Beyond Home Bias: Portfolio Holdings and Information Heterogeneity

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Abstract

We investigate whether information heterogeneity is an important determinant of banks' international portfolio holdings. Going beyond the classic distinction of home versus foreign assets, we particularly focus on the heterogeneity within foreign holdings. First, we document that banks invest only in a few foreign countries, even when considering a class of assets that is homogeneous across destination countries (European sovereign bonds). This is true especially for small banks. Second, we propose a new model with a two-tiered information cost structure – that includes both a fixed and a variable component – that leads to 'sparse' portfolios that vary as a function of wealth, as in the data. We find strong support for the key predictions of the model in the data, both regarding the extensive and intensive margins of portfolio holdings. In particular, we find that the elasticity of portfolio holdings with respect to the forecast of future yields is higher the more precise the underlying forecasts are, suggesting that information heterogeneity is indeed an important determinant in the allocation of foreign investment.

JEL classification: F30, G11.

Keywords: Home bias, Information frictions, Portfolio choice, Banks

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1 Introduction

Portfolio home bias, the surprising lack of international diversification in aggregate portfolios, is a well documented empirical phenomenon in international finance, and it has given rise to a large and active literature.[1] One of the leading potential explanations, costly information acquisition, is appealing in that it fits a number of features of the home bias in the data (see for example Van Nieuwerburgh and Veldkamp (2009), Dziuda and Mondria (2012), Valchev (2017)). Largely due to the lack of appropriate data, however, the primary focus of prior work has been on understanding the basic dichotomy between home and foreign assets, while the heterogeneity among individual foreign holdings has received less attention. Moreover, investor-level empirical tests of information based-theories have typically focused on the lack of sophistication of individual, retail investors, who do not directly hold a large portion of the aggregate portfolio.[2]

In this paper, we go beyond the classic home versus foreign distinction in holdings, and study both theoretically and empirically how information frictions affect the entire portfolio allocation of European banks, and specifically across individual foreign assets. Our work suggests that the information mechanism is a significant determinant of portfolio concentration, even among sophisticated investors like the ones in our data set. In order to analyze the link between information acquisition and portfolio holdings empirically, we take advantage of a unique dataset that matches European banks' domestic and foreign sovereign debt holdings and credit exposures from the European Banking Authority (EBA) with banks' forecasts on the same countries' 10-year sovereign debt yields, obtained from

[1]For the empirical documentation of the puzzle see, among others, French and Poterba (1991), Tesar and Werner (1998), and Ahearne et al. (2004). In terms of theories of the home bias see for example Obstfeld and Rogoff (2001), Van Nieuwerburgh and Veldkamp (2009), Coeurdacier and Gourinchas (2016), Heathcote and Perri (2007), Huberman (2001). Coeurdacier and Rey (2013) provide an excellent survey.

[2]Guiso and Jappelli (2008) trace portfolio under-diversification to the lack of financial literacy. Ahearne et al. (2004) document that countries with a larger share of companies publicly listed in the U.S. attract larger weights in the U.S. equity portfolio. Massa and Simonov (2006) show that Swedish investors do not hedge risk but invest in stocks they are better informed about, and earn higher returns doing so. Grinblatt and Keloharju (2001) provide evidence that cultural and geographical proximity determines trading patterns among Finnish investors.

Consensus Economics.[3] This dataset allows us to analyze not only the relationship between home assets and the aggregate of all foreign assets owned by a bank, but to also look at the holdings of specific foreign assets. Moreover, it allows us to track a bank's beliefs about the returns of the underlying individual portfolio holdings.[4] We are therefore able to link banks' information sets with their portfolio holdings, providing direct evidence in support of information-based models of international portfolio allocation.

We begin by discussing the stylized facts that characterize foreign portfolio holdings in our data set. We find that the foreign portion of a bank portfolio is typically 'sparse', in the sense that banks tend to hold sovereign debt from only a small subset of foreign countries (even when we restrict those countries to be from the relatively homogeneous set of EEA countries). We call this fact the *extensive* margin of the home bias. For the average bank, 60% of the observed home bias is due to the extensive margin. There is, however, substantial cross-sectional heterogeneity in the incidence of this extensive margin. The home bias of small banks, which is higher on average than for large banks, is almost entirely due to the extensive margin. The home bias of large banks instead is due to the fact that, although they invest in a large number of foreign countries, they still significantly underweight foreign countries as a group relative to domestic holdings. This is the *intensive* margin of the home bias. The distinction between extensive and intensive margin of international portfolio choice is an interesting pattern that has not received much prior attention.[5]

Next, we propose a general equilibrium model with costly information acquisition that is able to rationalize these stylized facts. The challenge for the model is to generate both the extensive margin (which countries to invest in) and the intensive margin (how much to

[3]We focus on holdings of European sovereign bonds to ensure that all assets receive the same regulatory treatment (0% risk–weight).

[4]Our model covers only tradable portfolio assets such as a government bond, which is why we focus on sovereign debt holdings in most of the empirical analysis. In robustness tests, we also analyze non-tradable assets such as loans and find corroborative evidence. Because of data limitations, we cannot analyze other tradable asset classes, such as equities or corporate bonds.

[5]Hau and Rey (2008) and Shin (2014) similarly notice that mutual funds tend to specialize in specific geographical regions, and often avoid investing in other regions altogether. They also show that larger funds tend to invest in a broader set of foreign countries, as large banks do in our sample. However, they do not analyze whether the sparseness persists within sets of homogeneous destination countries.

invest in each of the chosen countries) of portfolio adjustment, and the proper cross-sectional heterogeneity in the importance of both for small and large banks. To do that, we modify the benchmark model of Van Nieuwerburgh and Veldkamp (2009), which features an intensive margin of information and portfolio adjustment, but not an extensive one, in two ways. First, we make the information choice and cost structure two-tiered by including Merton (1987)-style fixed cost of acquiring priors about the unconditional distribution of returns. Second, we use CRRA preferences (as opposed to CARA) which introduce a wealth effect and thus decreasing marginal utility of paying for additional information. Thanks to these two new elements (both of which are needed), the optimal portfolios are sparse, with less wealthy agents (e.g. smaller banks) optimally choosing to pay the fixed cost to acquire information about (and thus invest in) fewer foreign countries. Thus, the model features both extensive and intensive margins of portfolio adjustment, and an explicit role for the size of the bank.[6]

In the model, agents can receive two types of information – i) information on the unconditional distribution of returns and ii) noisy signals, with endogenous precision, on the future return realizations of individual assets. The second type of information (which we call intensive information) works in the same way as in Van Nieuwerburgh and Veldkamp (2009), and similarly displays increasing returns and thus the optimal choice of intensive information is to acquire informative signals about only one country (which turns out to be the home country). The first type of information (which we call extensive information) is new to our paper, and it turns out that it does not display increasing returns, but rather decreasing returns. This is due to the interaction between CRRA utility and the optimal allocation of intensive information. On the one hand, agents know that they will optimally choose to not acquire additional informative signals for the foreign countries they invest in, which weakens the feedback loop between extensive information and portfolio holdings. On the other, the CRRA agents face decreasing marginal utility of investible wealth, and thus increasing marginal cost of information in utility terms. As a result, agents might optimally

[6] Gârleanu et al. (2016) develop a model with a discrete type of information friction which can also generate non-participation, but do not study its potential implications about international portfolio sparseness.

choose to save on the fixed information cost for some countries and only invest in a strict subset of all available countries. Thus, the model displays both increasing returns to intensive information, and decreasing returns to extensive information.

Lastly, the dual structure of information implies that there are two channels through which portfolios become home biased in equilibrium – (i) agents may acquire priors on a subset of foreign countries (thus leading to sparse portfolios) and (ii) agents only acquire acquire additional informative signals about the domestic asset, which increases its portfolio weight relative to the set of foreign assets the bank is actually investing in.[7] Moreover, the model also has rich implications about the composition of the foreign portion of agents' portfolios, which depends on the optimal acquisition of foreign information. With the model's predictions at hand, we use our dataset that links bank forecasts and bank sovereign portfolio holdings to document the importance of information frictions in determining both the extensive margin and the intensive margin of international portfolio allocations.

First, we show that indeed banks have an informational advantage over their home country relative to foreign ones, in the sense of producing more accurate forecasts about their domestic country compared to foreign ones.[8] This justifies the basic economic intuition of our model that portfolio bias is due to information differences across potential investments. Second, we show that producing a forecast about a country strongly predicts the likelihood of investing in that country; in other words, information acquisition seems to determine portfolio sparseness, just as it does in the model. These facts support the link between information frictions and the extensive margin of portfolio choice.[9]

We then turn our attention to the link between the intensive margin of information

[7]Since agents do not acquire any foreign information beyond the unconditional distribution of returns, foreign investments are on average made in proportion to their CAPM weights, and hence there are no persistent relative biases among them.

[8]Similar local information advantages are also documented in other settings by prior work. For instance, Bae et al. (2008) and Malloy (2005) study how geographical and cultural proximity affects accuracy for analysts, while Grinblatt and Keloharju (2001) find similar patterns for Finnish stock investors. Cornaggia et al. (2017) confirm that proximity leads credit rating analysts to issue more favorable ratings.

[9]In international trade, the connection between information frictions and the extensive margin of trade (which export market to enter) is studied in Morales et al. (2017) and Dickstein and Morales (2015).

and the intensive margin of portfolio bias. We show that, conditional on producing forecasts on a set of countries, the precision and relative optimism of these forecasts have statistically and economically significant effects on a bank's holdings in these countries. Specifically, both more optimistic expectations about a country and more precise information (lower squared forecast errors) strongly predict larger portfolio holdings of that country's sovereign debt. In addition, and as implied by the model, there is a significant interaction effect between the precision and the relative optimism of the forecasts. We find that the holdings of sovereign debt for which a given bank makes more precise forecasts are more sensitive to changes in the point forecast of that country's future yield - a given change in the bank's forecast of future yields produces a larger shift in the holdings of that country's sovereign debt, the more precise the forecast.[10]

Lastly, we find that while information differences can explain well the heterogeneity in the foreign portion of the sovereign portfolio, they cannot fully explain the significant overweighting of domestic assets relative to foreign assets as a whole. Indeed, when we run the intensive margin regressions including home exposure dummies, the latter show positive and significant coefficients. The home exposure dummies have explanatory power over and above what can be attributed to any home advantage in information. Thus, we conclude that information frictions play an important role in determining the heterogeneity in banks' foreign portfolio holdings, but they are not quite enough by themselves to explain the full extent of the classic home bias puzzle.

This paper contributes to the large literature on home bias in asset holdings. The basic observation has been extensively documented for both equities (French and Poterba (1991), Tesar and Werner (1998), Ahearne et al. (2004)) and bonds (Burger and Warnock (2003), Fidora et al. (2007), Coeurdacier and Rey (2013)), and is a robust feature of both the aggregate data and the micro, individual investor data (Huberman (2001), Ivković and Weisbenner (2005), Massa and Simonov (2006), Goetzmann and Kumar (2008)). Recently,

[10] Note that the returns on long-term bonds are directly proportional to future yields, and thus forecasts of future yields serve as a proxy of expected returns.

the European debt crisis has specifically emphasized the role of home bias in European banks' sovereign portfolios in transmitting credit risk from sovereign to the real economy (Altavilla et al. (2017), Popov and Van Horen (2014), DeMarco (2017)).

In terms of potential theoretical explanations, the idea of information frictions that create information asymmetry between home and foreign agents is a well-established hypothesis with a long tradition in the literature (Merton (1987), Brennan and Cao (1997), Hatchondo (2008), Van Nieuwerburgh and Veldkamp (2009), Mondria (2010), Valchev (2017)). Another set of mechanisms study frameworks in which home assets are good hedges for real exchange rate risk (Adler and Dumas (1983), Stockman and Dellas (1989), Obstfeld and Rogoff (2001), Serrat (2001)) and/or non–tradable income risk (Heathcote and Perri (2007), Coeurdacier and Gourinchas (2016)). Yet another strand of the literature analyzes corporate governance issues (Dahlquist et al. (2003)), political economy mechanisms (DeMarco and Macchiavelli (2015), Ongena et al. (2016)) and behavioral biases (Huberman (2001), Portes and Rey (2005), Solnik (2008)).

The contribution of this paper in terms of the home bias literature is twofold. On the empirical side, we provide new stylized facts about banks' international portfolio holdings, and in particularly show that there is an important extensive margin to international under-diversification. Second, and crucially, we also empirically link both the extensive and intensive margin of portfolio adjustment to information frictions. To the best of our knowledge, we are the first to directly link investors' information sets with their portfolio holdings empirically. Previous empirical studies on information frictions, even those at the investor level, cannot match each asset in the investor's portfolio with his or her expectation (and its accuracy) about the performance of the asset. By connecting information sets with asset allocations at the bank level, we are able to provide direct evidence in favor of the main implications of portfolio choice models with information frictions.

On the theoretical side, we extend the standard portfolio choice model with costly information (Van Nieuwerburgh and Veldkamp (2009)) by adding an extensive margin of information acquisition and power utility preferences that generate wealth effects. In this model, home bias is driven by both an intensive and an extensive margin, and generates portfolios that can rationalize the stylized facts we document. The model also has rich implications about the structure of the foreign portion of portfolios, that fits well with the new evidence we provide on the link between the extensive margin of information acquisition and the extensive margin (sparseness) of portfolio holdings. Moreover, its more detailed implications are also well supported by our empirical tests.

The paper is organized as follows. Section 2 describes the data and presents stylized facts. Section 3 presents the model and Section 4 the empirical tests the implications from the model. Section 5 concludes.

2 Data and Stylized Facts

2.1 Data

For our purposes, it is key to have data on portfolios and expectations on sovereign debt returns at the investor level. To this end, we merge information on European banks' sovereign portfolios from the EBA to banks' forecasts from Consensus Economics.

The EBA data, collected for the bank stress tests, is a semi-annual dataset of credit and sovereign exposures of the largest banks headquartered in the European Economic Area (EEA) from 2010Q1 to 2013Q4.[11] In order to keep our assets under study relatively homogeneous, we focus on the holdings of EEA sovereigns, excluding countries such as Japan, USA and Switzerland.[12] We do so for several reasons. First of all, because of data limitations: exposures to non–EEA countries are only available in 2010Q4 and 2013Q4, not in other dates. Second, restricting the sample to EEA countries yields a homogeneous group in terms of

[11]The stress tests were held at irregular intervals, thus the following reporting dates are available: 2010Q1, 2010Q4, 2011Q3, 2011Q4, 2012Q2, 2012Q4, 2013Q2 and 2013Q4. We treat the dataset as a semi-annual dataset, and consider 2010Q1 and 2011Q3 exposures as if they were from 2010Q2 and 2011Q2.

[12]The stylized facts are not affected if we include exposures towards non–EEA countries in the sample (if anything, they are even stronger).

regulatory treatment: in fact, all exposures to EEA central governments denominated in local currency (98% of total debt outstanding) are assigned a 0% risk–weight (ESRB (2015)). The different regulatory treatment or liquidity characteristics may explain why European banks hold so little non–EEA debt, but cannot directly account for the home bias even among EEA countries. Finally, sovereign bonds are a highly relevant asset class, as they form a significant proportion of the total security portfolio of European banks.

We then match the banks in the EBA sample to Consensus Economics, a survey of professional forecasters which includes many of the banks in our sample as participants. At the beginning of each month, Consensus surveys analysts working for banks, consulting firms, non-financial corporations, rating agencies, universities and other research institutions (see Table 9 in the Appendix for a detailed list of forecasters). These analysts provide forecasts for a set of key macroeconomic and financial variables for all major industrialized countries and some emerging ones. The forecasters include both domestic and foreign institutions. We match by name the banks in Consensus Economics to those in the EBA dataset. In case these appear through their international subsidiaries, we match the subsidiary's forecast to the portfolio of the banking group it belongs to – HSBC France forecasts for the French economy is matched with the share of French bonds in the consolidated portfolio of HSBC Holdings.

In the empirical analysis we use the 10–year sovereign yields as the main forecasting variable, because it is most relevant in determining expected returns of sovereign debt, while at the same time guaranteeing good coverage by analysts.[13] It is highly relevant, since expecting a higher future yield on a debt instrument (which provides a fixed stream of payments) translates into expecting a lower future price, and thus a lower current return.

