient on the *Market uncertainty* variable to take a positive sign in the regression of *Home bias* on *Market uncertainty* if investors in more uncertain markets form more home biased portfolios.

Table 8 presents the results of the regressions, in which the dependent variable is the institution's *Home bias* (from Eq. (1)) and the main independent variables are the two measures of the institution's home country degree of uncertainty, *Variance* and *Market uncertainty*, both discussed in Section 4. For *Variance*, we calculate the unconditional variance of monthly market returns both in local currency and in US dollars. Results are similar for both currencies. We present the results for monthly returns in the local currency. The second measure of uncertainty is *Market uncertainty*, which is the first principle component of the five uncertainty proxies (unconditional variance, market capitalization/GDP, number of analysts/number of firms, informativeness in asset prices, and functional efficiency). All regressions control for the portfolio size of each institution and include institution type, style, and year fixed effects.

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Table 8
Home bias and home market uncertainty.

This table presents the results of ordinary lease squares regressions testing the relation between an investor's portfolio home bias and the home market's degree of uncertainty. The dependent variable is portfolio *home bias*, calculated according to Eq. (1). The main independent variables are *Variance* and *Market uncertainty*. *Variance* is the market's unconditional variance of security returns in local currency three years prior to a given quarter. *Market uncertainty* is the first principle component of five market uncertainty proxies: variance, size of financial sector, number of analysts/firms, informativeness in asset prices calculated following Durnev, Morck, Yeung and Zarowin (2003), and a measure of functional efficiency of the stock market calculated following Morck, Yeung, and Yu (2000). *Skill* represents the decile of the investor's abnormal performance (10 = most skilled, 1 = least skilled). Where indicated, we interact the market uncertainty (*Variance* and *Market uncertainty*) with *Skill*. *Portfolio size* is the institution's total market value of equity in quarter *q*, in natural logarithm. All regressions include year, style, and type of fixed effects and are run with institution-clustered standard errors. Robust *t*-statistics are reported in brackets, with ***, **, and * indicating statistical significance at the 1%, 5%, and 10% level, respectively.

Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variance	25.9457***			22.3052***		6.6508**	
	[13.01]			[11.27]		[2.08]	
Market uncertainty		0.1004***			0.0944***		0.0308***
		[14.38]			[13.14]		[2.83]
Skill			0.0035**	0.0022*	0.0014	−0.0040**	0.0097***
			[2.56]	[1.65]	[1.04]	[−2.13]	[5.99]
Variance x *Skill*						2.4142***	
						[5.48]	
Market uncertainty x *Skill*							0.0101***
							[7.25]
Portfolio size	0.0034**	0.0027*	0.0009	0.0029**	0.0024*	0.0026*	0.0021
	[2.41]	[1.91]	[0.67]	[2.07]	[1.69]	[1.86]	[1.54]
Number of observations	117,924	117,754	115,023	114,663	114,501	114,663	114,501
Adjusted R^2	0.0676	0.0691	0.0569	0.0680	0.0709	0.0697	0.0738

We start the analysis by including each of the market uncertainty variables in Specifications 1 and 2. We include a regression with a proxy for the investor's capacity to learn, *Skill,* in Specification 3 and the regressions including *Skill* and each home market uncertainty variable in Specifications 4 and 5. We then examine the interaction effect between *Skill*, and home market uncertainty measures on *Home bias* (Specifications 6 and 7). Investors with higher learning capacity should concentrate holdings in more uncertain foreign markets to fully exploit their comparative advantage over average or less skilled investors. Therefore, we expect the coefficient on the interaction term to be positive.

The results presented in Table 8 can be summarized as follows. The coefficients on *Variance* and *Market uncertainty* are positive and statistically significant in all specifications, suggesting that the degree of *Home bias* is greater in markets with a greater level of *Market uncertainty*. This provides support for H3, the uncertainly hypothesis. Consistent with the implication of the information advantage theory, home investors in markets with more uncertainty hold more home-biased portfolios because of the higher degree of the initial information advantage relative to the average investor, which makes home assets particularly valuable to learn about.

Furthermore, the analysis of the interaction terms between *Skill* and home market uncertainty measures shows that more skilled investors are more likely to capitalize on the initial information advantage in home markets with greater home market uncertainty. The interaction terms are positive and significant for both measures of home market uncertainty. This finding is especially interesting in light of the result presented in Panel A of Table 7 that more skilled investors are less likely to hold home-biased portfolios, but they do so in markets with higher home market uncertainty, where the information asymmetry and the opportunity for higher risk-adjusted returns are greater. Our results support H3, the uncertainty hypothesis, in that home bias seems to be more prevalent in more uncertain markets.