We construct bank b's forecast precision as the average squared forecast error (SFE) for country c at horizon h as follows: $SFE^h_{bct} = (E_{bt}(X_{c,t+h}) - X_{c,t+h})^2$, where $X_{c,t+h}$ is the realization of 10–year yields of country c at time $t+h$ and $E_{bt}(X_{c,t+h})$ represents the forecast as of time t of 10–year yields h periods ahead. Since the SFE may be a noisy measure of

[13]GDP growth forecasts have the most coverage by analysts, but are less relevant as a direct proxy of expected returns on bonds than the 10-year sovereign yield forecasts.

the average forecast precision of a given bank for a given country, our preferred measure of information precision is the *average* squared forecast error for the whole sample period of forecasts, i.e. $\overline{SFE}_{bc}^{h} = \frac{1}{T}\sum_{t=1}^{T}(E_{bt}(X_{c,t+h}) - X_{c,t+h})^2$. There are two forecast horizons reported by Consensus: short-term (3-months ahead) and long-term (1 year ahead). Due to potential information leakage concerns, we focus on the short-term horizon forecasts (3-month ahead); we therefore omit the h superscript hereafter.

Table 2 contains the list of variables that we use in the empirical analysis. The forecasts on 10–year yields are available for 85 banks at the monthly frequency from September 2006 to December 2014 for 14 different countries.[14] We are able to match 40 such forecasters to the sample of EBA banks, from which we obtain information on sovereign bond holdings and credit exposures for all 14 destination countries. Table 3 displays summary statistics for the dataset. In Panel A we report summary statistics about 10–year yield forecast from all bank-forecasters available on Consensus Economics. The average point forecast for 10–year yields is 3.37% for all 14 countries between 2006 to 2014. The average squared forecast error is 0.35, which is about one-fourth of the standard deviation of the 10–year yields, suggesting that banks indeed have a non-trivial ability to forecast future yields. The time-averaged squared forecast error per forecaster is a bit higher on average (0.44), with a standard deviation of 0.54 which shows that there is significant heterogeneity in the ability of different banks to forecast different yields. In our main empirical results we will aim to leverage this heterogeneity to see if it can help explain the heterogeneity in portfolio holdings.

In Table 3, Panel B and C, we report the summary statistics for the matched EBA-Consensus sample either for all bank-country pairs, including those that are not held in positive quantity (extensive margin, Panel B), or those only held in positive quantities (intensive margin, Panel C). The shares of sovereign debt are markedly different across panels. In Panel B, we see that the average sovereign's portfolio share, including the domestic exposure, is about 4.53%, with a large standard deviation (14.32%). About 40% of the

[14] See Tables 8 in Appendix D for a list of countries and all forecasters

bank-country pairs observations show no exposure at all ($\mathbf{1}(ShareSovEEA_{b,c,t}) = 0$). If we exclude the holdings of domestic sovereign debt, both the average share of each investment and its standard deviation are halved compared to before (2% and 6%), highlighting the large domestic exposures most banks have. Finally, banks on average make a forecast on 10–year yields for only about 3% of all available countries throughout the sample period. In Panel C, where we restrict the sample to countries for which banks have positive exposures, the average exposure to EEA countries, including the home exposure, increases to 20% (12% for foreign positive exposures only). Point forecasts and squared forecast errors remain similar to Panel B.

2.2 Stylized Portfolio Facts

In our first set of empirical results, we exploit the heterogeneity in our dataset, both across banks and across foreign assets, to better understand the structure of the home bias in sovereign debt holdings. To quantify this bias, we use the standard measure in the literature, the Home Bias Index (HB Index):

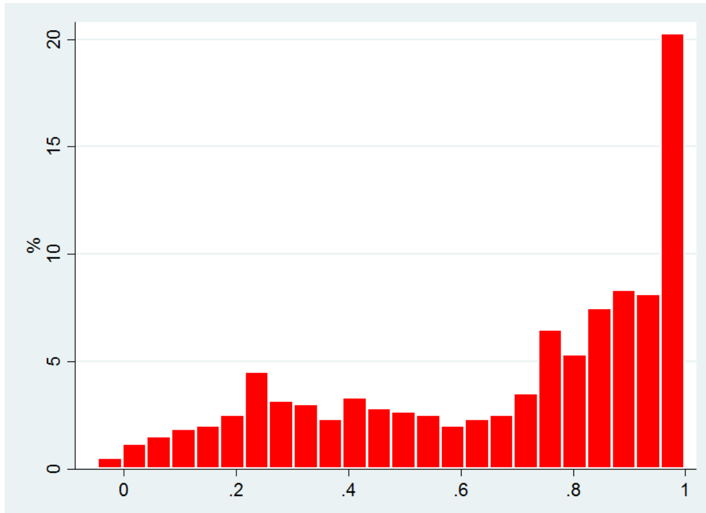
$$\text{HB} = 1 - \frac{1 - x_H}{1 - x_H^*}$$

where x_H is the portfolio share of a bank's holdings of domestic sovereign debt and x_H^* is the share of home country's debt as a fraction of total world debt (the CAPM portfolio). The HB index takes the value of 0 when the investor holds domestic assets in the same proportion as the benchmark CAPM portfolio ($x_H = x_H^*$), is positive when domestic assets are over-weighted, with a limiting value of 1 when the whole portfolio is composed exclusively of domestic assets ($x_H = 1$). It can be negative if domestic assets are under–weighted compared to the CAPM portfolio ($x_H < x_H^*$) . The histogram of HB values for the different banks in our dataset pooling across all dates (2010Q1-2013Q4) is presented in Figure 1.

Virtually all banks display at least some home bias (except for BNP Paribas, that has

Figure 1: Home Bias Index Histogram

This figure plots the distribution for the home bias index, $\text{HB} = 1 - (1 - x_H)/(1 - x_H^*)$, for all EBA banks in 2010Q1-2013Q4.



a negative HB index) and the median (mean) at 0.72 (0.61) is quite high. This is the basic observation of the home bias that has also been documented extensively in many previous studies. Size is a big driver of the overall level of home bias, but cannot alone explain it. In Figure 2 we sort banks according to the quintiles of total assets in 2010: while many of the banks in the bottom quintile of assets (<€38 billion in assets) hold almost exclusively domestic debt, even large banks (>€550 billion in assets) show significant home bias.

For the next set of results, it is useful to rewrite the HB index as:

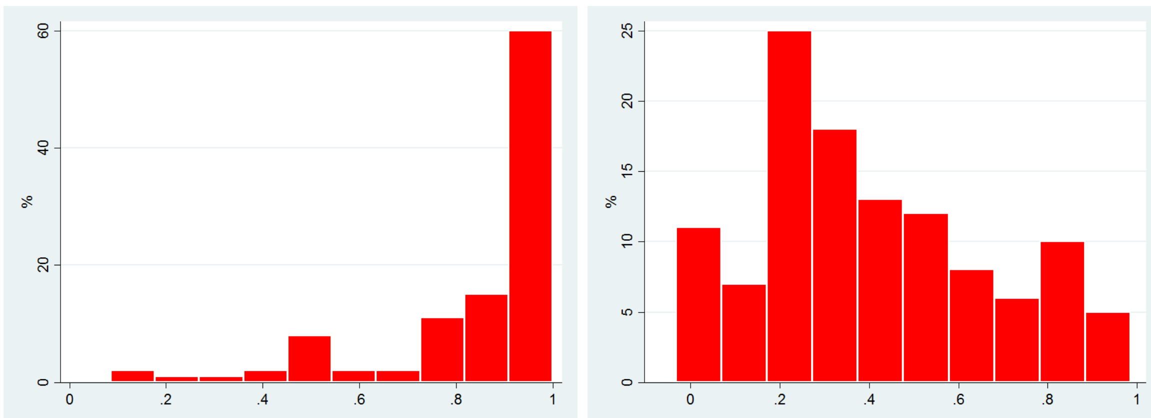
$$\text{Home Bias} = 1 - \frac{\sum_{j \neq H} x_j}{\sum_{j \neq H} x_j^*}$$

where x_j is the share of foreign country j bonds in the bank's portfolio, and x_j^* is the share of country j bonds in total world debt. That is, rather than subtracting the domestic exposure from one, we sum over all foreign holdings ($1 - x_H = \sum_{j \neq H} x_j$). This alternative expression will be useful for the counterfactual measures of home bias considered below.

Figure 2: Home Bias Index: Small vs. Large Banks

This figure plots the distribution for the home bias index, $\text{HB} = 1 - (1 - x_H)/(1 - x_H^*)$, by bank size. Panel (a) plots the distribution for banks in the bottom quintile of total assets in 2010 (<€38 billion), while Panel (b) for banks in the top quintile of total assets in 2010 (>€550 billion).

(a) Small (b) Large



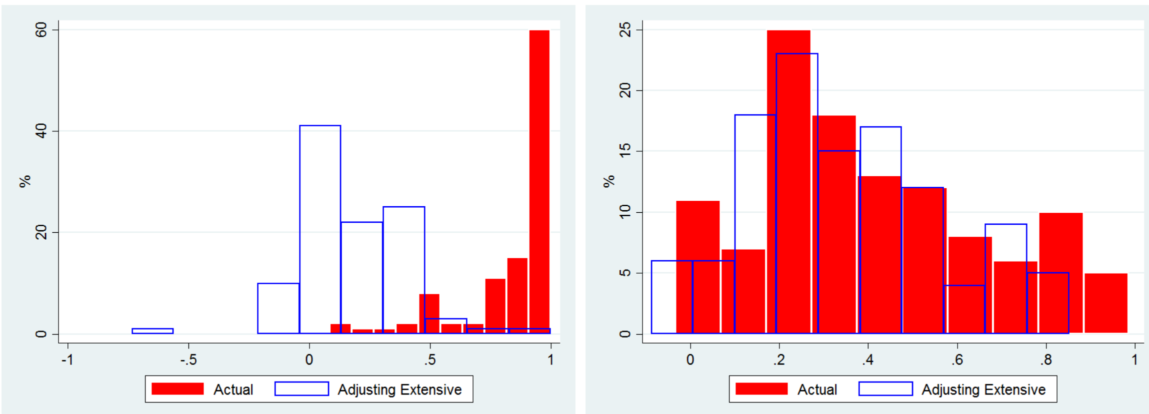
Extensive Margin of Home Bias: Another prominent feature of the data is that portfolios are sparse: the average bank only invests in 11 out of the 28 potential foreign countries. To quantify the extensive margin of the home bias, we construct a counterfactual home bias index for each bank by setting the portfolio share of foreign sovereigns held in zero quantities equal to their world market share, i.e. we set $x_j = x_j^*$ for all $x_j = 0$, $j \neq H$. Thus, the counterfactual portfolio deviates from the market portfolio in terms of foreign investments only through its zeroes, i.e. its sparseness. The results are presented in Table 1. The average home bias index is reduced from 0.61 to 0.25 by adjusting the extensive margin, a decrease of about 60%. The result for the average bank hides a considerable heterogeneity depending on the size of the bank. We show the heterogeneity by bank size in Figure 3 where we adjust the extensive margin for small and large banks separately, in panels (a) and (b).

We see that the extensive margin is indeed a major driver of the home bias for small banks – correcting it leads to a strong shift of the HB distribution towards zero, with a median (average) home bias of just 0.06 (0.09). Thus, the main driver of the home bias for small banks is the fact that those institutions do not invest at all in many foreign countries.

Figure 3: Home Bias Index: Adjusting the Extensive Margin, Small and Large Banks

This figure plots the distribution for a counterfactual home bias index replacing all zero exposures with the optimal portfolio shares ($x_j = x_j^*$ if $x_j = 0$). Panel (a) plots the distribution for banks in the bottom quintile of total assets in 2010 (<€38 billion), while Panel (b) for banks in the top quintile of total assets in 2010 (>€550 billion).

(a) Small (b) Large



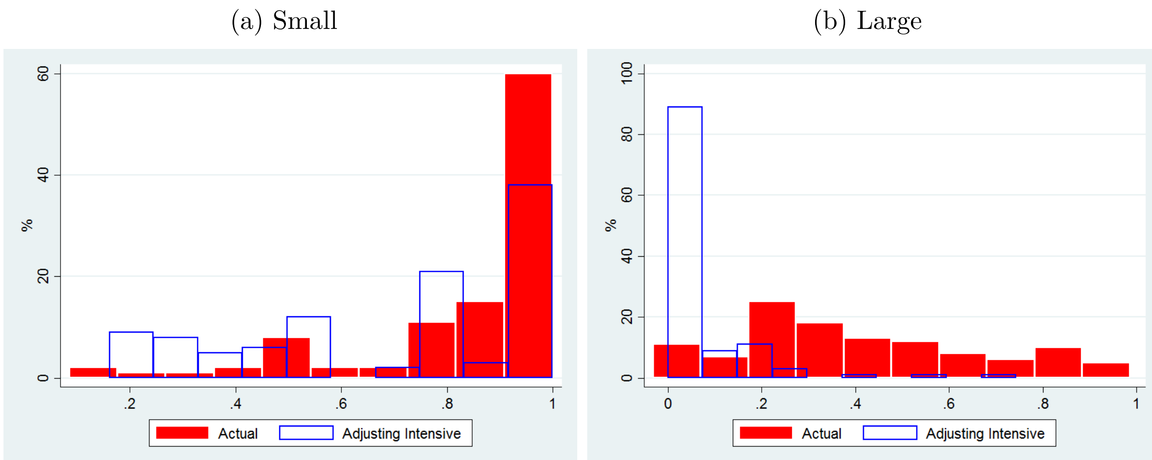
On the other hand, eliminating the extensive margin has a small effect on the home bias distribution for the largest banks. Those institutions tend to invest in the sovereign debt of all EU countries already, and only a small portion of their overall home bias can be attributed to portfolio sparseness.

Intensive Margin of Home Bias: To measure the extent to which the home bias is driven by the intensive margin of portfolio adjustment, we construct a different counterfactual home bias index, where we set the portfolio share of all non-zero foreign investments equal to their respective market share, while leaving any zeros unchanged ($x_j = x_j^*$ if $x_j > 0$). We report the results for all banks in Table 1 and we plot the results for small and large banks separately in panel (a) and (b) of Figure 4.

It is striking to see how in this case the home bias for large banks is almost entirely eliminated, while it is still significant for small banks. This is the flip side of the adjustment on the extensive margin we saw previously. Taking both results together, we can conclude that while small banks still underweight the foreign investment they hold in positive quantities,

Figure 4: Home Bias Index: Adjusting the Intensive Margin, Small and Large Banks

This figure plots the distribution for a counterfactual home bias index replacing all non-zero exposures with the optimal portfolio shares ($x_j = x_j^*$ if $x_j > 0$). Panel (a) plots the distribution for banks in the bottom quintile of total assets in 2010 (<€38 billion), while Panel (b) for banks in the top quintile of total assets in 2010 (>€550 billion).



most of their home bias is explained by the fact that they do not invest at all in many countries (the 'extensive margin' is most important). Large banks, on the other hand, tend to invest in all countries, but significantly underweight their foreign investments compared to holdings of domestic assets.

Individual Foreign Holdings Bias: The previous section has documented that in the typical bank's portfolio home assets are significantly overweighted relative to the *total* holdings of foreign assets. We have also shown that the foreign portion of portfolios is sparse, and thus there is a relevant extensive margin in the choice of foreign investments. In this section, we turn our attention to potential biases across the individual non-zero, *foreign* asset holdings of banks. In other words, we examine if the individual foreign investments a bank does make also exhibit any over- or under-weighting (relative to CAPM) patterns. These potential differences in the portfolio weights of individual foreign investments is something that the previous literature has remained largely silent on, having focused on the relative size of home asset holdings.

Since we know that foreign assets as a whole are under-weighted relative to the home asset (e.g. Table 1), in this section we compute deviations from CAPM weights of individual foreign holdings relative to the *foreign portion* of the bank's portfolio (i.e. sum total of non-zero foreign investments). For each non-zero foreign holding we define the bias index:

$$Bias_j = 1 - \frac{1 - x_j^{-H}}{1 - x_j^{*,-H}}$$

where x_j^{-H} is the holdings of country j's sovereign debt, as a share of all *positive foreign* holdings of a bank, defined as

$$x_j^{-H} = \frac{x_j}{\sum_{i \in \mathcal{F}} x_i},$$

where $\mathcal{F} = \{j | x_j > 0, j \notin \mathcal{F}\}$ is the set of foreign countries that the bank has positive holdings in. Similarly, $x_j^{*,-H}$ is country j's debt as a share of the total market capitalization of sovereign debt of the countries in the set $\mathcal{F}$ (the foreign countries that the bank actually invests in). Notice that this measure varies at the bank-country level – there is a separate value for each one of the positive foreign holdings of a bank.

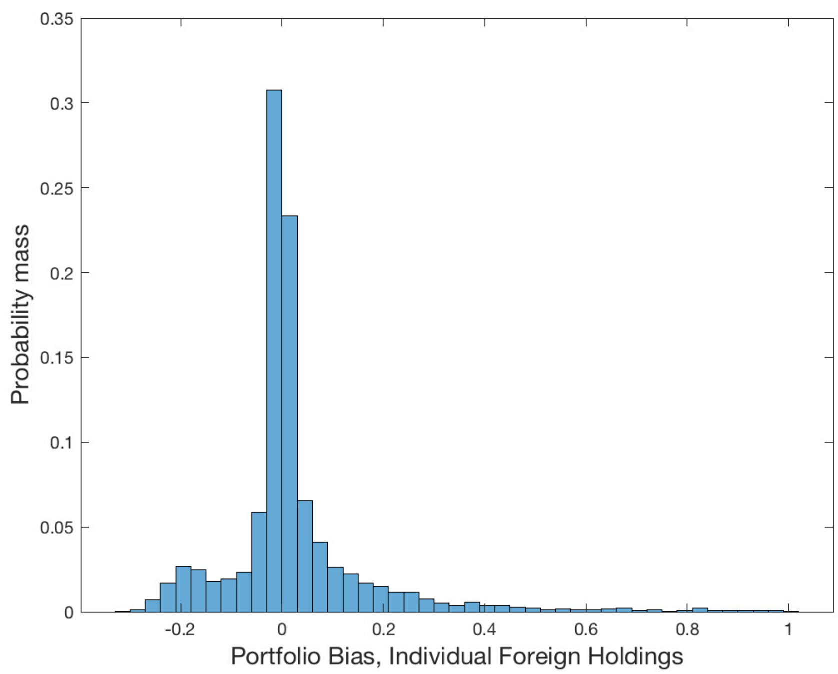
Thus, the $Bias_j$ variable measures the extent to which non-zero foreign holdings are more or less concentrated relative to each other. This cleans out the strong home bias effect we found previously, and focuses squarely on the foreign portion of portfolios. This index follows the logic of the standard home bias index: a value of 0 means that the bank's investment in country j equals the market weight of country j debt in the sub-portfolio of assets that the bank actually invests in. A positive value corresponds to over-weighting of that asset, and a negative value an under-weighting.[15] The values of the index can help us understand if the typical bank purchases foreign investments as a basket that has relative weights in line with CAPM weights (but then underweights this basket as a whole relative to home assets) or if the foreign portion of the portfolio is also concentrated in just one or two

[15] We stress that this over- and under-weighting is not in respect to the weight of that asset in the whole market portfolio, but is relative to the other non-zero foreign holdings of the particular bank.

assets.

Figure 5 presents the distribution of these individual holdings biases in our sample, pooling over all banks and time periods, and showcases the large amount of heterogeneity in the deviations from CAPM among the foreign investments of banks. While the bias in the portfolio share of the typical holding is essentially zero, with the median (mean) $Bias_j$ being -0.0001 (0.0243), there is significant dispersion among the individual biases. The standard deviation is 0.15, which is half of the standard deviation of the home bias index (0.3). Thus, the relative CAPM deviations within the foreign holdings of the typical bank could be quite heterogeneous, although the total variation is not quite as high as the variation in the degree of home bias we observe. Still, the biases within foreign holdings are economically meaningful – for example a value of 0.15 means that the non-country j investments are 85% of their implied CAPM weight.

Figure 5: Foreign Bias



Thus, the foreign portion of the typical bank's portfolio includes both assets that are over- and under-weighted relatively to each other, with a substantial amount of heterogeneity in the implied CAPM-deviations of the individual holdings. A key hypothesis that we will test in the latter part of the paper is whether or not this heterogeneity is related to heterogeneity in the beliefs of banks among different countries. As we saw in the summary statistics on the forecasts of 10-year yields, both the precision and the point forecasts tend to differ substantially across banks and countries.

2.3 Stylized Facts: Home Bias in Information

The previous section analyzed the basic structure of banks' portfolios. In this section, we turn our attention to the basic structure of the typical bank's forecast precision. The main finding is that while there is a lot of heterogeneity in the precision of banks' forecasts, there is a clear home bias in information precision – i.e. forecasts of home yields are significantly more precise than foreign forecasts.

We examine whether forecasts about future domestic sovereign yields are any more or less accurate than forecasts of foreign sovereign yields. One way to look at this is to see if, for a given sovereign, domestically domiciled forecasters are more accurate than foreign forecasters. Moreover, since we have data on both foreign and domestic forecasts for the *same* forecaster, we can also compare the accuracy of home and foreign forecasts for a given forecaster. This is a powerful test of whether individual forecasters indeed have superior information about home yields (Bae et al. (2008)). We run the following panel regression:

$$\overline{SFE}(Y10_{bct}) = \beta Home_{bc} + \alpha_b + \alpha_c + \varepsilon_{bct} \tag{1}$$

where $\overline{SFE}(Y10_{bct})$ is the average squared squared forecast error on the 3-month ahead forecast of 10-year yields over our sample, $Home_{bc}$ is a dummy variable that equals one when country c is the "home" country for forecaster b. We allow for both forecaster and destination country fixed-effects, α_b and α_c.

Table 4 shows the estimates. The sample contains 85 banks that make forecasts on a total of 14 separate countries. Moving across columns (1) to (3) we progressively introduce bank and destination country fixed effects. The forecaster fixed effects allow us to estimate, within each forecaster, the relative precision of forecasts of home yields versus forecasts of foreign yields; this eliminates concerns about the potential selection of ex-ante better forecasters into only forecasting their home country. Destination country fixed-effects absorb the aggregate ability of all forecasters to forecast specific countries; this controls for the possibility that all banks make better forecasts for some bigger or more important countries and for differences in the overall level of uncertainty in different countries' yields.

In all three specifications, we find that home forecasts are significantly more precise than foreign forecasts. The effects we find are both statistically and economically significant. The estimates in column (1) imply that home forecasters have an average squared forecast error about one-third of a standard deviation smaller than foreign forecasters'. Controlling for a forecaster fixed-effect, the coefficient doubles in magnitude, suggesting that the effect is even stronger within forecasters (column (2)). Including a fixed effect for the destination country, and thus controlling for the average uncertainty around each country, the coefficient on the $Home$ dummy remains virtually unchanged.

Thus, we conclude that in addition to a clear pattern in portfolio holdings, banks also exhibit an advantage in forecasting domestic sovereign yields, over foreign sovereign yields. This observation motivates the basic premise of the model we develop in the next section, where banks endogenously become better informed about home yields in equilibrium. We then use the model to derive additional, precise implications about the relationship between point forecasts and portfolio holdings, and then take them to the data in the following section.

3 Model

In this section, we turn our attention to a model that can explain the stylized facts we have documented. We consider a simple three period model where agents can trade risky and risk-free assets and can acquire costly information about the asset payoffs. In period 0 agents choose their information acquisition strategy, and in period 1 new information arrives according to the chosen information strategy, agents update their beliefs and form optimal portfolios. In period 3 shocks realize and the agents consume the resulting returns on their portfolios. To keep things tractable, we work with generic "risky" assets with uncertain payoffs, but those can be viewed as long-term bonds which have uncertain payoffs due to uncertainty in their future price.

There are N different countries of equal size, with a continuum of agents of mass $\frac{1}{N}$ living in each. There are N risky assets, one associated with each country, and a risk-free savings technology with an exogenous rate of return R^f. Thus, in period 1 agent i in country j faces the budget constraint

$$W_{1j}^{(i)} = \sum_{k=1}^{N} P_k x_{jk}^{(i)} + b_j^{(i)},$$

where P_k is the price of the risky asset of country k, $x_{jk}^{(i)}$ are the portfolio holdings of risky assets, $b_j^{(i)}$ the holdings of the risk-free asset and $W_{1j}^{(i)}$ is the investible wealth of the agent. It is useful to rewrite the budget constraint in terms of portfolio shares $\alpha_{jk}^{(i)} = \frac{P_k x_{jk}^{(i)}}{W_{1j}^{(i)}}$, instead of the absolute holdings $x_{jk}^{(i)}$, in which case the budget constraint can be expressed as

$$1 = \sum_{k=1}^{N} \alpha_{jk}^{(i)} + \frac{b_j^{(i)}}{W_{1j}^{(i)}} \tag{2}$$

Each asset yields a stochastic payoff D_k, and hence the return on agent i's portfolio is

$$R_j^{p,(i)} = \sum_{k=1}^{N} \alpha_{jk}^{(i)} \frac{D_k}{P_k} + \frac{b_j^{(i)}}{W_{1j}^{(i)}} R = \boldsymbol{\alpha}_j^{(i)\prime} \mathbf{R} + \frac{b_j^{(i)}}{W_{1j}^{(i)}} R^f \tag{3}$$

where bold letters denote N-by-1 vectors, $R_k = \frac{D_k}{P_k}$ is the gross return on asset k, and the k-th element of $\mathbf{R}$. Using the portfolio return, we can express agent i's period 2 (terminal) wealth as $W_{2j}^{(i)} = W_{1j}^{(i)} R_j^{p,(i)}$. To reduce clutter, from now we will suppress the i index if there is no chance of confusion.

In period 0, agents choose their information acquisition strategy, which helps them reduce the uncertainty in the stochastic asset payoffs $\mathbf{d}$. We assume that the payoffs follow a joint Normal distribution: $\mathbf{d} \sim N(\mu_d, \Sigma_d)$. For tractability purposes, we assume that the variance matrix is diagonal, and thus fundamentals of different countries are independent of one another. This assumption has no effect on the qualitative results of the model, and could be relaxed by introducing a factor structure to payoffs. Intuitively, if we were to introduce a global factor (or more generally common factors), then learning about that factor would not affect the relative portfolio weights of different assets. It is the differential learning about individual country factors that drives portfolio concentration and home bias. Thus, for the sake of clarity of the exposition, we consider a framework where we abstract from common factors, and simply focus on the agent's incentives to learn about country-specific factors.

Agents can purchase two types of costly information. First, as in Merton (1987), we assume that the knowledge of the unconditional distribution of the asset payoffs is not available to the agents for free, but rather they have to "purchase" their priors. In particular, the agents know that the return distribution is joint normal with a known diagonal variance matrix Σ_d, but do not know the values of the mean returns of the different assets. They can purchase information about the unconditional mean of each element of $\mathbf{d}$ separately, at a fixed cost c. Crucially, we assume that without acquiring this prior information on the unconditional mean of the payoffs of a given asset, the agents will not hold any of that asset. This is the Merton (1987) view of information, which postulates that agents must first acquire the basic information about an asset, before holding any of it. We view this as a modelling device for the standard due diligence procedures and basic vetting that a bank engages in before acquiring an asset. Without having done such initial due diligence for asset k, the agents will not enter that market and set $\alpha_k = 0$.[16,17]

[16] We view this as a good description of the actual investment decision process of banks. To get initial approval to invest in a given asset (i.e. debt of country k) the investment team needs to do a substantial amount of due diligence work upfront – e.g. the bank will need to first carry out an initial study for a given country at a cost c. But once such approval is granted, future portfolio adjustments do not require to go through extensive initial approval procedures.

[17] The reason that agents do not hold assets that are unfamiliar to them can also be further micro-founded

In addition to learning the unconditional distribution of payoffs, the agents can also purchase unbiased signals about the actual realization of the different payoffs d_k:

$$\eta_{jk}^{(i)} = d_{jk} + u_{jk}^{(i)},$$

where $u_{jk}^{(i)} \sim iidN(0, \sigma_{u_{jk}}^{(i)2})$. The precision of these signals is not exogenously given, but the agents choose it optimally, subject to an increasing and convex cost $C(\kappa)$ of the total amount of information, κ, encoded in their chosen signals. Information, κ, is measured in terms of entropy units (Shannon (1948)). This is the standard measure of information flow in information theory and is also widely used by the economics and finance literature on optimal information acquisition (e.g. Sims (2003), Van Nieuwerburgh and Veldkamp (2010)). It is defined as the reduction in uncertainty, measured by the entropy of the unknown asset payoffs vector $\mathbf{d}$, that occurs after observing the vector of noisy signals $\boldsymbol{\eta}_j^{(i)} = [\eta_{j1}, \ldots, \eta_{jN}]'$:

$$\kappa = H(\mathbf{d}|\mathcal{I}_j^{(i)}) - H(\mathbf{d}|\mathcal{I}_j^{(i)}, \boldsymbol{\eta}_j^{(i)}).$$

$H(X)$ denotes the entropy of random variable X and $H(X|Y)$ is the entropy of X conditional on knowing Y.[18] Moreover, $\mathcal{I}_j^{(i)}$ is the prior information set of agent i, which contains both the subset of priors on $\mathbf{d}$ which he has purchased and the public information that is observed for free by all agents (such as the equilibrium prices). Thus, κ measures the total amount of information about the vector of asset returns $\mathbf{d}$ contained in the vector of private signals, $\boldsymbol{\eta}_j^{(i)}$, over and above the agent's priors and any publicly available information. Given our assumption that asset payoffs are uncorrelated across countries, we can express κ as the sum of the informational contents of the country-specific signals $\eta_{j1}^{(i)}, \ldots, \eta_{jN}^{(i)}$: $\kappa = \kappa_1 + \cdots + \kappa_N$. The information content of each individual signal is similarly defined as the information

by introducing ambiguity that can be reduced by doing the due diligence step.

[18] Entropy is defined as $H(X) = -E(\ln(f(x)))$, where $f(x)$ is the probability density function of X.

about the underlying fundamental over and above the publicly available information:

$$\kappa_k = H(d_k|\mathcal{I}_j^{(i)}) - H(d_k|\mathcal{I}_j^{(i)}, \eta_{jk}^{(i)}).$$

Finally, we also assume that agents have an arbitrarily small information advantage over their home assets, which is modeled by assuming that they receive a free, unbiased signal with exogenously fixed precision $\frac{1}{\sigma_\eta^2}$ about the domestic asset payoff. As it will become clear later, this gives home information a slight edge that the optimal information choice endogenously amplifies, and leads to home bias in portfolios. This wedge needs to be only arbitrarily small, hence for simplicity we introduce it exogenously. However, it can be endogenized in a number of ways, such as for example by modeling the fact that the agents can also make non-tradable investments in the home country, and hence value home information slightly more than foreign information.[19].

After observing all of their chosen signals, the agents use standard Bayesian updating to update their beliefs about the asset payoffs. Thus, acquiring more informative signals $\boldsymbol{\eta}_j^{(i)}$ reduces the posterior variance of the asset payoffs. This is the Grossman and Stiglitz (1980) view of information, and can also be seen as an "intensive" margin of information acquisition, whereas the Merton (1987) view represents the "extensive" margin of information acquisition. Our model combines both of these views of information. Intuitively, the framework captures the idea that before buying an asset banks need to pay an upfront cost for an initial due diligence study that would reveal the unconditional distribution of payoffs of the given asset. Once that is done, they can then also form a dedicated analysis team that can devote additional resources to following the fundamentals of that country, and produce more or less precise forecasts of the particular future realization of the payoff d_k.

Lastly, the agents maximize expected CRRA utility $u(W) = \frac{W_j^{1-\gamma}}{1-\gamma}$ over their terminal wealth $W_{2j}^{(i)}$. We solve the model by backward induction, by starting with the optimal portfolio choice in period 1, and then solving for the optimal information choice in period 0.

[19] See for example Nieuwerburgh and Veldkamp (2006) and Valchev (2017)

3.1 Period 1: Portfolio Choice

In period 1, agents observe the unconditional payoff distributions and additional informative signals $\boldsymbol{\eta}$ that they chose in period 0, and update their beliefs accordingly. Conditional on those beliefs, agents pick the portfolio composition that maximizes their expected utility:

$$\max_{\boldsymbol{\alpha}_j^{(i)\prime}} E\left[\frac{(W_{2j}^{(i)})1-\gamma}{1-\gamma}|\mathcal{I}_j^{(i)}, \boldsymbol{\eta}_j^{(i)}\right]$$

s.t.

$$W_{2j}^{(i)} = \underbrace{(W_0 - \Psi_j^{(i)} - C(K_j^{(i)}))}_{W_{1j}^{(i)}} R_j^{p,(i)} = W_{1j}^{(i)}(\boldsymbol{\alpha}_j^{(i)\prime}\mathbf{R} + (1-\boldsymbol{\alpha}_j^{(i)\prime}\mathbf{1})R^f)$$

$$\alpha_{jk}^{(i)} = 0 \text{ for all } k \notin \mathcal{F}_j^{(i)}$$

where $\mathcal{F}_j^{(i)}$ is the set of countries for which agent i has purchased information about the unconditional distribution of returns, $\Psi_j^{(i)} = |\mathcal{F}_j^{(i)}|c$ is the total expenditure on prior information, $C(K_j^{(i)})$ is the cost of the additional noisy signals, and thus $W_{1j}^{(i)} = W_0 - \Psi_j^{(i)} - C(\kappa_j^{(i)})$ is the wealth of the agent at the beginning of period 1. This is his investible wealth – it is equal to his initial wealth, W_0, minus all information costs he incurred in period 0. Substituting the constraint out, the objective function becomes

$$\max_{\boldsymbol{\alpha}_j^{(i)\prime}} \frac{(W_{1j}^{(i)})^{1-\gamma}}{1-\gamma} E\left[\exp((1-\gamma)r_j^{(i),p})|\mathcal{I}_j^{(i)}, \boldsymbol{\eta}_j^{(i)}\right] \tag{4}$$

where lower case letters denote logs. Next, we follow Campbell and Viceira (2001) and use a second-order Taylor expansion to express the log portfolio return as

$$r_j^{(i),p} \approx r^f + \boldsymbol{\alpha}_j^{(i)\prime}\left(\mathbf{r} - r^f + \frac{1}{2}diag(\hat{\Sigma}_j)\right) - \frac{1}{2}\boldsymbol{\alpha}_j^{(i)\prime}\hat{\Sigma}_j\boldsymbol{\alpha}_j^{(i)} \tag{5}$$

where we have used $\hat{\Sigma}_j = \text{Var}(\mathbf{r}|\mathcal{I}_j^{(i)}, \boldsymbol{\eta}_j^{(i)})$ to denote the posterior variance of the risky asset payoffs. We have dropped the subscript i to reduce clutter, but stress that posterior variances could potentially differ among agents within the same country. For future reference, note that since $\mathbf{r} = \mathbf{d} - \mathbf{p}$ and $\mathbf{p}$ is in the information set of the agent, it follows that $\hat{\Sigma}_j = \mathrm{Var}(\mathbf{d}|\mathcal{I}_j^{(i)}, \boldsymbol{\eta}_j^{(i)})$.