6. Conclusion

Prior empirical studies show that investors often pursue concentrated instead of diversified strategies when investing in international markets. This behavior is not predicted by traditional asset pricing theory, in which diversification is king and investors do not seemingly take advantage of international diversification opportunities. More recent theoretical studies (e.g., Gehrig, 1993; Van Nieuwerburgh and Veldkamp, 2009, 2010) argue that portfolios can be under-diversified but optimal if the investor is using an information advantage in the decision making process.

We examine and affirm that the observed portfolio concentration in international markets is consistent with a rational decision-making process implied by the Van Nieuwerburgh and Veldkamp (2009) theory. We provide evidence, as the information advantage theory suggests, that investors capitalize on their initial information advantage and amplify their advantage through learning and specialization in markets in which they can add the most value.

In contrast to prior studies that provide support for the information advantage hypothesis in a single market, we are the first to test the empirical implications of the information advantage theory specific to home bias and foreign country concentration. Using data on institutional investors from 72 countries, we find strong support for the information advantage theory on home bias. Our study makes a significant contribution to the existing literature by showing that the widely observed deviation from the well-diversified world market portfolio enhances investors'

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risk-adjusted performance. Results show that home country, foreign country, and industry concentration are all associated with higher risk-adjusted returns of institutional investors' portfolios. In addition, higher concentration in a given country (either home or foreign) and in the industries of that country is associated with better performance in the part of the portfolio allocated to that country. This evidence suggests that institutional investors concentrate their holdings in home markets and selected foreign markets and industries, as if they possess an information advantage in these assets.

Our analysis of different types of institutional investors allows us to study investors with varying degrees of learning capacity. We conclude that institutional investors with higher capacity to learn (i.e., more skilled investors) form more concentrated portfolios, especially in foreign markets and industries. Finally, home bias is positively related to home market uncertainty, meaning that informed investors are concentrating efforts where they can add the most value.

Appendix. Portfolio concentration measures: computation and examples

A.1. Foreign concentration

To illustrate the computation of the *Foreign concentration* measure (see Eq. (3)), assume that there are only five countries in the world (A, B, C, D, E) with equal market capitalization ($20 each, with world market capitalization of $100). Consider institutional investor *i*, with a total portfolio value of $100 invested in home and foreign securities. Country C is the investor's home country.

As a starting point, we calculate actual and expected portfolio weights in each country relative to the overall portfolio value and the world market capitalization (including home and foreign investments and markets). Using these weights, we show the computation of *Global concentration.* We then illustrate the computation of *Foreign concentration*, excluding the home market.

Dollar values of institution *i*'s holdings in each of the five countries are given in Column (1) of Table A1. Actual weight (Column 3) is the value of institution *i*'s holdings in each country divided by the total value of institution's portfolio (home and foreign investments), and expected weight (Column 4) is the country's market capitalization (Column 2) divided by the world market capitalization. Bias is calculated as the difference between actual and expected weights.

Global concentration is defined as half the sum of the absolute value of the country biases. The *Global concentration* in this example is 0.3. According to the traditional asset pricing theory, 30% of the institution's entire portfolio presented in Table A1 should be reallocated to achieve full diversification across global markets. One solution would be to move 20% of the total portfolio value out of Country C and reinvest it in Country B and to withdraw 10% of the total portfolio value from Country E and invest it in Country D.

We now turn to the calculation of *Foreign concentration*. The majority of investors worldwide hold a large portion of their portfolios in the home market, thus the *Global concentration* metric is highly correlated with the home country holding weight. In this example, the home weight is 0.4 and the global concentration is 0.3. To obtain full diversification this investor needs to reallocate 30% of her holdings, most of which are invested in the home country. We calculate *Foreign concentration* by omitting the holdings in the home country from the total portfolio value and omitting the market capitalization of the home country from the world market capitalization. The process, described in Section 4.1, is illustrated in Table A2.

The foreign weight for each country is the value of institution *i*'s holdings in each foreign country, divided by the total value of the portfolio invested in foreign markets (excluding the home market). The expected weight for each foreign country is calculated as the country's market capitalization, divided by the world market capitalization, excluding the market capitalization of the home market. *Foreign bias* is the difference between foreign weight and expected weight of each foreign country, as defined in Eq. (2). Using Eq. (3) the *Foreign concentration* in this example is 0.333 indicating that one-third of the foreign portfolio holdings should be reallocated across foreign markets to achieve perfect foreign diversification. A solution would be to move 8.33% of total overweighted holdings out of Country A to underweighted Country D and to withdraw 25% of total foreign portfolio holdings from Country E and reinvest it in Country B.