We can then plug (5) into the objective function (4), and take expectations over the resulting log-normal variables and obtain a closed-form objective function. Taking first order conditions, and solving for the portfolio shares $\boldsymbol{\alpha}_j$ yields:

$$\boldsymbol{\alpha}_j = \frac{1}{\gamma}\hat{\Sigma}_j^{-1}(E(\mathbf{r}_{t+1}|\mathcal{I}_j^{(i)}, \boldsymbol{\eta}_j^{(i)}) - r^f + \frac{1}{2}diag(\hat{\Sigma}_j))$$

Given the assumption that all factors are independent, this simplifies further so that the holdings of agent i in country j of asset k are:

$$\alpha_{jk}^{(i)} = \frac{E(r_k|\mathcal{I}_j^{(i)}, \eta_{jk}^{(i)}) - r^f + \frac{1}{2}\hat{\sigma}_{kr}^2}{\gamma\hat{\sigma}_{jk}^2} \tag{6}$$

where $\hat{\sigma}_{jk}^2$ is the k-th diagonal element of $\hat{\Sigma}_j$. Thus, agents invest more heavily in assets they expect to do better (high $E(r_k|\mathcal{I}_j^{(i)}, \eta_{jk}^{(i)})$), and invest less in more uncertain assets that have higher posterior variance of log-returns.

3.2 Asset Market Equilibrium

In addition to the informed traders, there are also noise traders that trade the N assets for reasons orthogonal to the fundamentals $\mathbf{d}$. From a technical perspective, they are needed in order to ensure that there are more shocks than asset prices, otherwise the prices will fully span the uncertainty facing the agents and thus unravel private information (Grossman-Stiglitz paradox). In reality, a substantial amount of bonds is held for liquidity and hedging purposes, and to the extent to which those reasons for holdings bonds are unrelated to the financial payoffs of the bonds, they are modeled by z_k. Market clearing requires that the sum of the asset demands of all informed traders equals the net supply arising from noise trading,

$$\sum_{j=1}^{n} \int \frac{W_{1j}^{(i)}}{N} \alpha_{jk}^{(i)} di = z_k \tag{7}$$

where we denote the net effect of noise trading for asset k as $z_k \sim iidN(\mu_{zk}, \sigma_{zk}^2)$. One can think of z_k as the "effective" supply of asset k, it is the amount of bonds that needs to be absorbed by the informed traders.

We guess and verify that the equilibrium price is linear in the states and of the form

$$p_k = \bar{\lambda}_k + \lambda_{dk} d_k + \lambda_{zk} z_k.$$

Thus, the price itself contains useful information about the unknown d_k, and the agents can extract the following informative signal from it,

$$\tilde{p}_k = d_k + \frac{\lambda_{zk}}{\lambda_{dk}}(z_k - \mu_z).$$

The agents combine this signal together with their private signals η and the priors, and use Bayes' rule to form posterior beliefs, leading to the following expressions for the conditional expectation and variance:

$$E(d_k | \mathcal{I}_j^{(i)}, \boldsymbol{\eta}_j^{(i)}) = \left(\frac{1}{\sigma_{dk}^2} + (\frac{\lambda_{dk}}{\lambda_{zk}} \sigma_{zk})^2 + \frac{1}{\sigma_{\eta jk}^2} \right)^{-1} \left(\frac{\mu_{dk}}{\sigma_{dk}^2} + (\frac{\lambda_{dk}}{\lambda_{zk} \sigma_{zk}})^2 \tilde{p}_k + \frac{1}{\sigma_{\eta jk}^2} \eta_{jk}^{(i)} \right)$$

$$\hat{\sigma}_{jk}^2 = \left(\frac{1}{\sigma_{dk}^2} + (\frac{\lambda_{dk}}{\lambda_{zk}} \sigma_{zk})^2 + \frac{1}{\sigma_{\eta jk}^2} \right)^{-1}$$

We can then substitute back everything into the market clearing conditions and solve for the equilibrium asset price's coefficients. The details are given in the Appendix, and here we just highlight the resulting coefficients λ_{dk} and λ_{zk} which determine the informativeness of the prices. The resulting coefficients are:

$$\lambda_{zk} = -\gamma\bar{\sigma}_k^2 \left(1 + \frac{\bar{\phi}_k \bar{q}_k}{\gamma^2 \sigma_z^2}\right)$$

$$\lambda_{dk} = \bar{\sigma}_k^2 \bar{q}_k \left(1 + \frac{\bar{\phi}_k \bar{q}_k}{\gamma^2 \sigma_z^2}\right)$$

where

$$\bar{q}_k = \sum_j \frac{W_{1j}^{(i)}}{N} \frac{\hat{\sigma}_{jk}^2}{\hat{\sigma}_{jk}^2 + \sigma_e^2} \frac{1}{\sigma_{\eta_{jk}}^2}$$

is a wealth weighted-average of the signal precisions of all market participants,

$$\bar{\sigma}_k^2 = \left(\frac{1}{N} \sum_j \frac{W_{1j}^{(i)}}{\hat{\sigma}_{jk}^2}\right)^{-1}$$

is the wealth weighted-average posterior variance of returns.

3.3 Period 0: Information Choice

Information choice is made ex-ante, before asset markets open and agents see the actual realizations of their private signals η. However, they fully take into account how their information choices affect their future conditional beliefs, optimal portfolio holdings and resulting wealth. Given that all country factors are independent, the time 0 objective function of the agent becomes a sum of the expected benefits of acquiring information for each country separately. Details are given in the Appendix, but by doing appropriate evaluations of expectations, we can show that the time 0 expectation of the log-objective function of an agent in country j is given by:

$$U_{0j} = (1-\gamma)\ln(\frac{W_{1j}}{\gamma - 1}) + \sum_{k \in \mathcal{F}_j} \frac{1}{2} \ln\left(1 + (\gamma - 1)\frac{\sigma_k^2}{\hat{\sigma}_{jk}^2}\right) + \frac{\gamma - 1}{2} \sum_{k \in \mathcal{F}_j} \frac{m_k^2}{\hat{\sigma}_{jk}^2 + (\gamma - 1)\sigma_k^2} \qquad (8)$$

where $m_k = E(d_k - p_k)$ is the ex-ante unconditional expected excess return on asset k based only on prior information on the unconditional distribution of asset payoffs. The set $\mathcal{F}_j$ is the set of countries for which the agent has decided to purchase priors and hence holds positive investments in. Again, we have suppressed the i index, but variances and countries chosen to invest in could differ among agents within the same country.

We solve the information choice problem in three steps. First, we solve for the optimal allocation of intensive information, given a choice of total intensive information acquired K and the set of countries that the agent has chosen to learn about $\mathcal{F}_j$, by solving:

$$\max_{\hat{\sigma}_{jk}^2} \sum_{k \in \mathcal{F}_j} \frac{1}{2} \ln \left(1 + (\gamma - 1) \frac{\sigma_k^2}{\hat{\sigma}_{jk}^2} \right) + \frac{\gamma - 1}{2} \sum_{k \in \mathcal{F}_j} \frac{m_k^2}{\hat{\sigma}_{jk}^2 + (\gamma - 1)\sigma_k^2} \tag{9}$$

s.t.

$$\sum_{k \in \mathcal{F}_j} \kappa_k \leq K$$

The details are given in the Appendix, but the main result is that as long as ex-ante Sharpe Ratios are less than one (as is true in the data), the problem is strictly convex in the information allocated to any given country (κ_k) and hence agents find it optimal to allocate all intensive information to the payoffs of a single asset. Given our assumption that agents receive a free signal on the payoff of the domestic assets, then unless there is a lot of asymmetry among countries, so that certain countries are ex-ante seen as much superior investments, the optimal choice will be to acquire information only about the home asset – so that for agents in country j, $\kappa_j = K$ and $\kappa_{j'} = 0$ for all $j' \neq j$. Formally, we can prove that agents are always weakly better informed about home assets than foreign agents, and in the case of a symmetric world they are strictly better informed, because in that case it is clear that all agents only learn about their respective domestic assets.

Proposition 1. ***Home Bias in Information:*** *If ex-ante Sharpe Ratios are less than one,* $\frac{E(d_k - p_k)}{\sqrt{\mathrm{Var}(d_k - p_k)}} < 1$ *for all k, learning amplifies the home bias in information, so that*

$$\kappa_{jj} \geq \kappa_{j'j}$$

for all $j \neq j'$ for all agents in each country. In a symmetric world where all countries are *ex-ante identical, the inequality is strict.*

Proof. Intuition sketched in the text, details in the Appendix. □

The basic idea behind the Proposition is that since the learning problem is convex, the additional free signal agents receive on home assets means that if anyone chooses to learn about the home asset, it must be the case that the home agents are also learning about it – they have a comparative advantage in learning about that asset. If they are indeed learning about the home asset, then they are also strictly better informed than any of the foreign agents (since they also have the free signal). If they are not learning about the home assets, then no one else is either, and thus everyone is equally uninformed. In a symmetric world, agents always find it optimal to learn about their home asset, so the inequality is strict.

Next, taking the optimal allocation of intensive information as given, we solve for the optimal choice of the total intensive information acquired K. Since all additional information is allocated to a single asset, call it k, we just need to figure out what is the optimal precision of information about that asset. The first-order condition for this choice simplifies down to:

$$\frac{C'(K_j^*)}{W - C(K_j^*) - \Psi_j} = \frac{(\gamma-1)\left[4\hat{\sigma}_k^2(m_k^2 + \sigma_k^2 - (\gamma-1)m_k\sigma_k^2) + 4(\gamma-1)\sigma_k^4 - \hat{\sigma}_k^6 - 2(\gamma-1)\sigma_k^2\hat{\sigma}_k^4\right]}{8(\hat{\sigma}_k^2 + (\gamma-1)\sigma_k^2)^2}. \tag{10}$$

Given a convex information cost function $C(K)$, this defines a unique solution for total intensive information K_j^* acquired by agents in country j.

Last, we determine the optimal number of countries about which agents choose to purchase information on the unconditional distribution of asset payoffs, i.e. the extensive margin information choice. The cost of adding an asset to the learning (and hence investment) portfolio is a fixed amount c that agents need to pay for the due diligence study. The gain is derived from expecting to earn positive excess returns on the asset (on average). The detailed characterization of this choice is presented in the Appendix, but the key intuition for why it is uniquely determined is the fact that the marginal cost of adding an additional asset to the learning portfolio is increasing.

This happens for two reasons. First, marginal utility of investible wealth W_{1j} is declining (see the term $\ln(\frac{W_{1j}}{\gamma-1})$ in eq. (8)), but the more resources an agent spends on due diligence studies (Ψ_j) the fewer are left for portfolio investment (lower W_{1j}). As a result, even though all due diligence studies cost the same fixed amount c in terms of wealth, each additional study has an increasing utility cost because of the concavity of the log function. Second, lower investible wealth also translates to a lower optimal choice of K_j^*, through its effect on the LHS of equation (10), and therefore lower utility from the asset holdings about which the agent acquires additional information. Thus, increasing the breadth of the portfolio carries increasing costs. As a result, unless the fixed cost of acquiring priors is very small relative to the agent's initial wealth, it is unlikely that the agent will learn about all available assets. This generates sparse portfolios, with the level of sparseness varying with the wealth level of the agent, as formalized in the next section.

3.4 Model Implications

The model is able to match the stylized portfolio facts that we documented earlier. For all propositions in this section, we focus on symmetric equilibria where we assume all countries are ex-ante the same and all agents within the same country follow the same optimal policy. Moreover, the ex-ante Sharpe Ratios are less than one $\frac{E(d_k-p_k)}{\sqrt{\mathrm{Var}(d_k-p_k)}} = \frac{E(d-p)}{\sqrt{\mathrm{Var}(d-p)}} < 1$, so that the information problem of the agents is guaranteed to be strictly convex.

Proposition 2. *The equilibrium portfolio holdings of an agent in country j, $\boldsymbol{\alpha}_j = [\alpha_{j1}, \ldots, \alpha_{jN}]$, display the following key features:*

1. ***Sparseness:*** *There exists a threshold wealth level $\bar{W}$, such that if the initial wealth of agents is less than that, $W_0 < \bar{W}$, the agents do not invest in all available foreign assets, i.e. $\alpha_{jk} = 0$ for some k for all j.*

2. ***Sparseness decreases with wealth:*** *The number of countries k for which $\alpha_{jk} = 0$ is decreasing with $W_{1j}^{(i)}$, i.e. the size of the agent's investment portfolio*

3. ***Average Foreign bias is zero:*** *The portfolio shares of foreign assets that the agent invests a positive amount in, are on average the same. Formally, if* $k, k' \in \mathcal{F}_j$*, then*

$$E(\alpha_{jk}) = E(\alpha_{jk'})$$

and hence the expected Bias index of individual, non-zero foreign holdings is zero up to a first order approximation :

$$E(Bias_j) \approx 1 - \frac{1 - \frac{1}{\tilde{N}}}{1 - \frac{1}{\tilde{N}}} = 0$$

where $\tilde{N} = |\mathcal{F}_j| - 1$ *is the cardinality of the set of foreign countries that the agent learns about and thus has a positive exposure to.*

Proof. Intuition sketched in the text, details in the Appendix. □

The first result, sparseness, is a consequence of the two-tiered information structure of the model and the fact that acquiring extensive information faces increasing costs, but fixed benefits (the ex-ante expected utility of adding an additional asset to the portfolio in the symmetric world is the same for all foreign assets). An agent will add new assets to their portfolio up to the point at which the cost of doing a new initial country study exceeds the gain of doing so. The gain is pretty straightforward – the agent likes to add new assets to his portfolio because they offer (1) positive excess returns and (2) diversification benefits.

As discussed earlier, even though the financial cost of an extra due diligence study is a constant amount c, the cost in utility terms is increasing because (i) marginal utility is declining in investible wealth and (ii) each decrease in investible wealth decreases the amount of intensive information K^* acquired. In the symmetric equilibrium of Proposition 1, the gain of learning about an additional country is constant, hence there is an optimal number of foreign countries that the agent will learn about. This could be zero (i.e. only invest in the home country) if the agent's wealth is sufficiently low. The utility cost of an additional due diligence studies, however, is decreasing in the initial wealth of the agent, hence richer agents would learn about at least some of the foreign countries, and possibly all foreign countries given enough wealth. This last observation is also behind the second result that the sparseness of the portfolio is decreasing in the agent's wealth.

Lastly, to understand the result on the average foreign bias, consider how the positive foreign holdings of the agent relate to one another. Recall that agents find it optimal to specialize in acquiring additional intensive information only about the home asset. Thus, for all foreign assets they rely only on publicly available information and their priors. In a symmetric world where all countries are ex-ante identical, the relative informativeness of the equilibrium prices of the different assets will be the same as well. Therefore, the posterior variance of foreign assets payoffs, which only relies on priors and the information contained in prices, is the same. Thus, the average portfolio weight of a foreign asset k is:

$$E(\alpha_{jk}) = \frac{m - r^f + \frac{1}{2}\tilde{\sigma}^2}{\gamma \tilde{\sigma}^2}$$

where $m = m_k$ for all k is the expected excess return on the risky assets, and $\tilde{\sigma} = Var(d - p|p)$ is the perceived variance conditional on publicly available information. As a result, the average foreign bias of any non-zero foreign holding is the same, and is in fact zero.

Lastly, note that combining the results of Propositions 1 and 2 implies that the equilibrium portfolios are biased towards home assets due to both an extensive and an intensive margin, just as in the data. First, the agents do not invest in all available foreign countries (result 1 in the above Proposition), and second, they specialize intensive information acquisition in home assets (see Proposition 1). Thus, the model can fit all of the salient portfolio facts we documented earlier.

Perhaps the key economic insight is that the model features both increasing returns to intensive margin information, and decreasing returns to extensive margin information. The increasing returns in intensive information come about due to a strong feedback between portfolio holdings and additional precision of beliefs – the more precise one's beliefs, the higher the average exposure to that asset, and thus the higher the incentives to procure more information about it. On the other hand, knowing that all intensive information is going to be allocated to just one asset, there is no such strong feedback effect between the extensive margin of information acquisition and portfolio holdings. As a result, the model can feature both a strong home bias among assets held in positive proportions (because any private information provision is dedicated to the home asset), and sparse foreign portfolios, because at lower levels of wealth it is not optimal to purchase priors (and thus invest in) about all foreign countries. Both of these forces contribute to the overall home bias of the portfolios, as is also true in the data.

4 Empirical Tests

As we have seen, the model with two-tiered information cost structure can rationalize the stylized portfolio facts documented in Section 2.2, but is this mechanism empirically relevant? To examine this question, we directly test the model's key implications in the data. We derive two sets of implications that are crucial to the inner-workings of the mechanism, and examine each of them in the following sections. First we test whether portfolio sparseness is associated with sparseness in information (the extensive margin). Second, we test whether optimism and accuracy of forecasts matter for actual portfolio holdings (the intensive margin).

4.1 Extensive Margin of Information and Portfolios

In our model, the sparseness of portfolios follows directly from the sparseness of information. In our two-tiered information structure, we follow Merton (1987) and assume that agents only hold assets for which they have done due diligence and performed an initial country study. Due to the fixed costs incurred, agents may optimally choose to not acquire any information about certain countries and, as a result, decide not to invest anything in them, leading to sparse portfolios. In this section, we examine whether sparseness of information is indeed associated with sparseness of portfolios in our dataset.

To begin with, we examine whether a bank's portfolio holdings of sovereign debt of a given country correlate with whether or not the bank produces a forecast for that country's bond yields.[20] Since every bank invests in its domestic country, we restrict the sample to foreign holdings only and estimate the following regression:

$$Share_{bct} = \beta ForeignFcst_{bct} + \mu_{bt} + \gamma_{ct} + \varepsilon_{bct} \tag{11}$$

where $Share_{bct}$ is the share of foreign country c in bank b's portfolio at time t and $ForeignFcst_{bct}$ is a dummy variable that equals 1 if bank b makes a 10–year yield forecast about country c at time t, and 0 otherwise. Finally, μ_{bt} and γ_{ct} represent bank-time and country-of-destination-time fixed effects, respectively.

The results are presented in Table 5, Panel A: when a bank makes a forecast for a foreign country, its foreign sovereign exposure to that country is 10-11% higher, which is about two standard deviations higher (see Table 3, Panel B). We progressively saturate the model with fixed effects in order to make sure that unobserved heterogeneity does not affect the main result. We start with no fixed effects in column (1), we then add time (column (2)), bank (column (3)), destination country (column (4)) and finally bank–time (column (5)) and country–time (column (6)) fixed effects. Basically, in the last specification we are only using variation across foreign holdings for the same bank at the same time, absorbing all other country–level shocks. In all cases the coefficient on $ForeignFcst_{bct}$ is remarkably stable. The results thus indicate that information acquisition is strongly correlated with bank foreign exposures, consistent with our model's implications.

Next, in Table 5, Panel B we specifically examine if sparseness of portfolios is associated with sparseness in information sets. To this purpose, we replace the continuous dependent

[20] Again, we focus on forecasts of future bond yields as those can be mapped directly to the expected excess return on bonds.

variable, $Share_{b,c,t}$, with a dummy, $\mathbf{1}(Share_{b,c,t})$, that is equal to 1 if bank b holds any positive amount of country c's sovereign debt, and zero otherwise The results indicate that if a bank makes a foreign forecast for a country it is around 20–40% more likely to hold sovereign bonds from that country. The results are both highly statistically and economically significant, supporting the idea that collecting information on a particular country is predictive of investing in it.

4.2 Intensive Margin of Information and Portfolios

Next, we look at the specific relationship between the precision of beliefs and portfolio shares in the data. In the model, the optimal portfolio share for an asset k for which an agent pays the fixed information cost c is:

$$\alpha_k = \frac{E(r_k|\mathcal{I}_j^{(i)}, \eta_{jk}^{(i)}) - r^f}{\gamma \hat{\sigma}_k^2} + \frac{1}{2\gamma} \tag{12}$$

This puts specific *non-linear* restrictions on the relationship between portfolio shares, expected returns and the precision of those expectations as summarized in Proposition 2 below.

Proposition 3. ***(Comparative Statics)*** *The optimal portfolio share of asset k in the portfolio of agent i in country j is*

1. ***Increasing in the conditional expected return*** $E(r_k|\mathcal{I}_j^{(i)}, \eta_{jk}^{(i)})$***:***

$$\frac{\partial \alpha_{jk}}{\partial E(r_k|\mathcal{I}_j^{(i)}, \eta_{jk}^{(i)})} = \frac{1}{\gamma \hat{\sigma}_{jk}^2} > 0$$

2. ***Increasing in the precision of beliefs:***

$$\frac{\partial \alpha_{jk}}{\partial \hat{\sigma}_k^2} = -\frac{E(r_k|\mathcal{I}_j^{(i)}, \eta_{jk}^{(i)}) - r^f}{\gamma \hat{\sigma}_k^4} < 0 \iff E(r_k|\mathcal{I}_j^{(i)}, \eta_{jk}^{(i)}) - r^f > 0$$

3. ***More elastic to expected returns the higher the precision of beliefs:***

$$\frac{\partial^2 \alpha_{jk}}{\partial E(r_k|\mathcal{I}_j^{(i)}, \eta_{jk}^{(i)})\partial \hat{\sigma}_{jk}^2} = -\frac{1}{\gamma \hat{\sigma}_{jk}^4} < 0$$

Proof. Follows directly from derivating equation (6). □

Thus, as demonstrated in Proposition 3, agents will hold more of a given asset the more optimistic they are about its returns ($\frac{\partial \alpha}{\partial E(r)} > 0$), and the more certain they are in their expectation – i.e. the lower the variance of their beliefs is ($\frac{\partial \alpha}{\partial \sigma^2} < 0$); moreover, the portfolio sensitivity to beliefs ($\frac{\partial \alpha}{\partial E(r)}$) increases with the precision of beliefs – i.e. when a bank becomes optimistic about a country, it reallocates more of its portfolio towards that country the more precise its beliefs about that country are ($\frac{\partial^2 \alpha}{\partial E(r)\partial \sigma^2} < 0$).[21]

We seek to test these implications of the model by estimating the following regression:

$$Share\_lt_{bct} = \beta_1 \overline{SFE}(Y10_{bct}) + \beta_2 Y10_{bct} + \beta_3 \overline{SFE}(Y10_{bct}) \times Y10_{bct} + \mu_b + +\gamma_{ct} + \varepsilon_{bct} \tag{13}$$

where $Share\_lt_{bct}$ is the share of country c in bank b's portfolio of long-term debt (i.e. with residual maturity of five years or more)[22] in quarter t; $Y10_{bct}$ is the 3-month ahead forecast[23] made by bank b regarding the 10–year yield on country c's sovereign debt averaged over quarter t, and $\overline{SFE}(Y10_{bct})$ is bank b's average squared forecast error regarding $Y10$. Finally, μ_b and γ_{ct} are bank and destination country-time fixed effects, respectively.[24]

[21] Although the above equations and comparative statics are only partial equilibrium expressions, they are still useful to gain intuition as the results carry over to general equilibrium as well. For more details see the Appendix.

[22] We focus on the share of long-term debt because the 3-month ahead forecast on 10–year yields is relevant for long-term holdings only. However, Table 10 in the Appendix shows that the results are robust if we use the share of total debt, including short-term debt (i.e. 3 month, 1 year, 2 years and 3 years maturity).

[23] We also use the 1-year ahead forecast for robustness in Table 11. Results remain very similar.

[24] We cannot include bank–time fixed effects in equation (13) as we did for the extensive margin regressions in equation (11) due to the limited sample size (150 versus more than 5000 observations). This is due the fact that we are able to match only about 15 banks and 10 foreign destination countries to the EBA sample of sovereign debt holdings. Moreover, we cannot cluster standard errors at either bank or country level with such a low number of clusters, as the estimated variance-covariance matrix would not be consistent (although the estimated coefficients are still significant even when we cluster). We use White-robust SEs instead.

As per Proposition 3, the model puts sign restrictions on the β coefficients in the above regression. First, it implies that $\beta_1 < 0$ because portfolio shares are decreasing in the uncertainty of banks' forecasts – hence the higher is the average squared forecast error of a bank forecast about a particular country, the lower the bank's investment in that country. Second, $\beta_2 < 0$ since investments in a given country's sovereign debt are increasing in the expected return on that sovereign bond (higher expected yields are associated with lower future prices, and hence lower expected returns). And third, $\beta_3 > 0$ since the sensitivity of portfolio shares to expected returns is increasing in the precision of the return forecast. In the above regression, the sensitivity of the portfolio share to changes in the forecast of future yields is given by:

$$\frac{\partial Share\_lt_{bct}}{\partial Y10_{bct}} = \beta_2 + \beta_3 \overline{SFE}(Y10_{bct})$$

Since we expect $\beta_2 < 0$ and the model predicts that more precise information (lower $\overline{SFE}$) would further add to this negative effect, we therefore expect β_3 to be positive. To sum up, the model predicts that $\beta_1 < 0$, $\beta_2 < 0$, and $\beta_3 > 0$.

The results are presented in Tables 6 and 7. The two tables differ as to their treatment of holdings of domestic sovereign debt. Table 6 tests the model implications using only the foreign holdings on the LHS. Thus, this specification does not ask the regression to explain the large amount of home bias present in portfolios, but rather focuses on the foreign portion of portfolios, which we have already seen are not nearly as concentrated. Moreover, there are numerous other theories, in addition to home bias in information, that could explain the home bias in portfolios. However, most existing theories are silent on potential heterogeneity among foreign holdings, while the information model has a rich set of implication about those as well. On the other hand, Table 7 uses the full sovereign portfolio, now including the share of home assets, but separately controls for the potential specialness of domestic exposures through a $Home$ dummy. For comparison purposes, the sample of banks is restricted to be the same in both tables, so that these are banks that have at least one foreign exposure in addition to the domestic one.

In Table 6 we find that, consistent with the predictions of our model, more precise information impacts portfolio holdings both directly and indirectly: more accuracy not only leads to higher holdings (direct effect β_1), but it also amplifies the effect of expectations on holdings (β_2), making portfolio shares more sensitive to changes in forecasts (amplification effect β_3). The results are similarly significant across all five columns, which increasingly saturate the regression with fixed effects to control for unobserved heterogeneity. In the last column, we are essentially using only variation within a bank's portfolio, taking out aggregate destination country shocks at each time period.

The estimated coefficients are also economically significant. The effect of uncertainty on portfolio holdings is large: the estimates in column (5) of Table 6 indicate that a one standard deviation decrease in $\overline{SFE}$ (0.32) at the average 10-year yield forecast (3.75%) is associated with an increased portfolio share of 3 percentage points, which is about 25% of the average foreign portfolio holdings.[25] The economic significance of the amplification effect of information precision (β_3) is also sizeable To illustrate this, we return to the previous example: had the point forecast of the 10–year yield been one standard deviation below the mean (i.e., at 2%), the implied portfolio share would have increased by an additional 5.6 percentage points, almost doubling the 3 percentage points increase found earlier.

A potential worry is reverse causality – perhaps banks first make investments in a given country, and then acquire information and produce forecast for Consensus. If some other force was the primary driver of portfolio holdings, however, we would not expect to see the large and significant estimates of β_2 and β_3. But our estimates imply that the portfolio holdings are highly sensitive to the particular point forecast of future bond yields, thus holdings appear to be directly affected by changing beliefs, and are thus unlikely to be primarily driven by some other force, that then causes information acquisition. What is more, the large and positive β_3 estimate implies that it is unlikely that the point forecasts communicated to Consensus are biased or untruthful – if that was the case, we would not expect to see the sensitivity of

[25]The relevant summary statistics for the sample on the intensive margin are found in Table 3, Panel C, third to last row.

the bank's own portfolio shares vary with the objective precision of the reported forecast. Lastly, the β_3 estimate can also help us rule out behavioral explanations such as familiarity – a sensitivity to expectations that is increasing in the precision of the expectations conforms with Bayesian updating, but would not be observed if expectations were sub-optimal.

Finally, Table 7 shows that the results still hold when we use the full sovereign debt portfolio of banks, including their over-weighted domestic holdings. The coefficient on the $Home$ dummy is always large (20-30 percentage points), statistically significant and explains a large fraction of the overall variation in the total portfolios (the adjusted R^2 in column 1 of Table 7 is 40 percentage points higher than in column 1 of Table 6)[26]. Taken together, these results also suggest that, while relevant, information frictions alone cannot explain the full extent of the home bias we observe in the data. Thus, we can conclude that information heterogeneity matter particularly for understanding the composition of foreign holdings, but are only part of the story of the apparent heavy preference for home assets.

5 Conclusion

In this paper we study whether information frictions can explain the heterogeneity in banks' sovereign debt holdings. We go beyond the standard home versus foreign divide, and analyze the entire portfolio allocation. In order to empirically connect information frictions with portfolio holdings, we use banks' sovereign exposure data from EBA, matched with banks' forecasts from Consensus Economics. The empirical findings suggest that information frictions are at the core of both extensive (which countries to invest in) and intensive (how much to allocate in each chosen country) margins of the portfolio allocation problem.

Regarding the extensive margin, we show that the typical bank sovereign portfolio is sparse: it has a large exposure to its domestic sovereign, a few other foreign countries and no exposure to most other countries. Moreover, having acquired information on a certain

[26]The results are not driven by the European debt crisis in 2010-2012, since excluding exposure to peripheral countries (GIIPS) does not affect the estimated coefficient (Table 12 in the Appendix).

country strongly predicts the likelihood of investing in such country. We also confirm previous results that banks have more precise information about their own domestic country.

Turning to the intensive margin, we show that optimism and accuracy of information about a country strongly predict higher portfolio holdings of that country's sovereign debt. Moreover, we also document that precise information amplifies the sensitivity of portfolio holdings to changes in expectations: for a given improvement in bank's forecasts about a country, receiving more accurate information predicts a larger portfolio allocation towards that country's sovereign debt.

Finally, we show that a model with information frictions and a two–tiered information structure with a fixed–cost of acquiring information can rationalize all of these findings: stylized facts about portfolio sparseness, the connection between information acquisition and sparseness (extensive margin), and the role of optimism and information precision in determining the intensity of portfolio holdings (intensive margin).

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Table 1: Home Bias Index: Intensive and Extensive Margin

This table contains summary statistics of the home bias index and the two counterfactual home bias indexes.

	Average	25^{th} pct.	50^{th} pct.	75^{th} pct.
HB	0.61	0.39	0.72	0.84
Adjusting Extensive margin	0.25	0.06	0.23	0.43
Adjusting Intensive margin	0.37	0.08	0.29	0.62

Table 2: Variable Definition

This table contains the definition of variables used in all the empirical analyses.

Variable	Definition	TimePeriod	Data source
$\text{Y10}_{b,c,t}$	3–months ahead forecast for 10 –year sovereign bond yield of country c from forecaster b at time t	2006M9–2014M12	Consensus
$\text{SFE}(X_{b,c,t})$	Squared Forecast Error = $(\mathbb{E}_{t-h}(X_t) - X_t)^2$	2006M9–2014M12	Consensus
$\overline{SFE}(X_{b,c})$	Average SFE $=\sum_t SFE(X_{b,c,t})$	2006M9–2014M12	Consensus
$\text{Home}_{b,t}$	Dummy = 1 for domestic forecast		Consensus
$\text{ForeignFcst}_{b,c,t}$	Dummy = 1 if forecaster b makes a 10–year yield forecast for country c at time t		EBA–Consensus match
$\text{ShareSovEEA}_{b,c,t}$	Share of sovereign bonds of country c (EEA only) in bank b sovereign portfolio	2010Q1–2013Q4	EBA
$\text{ShareCredEEA}_{b,c,t}$	Share of credit to country c (EEA only) in bank b lending portfolio	2010Q1–2013Q4	EBA

Table 3: Summary Statistics

This table provides summary statistics for all variables used in the empirical analyses.