A.2. Global and country industry concentration measures

To calculate *Global industry concentration*, we include all of an institution's holdings. Assume there are three countries (A, B, C) and five industries (1–5). Some industries are

Table A1
Computing global concentration.

Country	Institution *i*'s holdings (dollars) (1)	Country market capitalization (dollars) (2)	Actual weight (3)	Expected weight (4)	Bias (3)–(4)
A	20	20	0.2	0.2	0.0
B	0	20	0.0	0.2	−0.2
C (home)	40	20	0.4	0.2	0.2
D	10	20	0.1	0.2	−0.1
E	30	20	0.3	0.2	0.1
Total	$100	$100	1.0	1.0	

Table A2
Computing foreign concentration.

Country	Institution *i*'s holdings (dollars) (1)	Country market capitalization (dollars) (2)	Foreign weight (3)	Expected weight (4)	Foreign bias (3)–(4)
A	20	20	0.33	0.25	0.083
B	0	20	0.00	0.25	−0.250
C (Home)	Excluded	Excluded			
D	10	20	0.16	0.25	−0.083
E	30	20	0.50	0.25	0.250
Total	$60	$80	1.00	1.00	

Table A3
Computing global industry concentration.

Industry	Country A (1)	Country B (2)	Country C (3)	Industry's market value (dollars) (4)	Global industry weight (5)	Institution *i*'s holdings (dollars) (6)	Actual weight (7)	Global industry bias (7)–(5)
1	20	30	20	70	0.23	10	0.1	−0.13
2	20	0	0	20	0.06	40	0.4	0.33
3	30	0	20	50	0.16	0	0.0	−0.16
4	10	20	0	30	0.10	50	0.5	0.40
5	20	50	60	130	0.43	0	0.0	−0.43
Total	$100	$100	$100	$300	1.00	$100	1.0	

Table A4
Computing country industry bias.

Industry	Industry weight Country A (1)	Industry weight Country B (2)	Industry weight Country C (3)	Bias country A (4)	Bias country B (5)	Bias country C (6)
1	0.2	0.3	0.2	−0.1	−0.2	−0.1
2	0.2	0.0	0.0	0.2	0.4	0.4
3	0.3	0.0	0.2	−0.3	0.0	−0.2
4	0.1	0.2	0.0	0.4	0.3	0.5
5	0.2	0.5	0.6	−0.2	−0.5	−0.6
Total	1.0	1.0	1.0			

not present in all countries. An industry's representation in each country and total market value and institution *i*'s holdings in each industry are reported in Table A3. All five industries are traded in Country A, and three out of five industries are available in Countries B and C. In Table A3, Columns 1, 2, and 3 report the dollar value of each industry represented in each country, and Column 6 shows the dollar value of institution *i*'s holdings in each industry.

To calculate *Global industry concentration*, we first add market values of all industries that exist in the world market (Column 4) and calculate global industry weight (Column 5) by dividing the market value of each industry by the world market capitalization ($300 in this example). Actual weight (Column 7) is institution *i*'s portfolio weight invested in each industry. *Global industry bias* is calculated using Eq. (4) as the difference between the actual weight (Column 7) and the global industry weight (Column 5). Using Eq. (5) *Global industry concentration* in this example is calculated to be 0.7333, i.e., 73.33% of institution *i*'s total holdings need to be reallocated across industries worldwide to achieve perfect global industry diversification. One possible way to achieve maximum diversification would be to withdraw 33.33% of total portfolio holdings from Industry 2, invest 13.33% in Industry 1 and 20% in Industry 5; and then withdraw 40% of the total portfolio from Industry 4 and invest 16.67% in Industry 3 and 23.33% in Industry 5. To calculate *Country industry concentration*, we treat each country as a separate market and calculate the industry concentration measure for each country. The process is illustrated in Table A4.

Industry weights for each country (Columns 1, 2, and 3) are calculated based on the market capitalization of industries in each country separately. For example, Industries 2 and 3 do not exist in Country B, so when calculating industry weight, only the market capitalization of Industries 1, 4, and 5 are summed as the denominator. Bias for Countries A, B, and C are calculated according to Eq. (6), and using Eq. (7) and the country biases in Columns 4, 5, and 6, the *Country industry concentration* for Country A, B, and C is 0.6, 0.7, and 0.9, respectively.

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