Variable	Mean	Std. Dev.	25th pct.	50th pct.	75th pct.	90th pct.	99th pct.	N
Panel A. Consensus Economics								
$Y10_{b,c,t}$	3.37	1.48	2.2	3.5	4.35	5.06	7.6	8828
$SFE(Y10_{b,c,t})$	0.35	0.58	.02	0.12	0.39	0.95	3.35	8815
$\overline{SFE}(Y10_{b,c})$	0.44	0.54	0.17	0.29	0.47	0.84	2.84	212
Home	0.52	0.49	0	1	1	1	1	8828
Panel B. EBA–Consensus Economics (extensive margin - including the 0s)								
$ShareSovEEA_{b,c,t}$	4.48	14.28	0	0.10	1.57	9.00	88.79	5418
$100 \times \mathbf{1}(ShareSovEEA_{b,c,t})$	61.11	48.75	0	100	100	100	100	5418
$ShareSovEEA_{b,c,t}$|Home=0	2.08	6.28	0	0.08	1.22	4.89	28.57	5178
$100 \times \mathbf{1}(ShareSovEEA_{b,c,t})$|Home=0	59.31	49.13	0	100	100	100	100	5178
$ForeignFcst_{b,c,t}$	0.032	0.176	0	0	0	0	1	5178
Panel C. EBA–Consensus Economics (intensive margin - excluding the 0s)								
$ShareSovEEA_{b,c,t}$	20.46	23.95	3.2	9.50	27.87	58.57	90.73	285
$\overline{SFE}(Y10_{b,c})$	0.46	0.29	0.29	0.36	0.52	0.84	1.58	285
$Y10_{b,c,t}$	3.50	1.54	2.3	3.1	4.3	5.8	8.1	285
$ShareSovEEA_{b,c,t}$|Home=0	12.37	17.73	1.41	5.72	13.8	33.2	72.3	206
$\overline{SFE}(Y10_{b,c})$|Home=0	0.49	0.32	0.30	0.37	0.49	1.10	1.58	206
$Y10_{b,c,t}$|Home=0	3.75	1.65	2.4	3.5	4.8	6.2	8.1	206

Table 4: Are Home Forecasters Better?

This table provides estimates for equation (1). The dependent variable is the average squared forecast error of bank b regarding the 3-month ahead forecast on country c's 10–year yield ($\overline{SFE}$(Y10)). Home is a dummy equal to one if the forecaster is domestic, zero otherwise. Standard errors are clustered at the forecaster level. ***,**,* indicate statistical significance at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)
Home	-0.188***	-0.369***	-0.358***
	(0.070)	(0.127)	(0.113)
Observations	212	160	160
N of Forecasters	85	33	33
N of Destination Countries	14	14	14
Forecaster FE	no	yes	yes
Destination Country FE	no	no	yes

Table 5: Extensive Margin: Foreign Sovereign Exposures and Foreign Forecast

This table provides the estimates for equation (11). The dependent variable is the share of EEA country c in bank b sovereign portfolio in Panel A and a dummy equal to one if bank b holds a positive amount of sovereign bonds of EEA country c in Panel B. The sample is restricted to exposures to foreign countries only. $\text{ForeignFcst}_{b,c,t}$ is a dummy equal to one if bank b makes a 10–year yield forecast for country c in year t and zero otherwise. Standard errors are clustered at the bank level. ***,**,* indicate statistical significance at 1%, 5%, and 10%, respectively.

Panel A: Dependent variable $ShareSovEEA_{b,c,t}$ for non–domestic exposures

	(1)	(2)	(3)	(4)	(5)	(6)
ForeignFcst	11.30***	11.30***	11.11***	10.06**	10.14**	10.30**
	(3.703)	(3.708)	(3.979)	(3.851)	(3.941)	(4.000)
Observations	5170	5170	5170	5170	5170	5170
Adj. R^2	0.103	0.102	0.127	0.254	0.239	0.210
N of Banks	35	35	35	35	35	35
N of Destination Countries	23	23	23	23	23	23

Panel B: Dependent variable $100 \times \mathbf{1}(ShareSovEEA_{b,c,t})$ for non–domestic exposures

	(1)	(2)	(3)	(4)	(5)	(6)
ForeignFcst	40.24***	40.43***	28.92***	19.46**	19.89**	20.13**
	(4.305)	(4.327)	(4.417)	(8.218)	(8.339)	(8.490)
Observations	5170	5170	5170	5170	5170	5170
Adj. R^2	0.0207	0.0264	0.228	0.386	0.387	0.379
N of Banks	35	35	35	35	35	35
N of Destination Countries	23	23	23	23	23	23
Time FE	no	yes	yes	yes	–	–
Bank FE	no	no	yes	yes	yes	–
Destination country FE	no	no	no	yes	–	–
Country–Time FE	no	no	no	no	yes	yes
Bank–Time FE	no	no	no	no	no	yes

Table 6: Intensive Margin – Foreign Exposures

This table provides the estimates for equation (13). The dependent variable is the share of EEA country c sovereign bonds in bank b sovereign portfolio of long-term debt (> 5 years residual maturity). $Y10$ is the 3-month ahead forecast made by bank b regarding the 10-year yield on country c's sovereign debt averaged over quarter t. $\overline{SFE}(Y10)$ is bank b's average squared forecast error regarding $Y10$ throughout the sample period. Standard errors are White-robust. ***,**,* indicate statistical significance at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)
$\overline{SFE}(Y10)$	-41.52***	-41.18***	-54.66***	-27.65**	-43.11***
	(12.311)	(12.394)	(7.645)	(10.841)	(10.369)
Y10	-5.435***	-5.675***	-4.787***	-2.530**	-3.543*
	(1.383)	(1.343)	(0.727)	(1.231)	(2.007)
$\overline{SFE}(Y10) \times Y10$	7.164***	7.205***	8.685***	5.852***	8.794***
	(2.063)	(2.037)	(1.370)	(2.225)	(2.056)
Observations	152	152	150	149	132
Adj. R^2	0.169	0.172	0.741	0.810	0.863
N of Banks	15	15	15	15	14
N of Destination Countries	10	10	10	10	8
Time FE	no	yes	yes	yes	–
Bank FE	no	no	yes	yes	yes
Destination Country FE	no	no	no	yes	–
Country–Time FE	no	no	no	no	yes

Table 7: Intensive Margin – Domestic and Foreign Exposures

This table provides the estimates for equation (13). The dependent variable is the share of EEA country c sovereign bonds in bank b sovereign portfolio of long-term debt (> 5 years residual maturity). $Y10$ is the 3-month ahead forecast made by bank b regarding the 10-year yield on country c's sovereign debt averaged over quarter t. $\overline{SFE}(Y10)$ is bank b's average squared forecast error regarding $Y10$ throughout the sample period. $Home$ equals one for domestic holdings, zero otherwise. Standard errors are White-robust. ***,**,* indicate statistical significance at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)
$\overline{SFE}(Y10)$	-36.93***	-36.82***	-35.59***	-52.38***	-63.28***
	(11.531)	(11.527)	(12.458)	(10.236)	(11.134)
Y10	-5.367***	-5.618***	-3.585***	-6.053***	-4.740
	(1.389)	(1.327)	(1.044)	(1.517)	(3.191)
$\overline{SFE}(Y10) \times Y10$	6.664***	6.735***	5.983***	8.938***	11.27***
	(1.963)	(1.923)	(1.944)	(1.976)	(1.957)
Home	32.25***	31.96***	29.55***	23.97***	23.29***
	(3.212)	(3.232)	(3.624)	(2.405)	(2.487)
Observations	221	221	221	221	205
Adj. R^2	0.542	0.533	0.739	0.823	0.798
N of Banks	15	15	15	15	14
N of Destination Countries	10	10	10	10	8
Time FE	no	yes	yes	yes	–
Bank FE	no	no	yes	yes	yes
Destination Country FE	no	no	no	yes	–
Country–Time FE	no	no	no	no	yes

Appendix

A Solving the Model

In period 2, the agents face the problem

$$\max_{\boldsymbol{\alpha}_j^{(i)\prime}} E\left[\frac{(W_{2j}^{(i)})1-\gamma}{1-\gamma}|\mathcal{I}_j^{(i)},\boldsymbol{\eta}_j^{(i)}\right]$$

s.t.

$$W_{2j}^{(i)} = \underbrace{(W_0 - \Psi_j^{(i)} - C(K_j^{(i)}))}_{W_{1j}^{(i)}} R_j^{p,(i)} = W_{1j}^{(i)}(\boldsymbol{\alpha}_j^{(i)\prime}\mathbf{R} + (1-\boldsymbol{\alpha}_j^{(i)\prime}\mathbf{1})R^f)$$

where $\Psi_j^{(i)} = \sum_k \iota_{jk} c$ is the total expenditure of the agents in country j on prior information (ι_{jk} is 1 if the agent purchases information about the k-th country, and zero otherwise), and $K_j^{(i)}$ is the total amount of intensive information acquired. Thus, the wealth available for investing at the beginning of period 1 is

$$W_{1j}^{(i)} = W_0 - \Psi_j^{(i)} - C(K_j^{(i)})$$

Substituting the constraint out, the maximization problem is equivalent to

$$\max_{\boldsymbol{\alpha}_j^{(i)\prime}} \frac{(W_{1j}^{(i)})^{1-\gamma}}{1-\gamma} E\left[\exp((1-\gamma)r_j^{(i),p})|\mathcal{I}_j^{(i)},\boldsymbol{\eta}_j^{(i)}\right] \tag{14}$$

where lower case letters denote logs. Next, we follow Campbell and Viceira (2001) and use a second-order Taylor expansion to express the log portfolio return as

$$r_j^{(i),p} \approx r^f + \boldsymbol{\alpha}_j^{(i)\prime}\left(\mathbf{r} - r^f + \frac{1}{2}diag(\hat{\Sigma}_j)\right) - \frac{1}{2}\boldsymbol{\alpha}_j^{(i)\prime}\hat{\Sigma}_j\boldsymbol{\alpha}_j^{(i)} \tag{15}$$

where we have used $\hat{\Sigma}_j = \mathrm{Var}(\mathbf{r}|\mathcal{I}_j^{(i)}, \boldsymbol{\eta}_j^{(i)})$ to denote the posterior variance of the risky asset payoffs. For future reference, note also that since $\mathbf{r} = \mathbf{d} - \mathbf{p}$ and $\mathbf{p}$ is in the information set of the agent, it follows that $\hat{\Sigma}_j = \mathrm{Var}(\mathbf{d}|\mathcal{I}_j^{(i)}, \boldsymbol{\eta}_j^{(i)})$.

Lastly, plugging (15) into the objective function (14) and taking expectations over the resulting log-normal variable yields the following objective function:

$$\frac{(W_{1j})^{1-\gamma}}{1-\gamma} \exp\left((1-\gamma)\left(r^f + \boldsymbol{\alpha}'\Big(E_{1j}(\mathbf{r}) - r^f + \frac{1}{2}diag(\hat{\Sigma}_j)\Big) - \frac{1}{2}\boldsymbol{\alpha}'\hat{\Sigma}_j\boldsymbol{\alpha}\right) + \frac{(1-\gamma)^2}{2}\boldsymbol{\alpha}'\hat{\Sigma}_j\boldsymbol{\alpha}\right)$$

where with a slight abuse of notation we have dropped the i subscript for convenience, and use the notation $E_{1j}(.) = E(.|\mathcal{I}^{(i)})$ to denote the conditional expectation of the agent using all of the information available to him at time 1.

Taking first order conditions, and solving for the portfolio shares $\boldsymbol{\alpha}$ yields:

$$\boldsymbol{\alpha}_j = \frac{1}{\gamma}\hat{\Sigma}_j^{-1}(E_{1j}(\mathbf{r}) - r^f + \frac{1}{2}diag(\hat{\Sigma}_j))$$

Furthermore, given the assumption that all factors are independent, this reduces to

$$\alpha_{jk} = \frac{E_{1j}(r_k) - r^f}{\gamma\hat{\sigma}_{jk}^2} + \frac{1}{2\gamma}$$

for all assets k.

A.1 Asset Market Equilibrium

We focus on symmetric equilibria, where all agents in a given country j make the same information choices. The market clearing condition for asset k is:

$$z_k = \frac{1}{N}\sum_{j\in\mathcal{B}_k} W_{1j} \frac{\hat{\sigma}_{jk}^2\left(\frac{\mu_{dk}}{\sigma_{dk}^2} + (\frac{\lambda_{dk}}{\lambda_{zk}\sigma_{zk}})^2(d_k + \frac{\lambda_{zk}}{\lambda_{dk}}(z_k - \mu_{zk})) + \frac{1}{\sigma_{\eta jk}^2}d_k\right) - (\bar{\lambda}_k + \lambda_{dk}d_k + \lambda_{zk}z_k) - r^f + \frac{1}{2}(\hat{\sigma}_{jk}^2)}{\gamma\hat{\sigma}_{jk}^2}$$

where the set $\mathcal{B}_k$ is the set of all countries whose agents choose to purchase prior information about asset k. Matching coefficients, we get

$$\bar{\lambda}_k = \underbrace{\left(\frac{1}{N_k}\sum_{j\in\mathcal{B}_k}\frac{W_{1j}}{\hat{\sigma}^2_{jk}}\right)^{-1}}_{=\bar{\sigma}^2_k}\left[\underbrace{\left(\frac{1}{N_k}\sum_{j\in\mathcal{B}_k}W_{1j}\right)}_{=\bar{\phi}_k}\left(\frac{\mu_{dk}}{\sigma^2_{dk}}-\frac{\lambda_{dk}}{\lambda_{zk}\sigma^2_{zk}}\mu_{zk}\right)+\sum_{j\in\mathcal{B}_k}\frac{W_{1j}}{2N}\right]-r^f$$

where we define two useful quantities for later use – 1) the (wealth-weighted) posterior variance of the average market participant in the market of asset k, $\bar{\sigma}^2_k$, and 2) the average wealth of the market participants in the market for asset k, $\bar{\phi}_k$. Similarly,

$$\lambda_{zk} = -\gamma\bar{\sigma}^2_k\left(1+\frac{\bar{\phi}_k\bar{q}_k}{\gamma^2\sigma^2_z}\right)$$

$$\lambda_{dk} = \bar{\sigma}^2_k\bar{q}_k\left(1+\frac{\bar{\phi}_k\bar{q}_k}{\gamma^2\sigma^2_z}\right)$$

where

$$\bar{q}_k = \sum_{j\in\mathcal{B}_k}\frac{W_{1j}}{N_k}\frac{1}{\sigma^2_{\eta_{jk}}}$$

is a weighted-average of the signal precisions of the different agents, and $N_k = |\mathcal{B}_k|$ is cardinality of $\mathcal{B}_k$ – i.e. the number of countries whose agents choose to learn about asset k.

Thus, we have confirmed that the equilibrium price is linear and solved for its equilibrium coefficients.

A.2 Information Choice

In period 0 agents solve for the optimal information strategy, given their knowledge of optimal portfolios as a function of information (the solution to period 1 problem discussed above). First, we compute the time 1 expected utility conditional on an information choice. Using the optimal portfolio shares computed before, and evaluating the expected utility, conditional on the agent's full information set gives

$$E_{1j}\left[\frac{W_{1j}^{1-\gamma}}{1-\gamma}\exp\left((1-\gamma)r_j^p\right)\right]=\frac{W_{1j}^{1-\gamma}}{1-\gamma}\exp\left((1-\gamma)r^f+\frac{1-\gamma}{2\gamma}\hat{\mu}_j'\hat{\Sigma}_j^{-1}\hat{\mu}_j\right) \tag{16}$$

where $\hat{\mu}_j = E_{1j}(\mathbf{r}) - r^f + \frac{1}{2}diag(\hat{\Sigma}_j)$. Conditional on just the priors of agents in country j (i.e. ex-ante), this is a Normal random variable, with the distribution $\hat{\mu}_j \sim N(\mathbf{m}_j, \Sigma - \hat{\Sigma}_j)$ where $\mathbf{m}_j$ is a Nx1 vectors with the following elements:

$$m_k = \bar{\sigma}_k^2\left(\gamma\mu_{zk} - \frac{1}{2}\bar{\phi}_k\right) + \frac{1}{2}\hat{\sigma}_{jk}^2$$

Thus, ex-ante excess return is increasing in the effective supply of the asset μ_{zk} and decreasing in the average invested wealth $\bar{\phi}_k$. Moreover, the variance of $\hat{\mu}_j$ is a diagonal matrix with the following diagonal elements

$$(\Sigma - \widehat{\Sigma}_j)_{kk} = \underbrace{\bar{\sigma}_k^2(\bar{\phi}_k + (\gamma^2\sigma_z^2 + \bar{\phi}_k\bar{q}_k)\bar{\sigma}_k^2)}_{=\sigma_k^2} - \hat{\sigma}_{jk}^2$$

To get better intuition, note that $\sigma_k^2 = \mathrm{Var}(d_k - p_k)$; thus σ_k^2 is the unconditional volatility of the excess return. Lastly, the above expected utility (16) was *conditional* on a choice of $\hat{\Sigma}_j$ and particular realizations of the informative signals. To compute the optimal information choice, we need to take its ex-ante expectation (meaning expectation over the actual realizations of signals and resulting asset prices). Doing so gives us

$$\begin{aligned}
E_{0j}\left[\frac{W_{1j}^{1-\gamma}}{1-\gamma}\exp\left((1-\gamma)r_j^p\right)\right] &= \frac{W_{1j}^{1-\gamma}}{1-\gamma}E_{0j}\left[E_{1j}[\exp((1-\gamma)r_j^p)]\right] \\
&= \frac{W_{1j}^{1-\gamma}}{1-\gamma}\exp((1-\gamma)r^f))E_0\left[\exp\left(\frac{1-\gamma}{2\gamma}\hat{\mu}_j'\hat{\Sigma}_j^{-1}\hat{\mu}_j\right)\right] \\
&= \frac{W_{1j}^{1-\gamma}}{1-\gamma}\exp((1-\gamma)r^f))\left|\frac{1}{\gamma}I - \frac{1-\gamma}{\gamma}\Sigma\hat{\Sigma}_j^{-1}\right|^{-\frac{1}{2}} * \\
&\exp\left(\frac{1-\gamma}{2\gamma}\left[(1-\gamma)\mathbf{m}'\hat{\Sigma}_j^{-1}(I-(1-\gamma)\Sigma\hat{\Sigma}_j^{-1})^{-1}(\Sigma\hat{\Sigma}_j^{-1}-I)+I\right]\mathbf{m}\right)
\end{aligned}$$

where we have applied the formula for the expectation of a Wishart variable to get from the second-to-last, to the last line. And finally, given the assumption that all variance matrices are diagonal, the log-objective function is

$$
\begin{aligned}
U_{0j} &= -\ln\left(-\frac{W_{1j}^{1-\gamma}}{1-\gamma}E_0[\exp((1-\gamma)r_j^p)]\right) \\
&= (1-\gamma)\ln(\frac{W_{1j}}{\gamma-1}) + \sum_{k\in\mathcal{F}_j}\frac{1}{2}\ln\left(1+(\gamma-1)\frac{\sigma_k^2}{\hat{\sigma}_{jk}^2}\right) + \frac{\gamma-1}{2}\sum_{k\in\mathcal{F}_j}\frac{m_k^2}{\hat{\sigma}_{jk}^2+(\gamma-1)\sigma_k^2} + A \quad (17)
\end{aligned}
$$

where we perform the transformation $-\ln(-U)$ to avoid taking the logarithm of a negative number (recall we assume $\gamma > 1$), and A is a constant that does not depend on the posterior variances.

For notational convenience, for the rest of the analysis of an individual agent's problem, we will drop the j subscript since the problems of agents in different countries are symmetric. Given that the risky factors are all Gaussian, the information content of the private signal about the asset return of country k (in terms of entropy units) is $\kappa_k = \frac{1}{2}\left(\ln(\mathrm{Var}(d_k|p_k) - \ln(\mathrm{Var}(d_k|\mathcal{I}_j^{(i)}\right)$. This follows from the expression for the entropy of Gaussian variables, and the fact that the only relevant public signal is the equilibrium market price p_k. Defining the variance of the risky payoffs conditional on public information only as $\tilde{\sigma}_k^2 = Var(d_k - p_k|p_k)$, and the conditional variance using all information as $\hat{\sigma}_k^2$, we have that $\hat{\sigma}_k^2 = \exp(-\kappa_k)\tilde{\sigma}_k^2$; this shows us that the conditional variance of the agent is decreasing in the amount of information, κ_k, that he acquires.

We solve the information choice problem in three steps – a choice of allocation of intensive information, a choice of the total amount of intensive information acquired, and a choice of extensive information. First, note that given choices of the extensive information $\mathcal{F}$ and total intensive information K, agents solve the problem

$$
\max_{\kappa_k}\sum_{k\in\mathcal{F}}\frac{1}{2}\ln\left(1+(\gamma-1)\frac{\sigma_k^2}{\exp(-\kappa_k)\tilde{\sigma}_k^2}\right) + \frac{\gamma-1}{2}\sum_{k\in\mathcal{F}}\frac{m_k^2}{\exp(-\kappa_k)\tilde{\sigma}_k^2+(\gamma-1)\sigma_k^2} \quad (18)
$$

s.t.

$$\sum_{k\in\mathcal{F}}\kappa_k \leq K$$

A.2.1 Step 1: Choice of κ_k

The partial derivative of the objective function, $\frac{\partial U_0}{\partial \kappa_k}$, is

$$\frac{(\gamma-1)\left[4\hat{\sigma}_k^2(m_k^2+\sigma_k^2-(\gamma-1)m_k\sigma_k^2)+4(\gamma-1)\sigma_k^4-\hat{\sigma}_k^6-2(\gamma-1)\sigma_k^2\hat{\sigma}_k^4\right]}{8(\hat{\sigma}_k^2+(\gamma-1)\sigma_k^2)^2}$$

and the second derivative, $\frac{\partial^2 U_0}{(\partial \kappa_k)^2}$, is

$$\frac{(\gamma-1)\left[\hat{\sigma}_k^6+3(\gamma-1)\hat{\sigma}_k^4\sigma_k^2+4(\gamma-1)\sigma_k^2(\sigma_k^2+(\gamma-1)m_k\sigma_k^2-m_k^2)+4\hat{\sigma}_k^2(m_k^2+\sigma_k^2(1+(\gamma-1)^2\sigma_k^2)-(\gamma-1)m_k)\right]}{8(\hat{\sigma}_k^2+(\gamma-1)\sigma_k^2)^3}$$

A sufficient condition for $\frac{\partial^2 U_0}{(\partial \kappa_k)^2} > 0$ is that the unconditional Sharpe Ratio (SR) is less than 1 ($\frac{\bar{m}}{\sigma_k} < 0$), which is true in the data. Thus, assuming the SR is less than one implies that information choice is a convex problem. Moreover, if $4 > \gamma\tilde{\sigma}_k^2$, which is also true under realistic parameters, we can show that the partial derivative with respect to information about asset k is positive when the agent's posterior variance equals the unconditional variance of the asset k:

$$\left.\frac{\partial U_0}{\partial \kappa_k}\right|_{\hat{\sigma}_k^2=\sigma_k^2} > 0$$

Together with the fact that the second derivative is also positive, we can conclude that the partial derivative in respect to information is always positive and increasing. Thus, the optimal information allocation is such that $\kappa_{j*} = K$ for one specific k, and $\kappa_k = 0$ for all $k \neq j*$.

A.2.2 Step 2: Choice of K

Choosing K amounts to choosing the amount of total additional information to acquire about the optimal asset j^*. The problem (17) becomes

$$\max_K (\gamma-1)\ln(W_1)+\frac{1}{2}\ln\left(\frac{\exp(-K)\tilde{\sigma}^2_{j*}+(\gamma-1)\sigma^2_{j*}}{\exp(-K)\tilde{\sigma}^2_{j*}}\right)+\frac{\gamma-1}{2}\frac{m^2_{j*}}{\exp(-K)\tilde{\sigma}^2_{j*}+(\gamma-1)\sigma^2_{j*}}+$$
$$+\sum_{k\in\mathcal{F}}\frac{1}{2}\ln\left(\frac{\tilde{\sigma}^2_k+(\gamma-1)\sigma^2_k}{\tilde{\sigma}^2_k}\right)+\frac{\gamma-1}{2}\sum_{k\in\mathcal{F}}\frac{m^2_k}{\tilde{\sigma}^2_k+(\gamma-1)\sigma^2_k}$$

The first order condition of this problem is

$$\frac{C'(K^*)}{W_1}=\frac{(\gamma-1)\left[4\hat{\sigma}^2_{j*}(m^2_{j*}+\sigma^2_{j*}-(\gamma-1)m_{j*}\sigma^2_{j*})+4(\gamma-1)\sigma^4_{j*}-\hat{\sigma}^6_{j*}-2(\gamma-1)\sigma^2_{j*}\hat{\sigma}^4_{j*}\right]}{8(\hat{\sigma}^2_{j*}+(\gamma-1)\sigma^2_{j*})^2}.$$

where $\hat{\sigma}^2_{j*}=\tilde{\sigma}^2_{j*}\exp(-K^*)$ and $\hat{\sigma}^2_k=\tilde{\sigma}^2_j$, for all $k\neq j*$. Given a convex information cost function $C(.)$, this defines a unique solution for total intensive information K^*.

A.2.3 Step 3: Choice of the set $\mathcal{F}$

Lastly, we need to find the cutoff point at which adding new assets is not worth it anymore. The cost of adding an asset is that the investible wealth W_1 goes down by c. The gain for acquiring priors on asset k and adding it to your portfolio is given by the term

$$\ln\left(1+(\gamma-1)\frac{\sigma^2_k}{\tilde{\sigma}^2_k}\right)+\frac{\gamma-1}{2}\frac{\sigma^2_k(1+m^2_k)}{\tilde{\sigma}^2_k+(\gamma-1)\sigma^2_k} \tag{19}$$

The first term captures the expected benefit of holding an additional asset with positive expected returns, and the second captures the diversification benefit of adding a new, independent asset to the portfolio. To arrive at that take the agent's ex-ante beliefs that $m_k\sim N(m_k,\sigma^2_k)$ and take expectations over the terms specific to asset k in U_0.

The marginal cost of purchasing priors is increasing in the amount of assets you already learn about. This works through two different effects. First, note that

$$\frac{\partial^2 \ln(W_1)}{(\partial\Psi)^2} = -\frac{1}{W_1^2}$$

which comes from the fact that marginal utility of investible wealth is declining, and further prior information acquisition, and thus incurring an additional fixed cost c, is becoming increasingly costlier in utility terms. Second, increases in Ψ leads to lower investible wealth, and hence a lower optimal intensive information choice K^* and therefore lower utility from trading the asset you purchase additional information about. Both of those effects combine to lead to the conclusion that there are increasing costs to increasing the breadth of information, and hence the portfolio. As a result, unless the fixed cost of acquiring priors is very small relative to the agent's wealth, it is unlikely that the bank will learn about all available assets. This generates sparse portfolios, with the level of sparseness varying with the agent's wealth.

B Proofs

B.1 Proof of Proposition 1

By the arguments in section $A.2.1$, the learning problem is convex and increasing in the precision of posterior beliefs. Since the home agents have a free signal on the home asset and both home and foreign agents observe the same public information, it is the case that

$$\frac{\partial U_{0j}}{\partial \kappa_j} > \frac{\partial U_{0j'}}{\partial \kappa_j},$$

meaning that the marginal utility of information about the home asset (asset j for agents in country j) is always higher than the marginal utility of the same information to a foreign agent (agent in $j' \neq j$). As a result, if any agent in country $j' \neq j$ finds it optimal to specialize in asset j, it must be the case that all agents in country j already specialize in their home asset as well. Essentially, agents have a comparative advantage to learning about their home asset. Thus if $k_{j'j} > 0$, then

$$\kappa_{jj} = \kappa_{j'j}$$

and both agents specialize in the asset j. If a foreign agent does not acquire information about asset j, then it is either the case that the country j agents specialize in their home asset anyway and thus

$$\kappa_{jj} > \kappa_{j'j} = 0$$

or the country j agents specialize in some other asset as well, and thus

$$\kappa_{jj} = \kappa_{j'j} = 0$$

As a result, we see that it is always the case that

$$\kappa_{jj} \geq \kappa_{j'j}$$

In the special case of a symmetric world, since we know that the agents have a comparative advantage over home assets and all world assets are ex-ante identical, it follows that everyone specializes in their home asset. As a result

$$\kappa_{jj} > \kappa_{j'j} = 0.$$

B.2 Proof of Proposition 2

1. In a symmetric world where all fundamental terms have the same variance $\sigma_k^2 = \sigma^2$ for all k and the ex-ante expected return on all assets is the same, $m_k = m$ for all k, all asset prices are symmetric in the sense that they are the same linear function of their respective state variables. Thus, all price coefficients are the same, $\lambda_{dk} = \lambda_d$, $\lambda_{zk} = \lambda_z$, and $\bar{\lambda}_k = \bar{\lambda}$ for all k , and the price only differ from each other because of different

realizations of the state variables:

$$p_k = \bar{\lambda} + \lambda_d d_k + \lambda_z z_k.$$

As a result, the precision of information that can be acquired from the price signal, $\frac{\lambda_d^2}{\lambda_z^2 \sigma_z^2}$ is the same for all prices. Combined with the fact that all fundamentals have the same prior variance, this implies that the variance conditional on public information is also the same for all assets:

$$\tilde{\sigma}_k^2 = \tilde{\sigma}^2$$

for all k. Thus, in this symmetric world assets are symmetric not only ex-ante, but also conditional on all publicly available information.

Then, turning to the information choice of agents, note that the gain (in utility terms) of doing a due diligence study and adding any new asset to your portfolio is:

$$\ln\left(1 + (\gamma - 1)\frac{\sigma^2}{\tilde{\sigma}^2}\right) + \frac{\gamma - 1}{2}\frac{\sigma^2(1) + m^2)}{\tilde{\sigma}^2 + (\gamma - 1)\sigma^2}$$

which is again the same for all k, except for the home asset, in which case it is higher because of the extra free information signal.

The financial cost of doing the due diligence study is simply c, and in terms of utility it is given by (i) the decrease in log financial wealth (the first term of the objective function in equation (17)) and (ii) the associated decrease in the optimal K^*. The marginal utility cost of spending an extra c, when you have already spent the amount $\Psi = \sum_{k \in \mathcal{F}} c$ on prior information and have chosen the resulting optimal intensive information $K^*(|\mathcal{H}|)$ is: :

$$\ln(W - C(K^*(|\mathcal{F}|)) - \Psi) - \ln(W - C(K^*(|\mathcal{F}| + 1)) - \Psi - c) = \ln(\frac{W - C(K^*(|\mathcal{F}|)) - \Psi}{W - C(K^*(|\mathcal{F}| + 1)) - \Psi - c})$$

Since the log function is concave, this utility cost is increasing in the total amount of resources spent on due diligence studies.

Thus, we can conclude that if

$$\ln(\frac{W - C(K^*(0))}{W - C(K^*(1)) - c}) < \ln\left(1 + (\gamma - 1)\frac{\sigma^2}{\tilde{\sigma}^2}\right) + \frac{\gamma - 1}{2}\frac{\sigma^2 + m^2}{\tilde{\sigma}^2 + (\gamma - 1)\sigma^2}$$

then the gain from adding the first foreign asset to their learning portfolio exceeds the cost of doing so, hence the agents will invest in at least one foreign asset. However, since the log function is concave, the utility cost of due diligence studies is increasing in the total amount of due diligence studies already done. So as long as the initial wealth of an agent W is low enough so that

$$\ln(\frac{W - C(K^*(N-1)) - (N-1)c}{W - C(K^*(N)) - Nc}) > \ln\left(1 + (\gamma - 1)\frac{\sigma^2}{\tilde{\sigma}^2}\right) + \frac{\gamma - 1}{2}\frac{\sigma^2 + m^2}{\tilde{\sigma}^2 + (\gamma - 1)\sigma^2}$$

then the agents will not invest in all foreign assets and hence

$$\alpha_k = 0 \text{ for some } k$$

2. For the same reason that the log financial wealth function is concave, it follows that increasing W lowers the cost of doing an additional due diligence study i.e.:

$$\frac{\partial \ln(\frac{W - C(K^*(|\mathcal{H}|)) - \Psi}{W - C(K^*(|\mathcal{H}|+1)) - \Psi - c})}{\partial W} < 0$$

Thus, as W increases the agents will add new assets to their learning portfolio, and hence the sparseness of portfolios will decrease.

3. Because the agent optimally chooses to not acquire any extra intensive information about his foreign portfolio holdings, the optimal portfolio holdings of these assets depend on the

public information contained in prices and priors. Evaluating the associated conditional expectation, and plugging in the solution for the equilibrium price coefficients, we can show that the equilibrium holdings of a foreign asset k is given by

$$\alpha_k = (\tilde{\sigma}_k^2 - \bar{\sigma}_k^2 \phi_k)(\frac{\mu_{dk}}{\sigma_k^2} + \frac{q_k}{\gamma \sigma_{zk}^2}) + \gamma \bar{\sigma}_k^2 z_k + \frac{\bar{\sigma}_k^2 \phi_k - \tilde{\sigma}_k^2}{\gamma \tilde{\sigma}_k^2}(\frac{d_k}{\sigma_k^2} + \frac{q_k}{\gamma \sigma_{zk}^2} z_k)$$

The first term is a constant, which is the same for all foreign holdings in a symmetric world (since all k subscripts fall out). Thus, the equilibrium holdings of foreign assets only differ from one another due to the specific realizations of the noise trading term z_k and payoff d_k.

Since those have asymmetric distributions across k, however, it follows that the average holdings of two foreign assets k and k' are the same

$$E(\alpha_k) = E(\alpha_{k'})$$

Thus, at the steady state all foreign holdings are equal to each other, hence as a share of the foreign portion of the portfolio they are all equal to $\frac{1}{\tilde{N}}$ where $\tilde{N} = |\mathcal{F}| - 1$ is the number of foreign countries the agents actually invest in. In a symmetric world all assets are in the same supply $\bar{z}$, hence , $\frac{1}{\tilde{N}}$ is also the market share of each of the foreign assets within the sub-portfolio of assets that agent j invests in.

Thus, up to a first order approximation the average value of the $Bias_k$ index (for an agent in country j) is:

$$E(Bias_k) = 1 - E(\frac{1 - \frac{\alpha_k}{\sum_{k' \in \mathcal{F}/|} \alpha_{k'}}}{1 - \frac{1}{\tilde{N}}}) \approx 1 - \frac{1 - \frac{1}{\tilde{N}}}{1 - \frac{1}{\tilde{N}}} = 0$$

C Portfolio Comparative Statics: PE vs GE

Although the comparative statics exercises in Proposition 2 are only partial equilibrium expressions, they are still useful to gain intuition and the results carry over to general equilibrium as well. In general equilibrium, if everyone revises their expectations about asset k upwards, it clearly cannot be the case that everyone also increases their holdings of asset k. The price will adjust to this increase in demand, and in fact only the agents who increased their beliefs more than the average belief are the ones who will increase their portfolios. Substituting in the expression for the equilibrium price, p_k, in the optimal holdings expression, we can show that the equilibrium portfolio holdings of asset k of bank j are given by

$$\alpha_{jk} = \frac{E_{1j}(d_k)) - \bar{E}_1(d_k)}{\gamma \hat{\sigma}_{jk}^2} + \frac{1}{2\gamma}\left(1 - \frac{\bar{\sigma}_k^2}{\hat{\sigma}_{jk}^2}\bar{\phi}_k\right) + \gamma z_k \frac{\bar{\sigma}_k^2}{\hat{\sigma}_{jk}^2} \tag{20}$$

where we define the average market expectation (wealth-weighted) $\bar{E}_1(d_k)$ as

$$\bar{E}_1(d_k) = \bar{\sigma}_k^2 \left(\sum_{j \in \mathcal{B}_k} \frac{W_{1j}}{N_k} \frac{\int E_{1j}^{(i)}(d_k)di}{\hat{\sigma}_{jk}^2}\right)$$

As we can see, the basic results of the partial equilibrium comparative statics still remain true as long as you control for the average market beliefs. Agents will hold more of a given asset the more optimistic they are about its return *relative* to the average market belief, the higher the precision of their beliefs *relative* to the average market precision, and their portfolio holdings will be more responsive to their relative optimism, the greater is the precision of their beliefs. In our empirical tests we control for all of this market effects by including the appropriate fixed effects.

D Additional Tables

Table 8: Number of forecasters per country

This table contains the number of forecasters for each country in Consensus Economics. Observations refers to the number of forecasters × number of months in the sample.

Country	Obs.	min	p25	p50	p75	max
France	1645	2	14	15	16	18
Germany	2396	9	24	25	27	30
Hungary	1408	4	7	8	10	13
Italy	1201	2	7	8	9	13
Japan	1742	12	16	18	19	22
Netherlands	784	4	7	7	8	9
Norway	744	2	5	6	7	9
Poland	1454	5	9	10	11	13
Slovakia	989	0	5	6	7	9
Spain	1328	3	10	12	13	16
Sweden	1215	4	10	12	13	15
Switzerland	1278	8	11	12	12	14
UK	2015	4	16	17	19	23
USA	2313	16	23	25	27	32
Total	16184	5	10	12	13	15

Table 9: Forecasters

ABI	DIW - Berlin	ISAE	OFCE
ABN AMRO	DIW Berlin	ITEM Club	OTP Bank
AFI	DNB	ITOCHU Institute	Oddo Securities
AXA Investment Managers	DTZ Research	IW - Cologne Institute	Oxford - LBS
Action Economics	DZ Bank	IfW - Kiel Institute	Oxford Economics
Allianz	Daiwa Institute of Research	Inforum - Univ of Maryland	PAIR Conseil
American Int'l Group	Danske Bank	Inst Estud Economicos	PKO Bank
BAK Basel	DekaBank	Inst L R Klein (Gauss)	PNC Financial Services
BBVA	Deutsche Bank	Institut Crea	Pictet & Cie
BHF-Bank	Dresdner Bank	Institute EIPF	Prometeia
BIPE	DuPont	Instituto de Credito Oficial	RBS
BNP Paribas	EFG Eurobank	Intesa Sanpaolo	RDQ Economics
BPCE	ENI	JP Morgan	REF Ricerche
BPH	Eaton Corporation	Japan Ctr for Econ Research	RWI Essen
Banca Com Romana	Econ Institute SAV	Japan Tech Info Services Corp	Rabobank
Banca IMI	Econ Intelligence Unit	KOF Swiss Econ Inst	Raiffeisen
Banesto	Econ Policy Institute	KUKE	Rexecode
Bank America Corp	Economic Perspectives	Kempen & Co.	Roubini Global Econ
Bank Julius Baer	Erik Penser Bank	Kiel Economics	SBAB Bank
Bank Vontobel	Erste Bank	Kopint-Tarki	SEB
Bank Zachodni	Est Inst of Econ Rsrch	La Caixa	Sal Oppenheim
Bank of America	Euler Hermes	Landesbank Berlin	Santander
Bank of Tokyo-Mits. UFJ	Euromonitor	Lehman Brothers	Schroders
Bankia	Exane	Liverpool Macro Research	Skandiabanken
Barclays	Experian	Lloyds TSB Financial Markets	Slovenska Sporitelna
BayernLB	FERI	Lodz Institute - LIFEA	Societe Generale
Beacon Econ Forecasting	FUNCAS	Lombard Street Research	Standard & Poor's
Bear Stearns	Fannie Mae	MESA 10	Statistics Norway
CASE	Feri EuroRating	MM Warburg	Svenska Handelsbanken
CEOE	First Securities	Macroeconomic Advisers	Swedbank
CEPREDE	First Trust Advisors	Merrill Lynch	Swiss Life
CIB Budapest	Fitch Ratings	Millennium Bank	Swiss Re
CSOB	Ford Motor Company	Mitsubishi Research Institute	Takarek Bank
Caja Madrid	Fortis	Mitsubishi UFJ Research	Tatra Banka
Cambridge Econometrics	GAMA	Mizuho Research Institute	The Conference Board
Capital Economics	GKI Econ Research	Mizuho Securities	Theodoor Gilissen
Capitalia	Gdansk University	Moody's Analytics	Total
Centre Prev l'Expansion	General Motors	Morgan Stanley	Toyota Motor Corporation
Centro Europa Ricerche	Georgia State University	NHO Conf Nor Enterprise	UBS
Chamber of Commerce	Global Insight	NHO Confed Nor Enterprise	UniCredit
Chrysler	Goldman Sachs	NIBC	United Bulgarian Bank
Citigroup	HBOS	NIESR	United States Trust
Coe-Rexecode	HQ Bank	NLI Research Institute	Univ of Michigan - RSQE
Commerzbank	HSBC	NYKredit	Vienna Institute - WIIW
Concorde Securities	HSH Nordbank	Nat Assn of Home Builders	WGZ Bank
Confed of British Industry	HWWI	National Institute - NIER	Wachovia Corp
Confed of Swed Enterprise	Helaba Frankfurt	Natixis	Wells Capital
Confindustria	Hypo Alpe Adria	Nippon Steel	Wells Fargo
Credit Agricole	IFL-Univers Carlos III	Nomura	WestLB
Credit Suisse	IFO - Munich Institute	Nordea	Z?rcher Kantonalbank
D&B	ING	Northern Trust	Öhman

Type	%	Type	%
Bank	51.50	University	2.88
Consulting Firm	21.15	Business Association	2.59
Research Institute	11.25	Corporation	2.02
Financial Services	8.32	Total	100

Table 10: Robustness Intensive Margin: Total Debt (incl. short–term debt)

This table provides a robustness test of the estimates for equation (13). The dependent variable is the share of EEA country c sovereign bonds in bank b sovereign portfolio. $Y10$ is the 3-month ahead forecast made by bank b regarding the 10-year yield on country c's sovereign debt averaged over quarter t. $\overline{SFE}(Y10)$ is bank b's average squared forecast error regarding $Y10$ throughout the sample period. $Home$ equals one for domestic holdings, zero otherwise. Standard errors are three–way clustered at the bank, country and year level. ***,**,* indicate statistical significance at 1%, 5%, and 10%, respectively.

Panel A. Foreign Exposures

	(1)	(2)	(3)	(4)	(5)
$\overline{SFE}(Y10)$	-33.90***	-34.09***	-51.33***	-15.49**	-21.06***
	(7.777)	(7.801)	(6.173)	(6.437)	(7.490)
Y10	-4.841***	-5.070***	-5.314***	-1.943**	-1.330
	(0.820)	(0.838)	(0.672)	(0.902)	(2.079)
$\overline{SFE}(Y10) \times Y10$	5.871***	6.012***	8.057***	2.897***	3.801***
	(1.175)	(1.199)	(0.923)	(1.023)	(1.209)
Observations	152	152	150	149	132
Adj. R^2	0.183	0.190	0.653	0.795	0.748
N of Banks	15	15	15	15	14
N of Destination Countries	10	10	10	10	8

Panel B. Foreign and Domestic Exposures

	(1)	(2)	(3)	(4)	(5)
$\overline{SFE}(Y10)$	-29.18***	-29.66***	-34.31***	-32.27***	-38.44***
	(8.229)	(8.383)	(10.966)	(8.866)	(10.354)
Y10	-4.637***	-5.051***	-4.269***	-5.190***	-3.907
	(0.961)	(0.936)	(0.950)	(1.460)	(3.327)
$\overline{SFE}(Y10) \times Y10$	5.293***	5.545***	5.641***	5.094***	6.295***
	(1.271)	(1.296)	(1.614)	(1.467)	(1.776)
Home	26.82***	26.41***	23.51***	20.59***	20.33***
	(2.757)	(2.784)	(3.317)	(2.457)	(2.555)
Observations	221	221	221	221	205
Adj. R^2	0.519	0.514	0.693	0.788	0.760
N of Banks	15	15	15	15	14
N of Destination Countries	10	10	10	10	8
Time FE	no	yes	yes	yes	–
Bank FE	no	no	yes	yes	yes
Destination Country FE	no	no	no	yes	–
Country–Time FE	no	no	no	no	yes

Table 11: Robustness Intensive Margin: 1-year ahead forecast of 10–year yields

This table provides a robustness test of the estimates for equation (13). The dependent variable is the share of EEA country c sovereign bonds in bank b sovereign portfolio of long-term debt (> 5 years residual maturity). $Y10\_2_{b,c,t}$ is the 1-year ahead forecast made by bank b regarding the 10-year yield on country c's sovereign debt averaged over quarter t. $\overline{SFE}(Y10\_2)$ is bank b's average squared forecast error regarding $Y10\_2$ throughout the sample period. $Home$ equals one for domestic holdings, zero otherwise. $Home$ equals one for domestic forecasts only. Standard errors are White robust. ***,**,* indicate statistical significance at 1%, 5%, and 10%, respectively.

Panel A. Foreign Exposures

	(1)	(2)	(3)	(4)	(5)
$\overline{SFE}(Y10\_2)$	-16.19***	-15.61***	-19.45***	-10.34	-14.70**
	(3.494)	(3.432)	(3.345)	(6.510)	(5.650)
$Y10\_2$	-5.395***	-5.596***	-5.041***	-3.296**	-7.182***
	(1.197)	(1.153)	(0.773)	(1.469)	(2.499)
$\overline{SFE}(Y10\_2) \times Y10\_2$	2.632***	2.551***	3.090***	1.740	2.685**
	(0.612)	(0.601)	(0.576)	(1.228)	(1.129)
Observations	149	149	146	145	127
Adj. R^2	0.162	0.167	0.749	0.794	0.821
N of Banks	14	14	14	14	13
N of Destination Countries	10	10	10	10	8

Panel B. Foreign and Domestic Exposures

	(1)	(2)	(3)	(4)	(5)
$\overline{SFE}(Y10\_2)$	-11.93***	-11.48***	-12.35**	-14.42**	-16.74***
	(3.853)	(3.808)	(5.576)	(5.723)	(6.195)
$Y10\_2$	-4.609***	-4.982***	-3.503***	-3.555*	-1.530
	(1.316)	(1.230)	(1.179)	(1.876)	(3.157)
$\overline{SFE}(Y10\_2) \times Y10\_2$	2.014***	1.985***	2.103**	2.497**	2.944**
	(0.670)	(0.658)	(0.858)	(1.040)	(1.129)
Home	32.40***	31.94***	29.79***	24.71***	24.81***
	(3.540)	(3.571)	(3.759)	(2.729)	(2.605)
Observations	209	209	209	209	193
Adj. R^2	0.506	0.496	0.728	0.813	0.779
N of Banks	14	14	14	14	13
N of Destination Countries	10	10	10	10	8
Time FE	no	yes	yes	yes	–
Bank FE	no	no	yes	yes	yes
Destination Country FE	no	no	no	yes	–
Country–Time FE	no	no	no	no	yes

Table 12: Robustness Intensive Margin: No Peripheral (GIIPS) Debt exposure

This table provides a robustness test of the estimates for equation (13), excluding the holdings of sovereign debt issued by peripheral countries (Greece, Ireland, Italy, Portugal and Spain). The dependent variable is the share of EEA country c sovereign bonds in bank b sovereign portfolio of long-term debt (> 5 years residual maturity). $Y10$ is the 3-month ahead forecast made by bank b regarding the 10-year yield on country c's sovereign debt averaged over quarter t. $\overline{SFE}(Y10)$ is bank b's average squared forecast error regarding $Y10$ throughout the sample period. $Home$ equals one for domestic holdings, zero otherwise. Standard errors are three–way clustered at the bank, country and year level. ***,**,* indicate statistical significance at 1%, 5%, and 10%, respectively.

Panel A. Foreign Exposures

	(1)	(2)	(3)	(4)	(5)
$\overline{SFE}(Y10)$	-41.30***	-41.37***	-50.38***	-25.42**	-40.54***
	(12.523)	(12.688)	(8.565)	(10.620)	(10.199)
Y10	-5.289***	-5.696***	-4.092***	-2.380*	-3.603*
	(1.410)	(1.386)	(0.879)	(1.397)	(2.134)
$\overline{SFE}(Y10) \times Y10$	7.054***	7.209***	7.972***	5.597**	8.478***
	(2.096)	(2.079)	(1.516)	(2.185)	(2.031)
Observations	134	134	132	131	122
Adj. R^2	0.156	0.159	0.756	0.809	0.866
N of Banks	15	15	15	15	14
N of Destination Countries	8	8	8	8	7

Panel B. Foreign and Domestic Exposures

	(1)	(2)	(3)	(4)	(5)
$\overline{SFE}(Y10)$	-58.01***	-58.75***	-35.21**	-54.72***	-77.33***
	(13.442)	(13.312)	(14.228)	(11.850)	(13.814)
Y10	-6.429***	-6.985***	-2.975**	-5.133***	-3.298
	(1.496)	(1.422)	(1.229)	(1.902)	(3.335)
$\overline{SFE}(Y10) \times Y10$	9.624***	9.928***	5.866***	9.495***	13.72***
	(2.188)	(2.128)	(2.190)	(2.113)	(2.226)
Home	29.69***	29.26***	29.08***	22.14***	21.35***
	(3.606)	(3.620)	(3.899)	(2.603)	(2.664)
Observations	192	192	192	192	183
Adj. R^2	0.514	0.503	0.725	0.820	0.796
N of Banks	15	15	15	15	14
N of Destination Countries	9	9	9	9	9
Time FE	no	yes	yes	yes	–
Bank FE	no	no	yes	yes	yes
Destination Country FE	no	no	no	yes	–
Country–Time FE	no	no	no	no	yes