Institutional investors and home bias in financial investments

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Abstract

Integrated capital markets facilitate risk sharing across countries. Lower home bias in financial investments is an indicator of risk sharing.

We highlight that existing indicators of equity home bias in the literature suffer from incomplete coverage because they consider only listed equities. We also consider unlisted equites and show that equity home bias is much higher than previous studies perceived. We also analyse home bias in debt securities holdings, and euro-area bias. We conclude that European Union membership may foster financial integration and reduce information barriers, which sometimes limit cross-country diversification.

We calculate home bias indicators for the aggregate of the euro area as if the euro area was a single country and report remarkable similarity between the euro area and the United States in terms of equity home bias, while there is a higher level of debt home bias in the United States than in the euro area as a whole.

We develop a new pension fund foreign investment restrictions index to control for the impact of prudential regulations on the ability of institutional investors to diversify geographically across borders.

Our panel regression estimates for 25 advanced and emerging countries in 2001-14 provide strong support for the hypothesis that the larger the assets managed by institutional investors (defined as pension funds, insurance companies and investment funds), the smaller the home bias and thereby the greater the scope for risk sharing.

JEL codes: C33, F21, F36, G11, G23

Keywords: home bias, institutional investment, portfolio diversification

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1. Rationale

Integrated capital markets facilitate risk sharing across sectors and countries, which in turn helps to smooth the impact of economic shocks on consumption and investment (Véron and Wolff, 2015). However, empirical evidence points to varying degrees in which risk sharing via capital markets actually helps smooth shocks in different jurisdictions. Valiante (2016) summarises the evidence that points to the limited contribution of risk sharing to consumption smoothing in the euro area and the EU.

Compared to the findings of Asdrubali *et al* (1996), who estimate that 48 percent of shocks to gross state product in the US between 1981-90 were smoothed by risk sharing (39 percent for 1964-1990), the seminal paper of Sørensen and Yosha (1998) found that the contribution of capital markets in smoothing shocks for six large member states of the (then) European Community was a mere 8 percent (and statistically not significant) during the period 1981-90. They suggest that the reduction of informational barriers to cross-country ownership would likely increase the volume of international capital flows and therefore foster integration[1].

More recent work by Afonso and Furceri (2007) estimated a close to 10 percent risk sharing in the EMU between 1998 and 2005, while the estimate of Furceri and Zdienicka (2013) is near to zero.

Demyanyk, Ostergaard and Sørensen (2008) found that the monetary union has facilitated risk sharing, although the level of risk sharing is still much below the level found among US states. They argue that removal of formal barriers to diversification of assets and obstacles to cross-border banking could help to improve integration.

Schoenmaker and Bosch (2008) also found that the home bias has declined in Europe since the introduction of the euro, and that the decline has been stronger in euro-area countries than in the non-euro-area countries. They also conclude that euro-area-based investors have switched from home to euro-area securities.

Therefore, while cross-border integration of European capital markets has increased in the 2000s (though there was a setback during the euro crisis in the early 2010s), risk sharing continues to remain below values observed within the United States and other large federations. This suggests that there is major scope for further cross-border capital markets integration which could bring many benefits, including increased cross-border risk sharing. The EU's Capital Markets Union initiative rightly recognises the benefits of further integration (European Commission, 2015).

We aim to focus on a particular aspect of financial integration and risk sharing in capital markets: institutional investment. The contribution of institutional investment to risk sharing depends on:

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[1] Sørensen and Yosha (1998) test empirically whether consumption smoothing is achieved by means of risk sharing. Their method requires decomposing GDP growth rates into five component growth rates using national account identities and, thus, use data from OECD National Accounts. They estimate a system of five linear regressions by a two-step Generalised Least Squares procedure, using a panel estimation with time fixed effects for OECD and (then) European Community countries; in each regression, the growth rates of the components are regressed on the GDP growth rates. Specifically, they identify the share of variation in output smoothed through income risk sharing with the slope coefficient of growth rates of net factor income from abroad on GDP rates. They obtained coefficients that are are statistically no different than zero for both the OECD and the EC, leading them to the conclusion that the bulk of consumption smoothing is not achieved by virtue of income risk-sharing but, instead, saving in credit markets. They compare and contrast their results to Asdrubali *et al* (1996), who carry out a similar exercise for US states and find that the majority of soothing occurs through "capital markets", which encompasses net factor income from abroad together with capital depreciation and corporate savings.

- The size of institutional investment;
- The degree of geographical diversification of portfolios, and
- The composition of assets held.

The aim is to investigate these three aspects of financial integration in the EU's Capital Markets Union and to assess the prospects for increased risk sharing in the EU.

Our main hypothesis is that the larger the assets managed by institutional investors, the smaller the home bias and thereby the greater the scope for risk sharing, *ceteris paribus*. Our focus will be on portfolio equity home bias, and less so on portfolio bond home bias, because the former is more important from the perspective of risk sharing.

2. Literature

The concept of 'home bias' refers to a preference for greater investment in home country assets. There is no uniform definition of home bias, but different authors define it differently (we detail our definition in section 5). A huge literature explores the complex determinants of equity home bias and the asset-allocation strategies of mutual funds, as we review below. However, surprisingly few research papers have been published on home bias of two major types of institutional investors, namely pension funds and insurance companies.

Strong and Xu (2003) try to explain the existence of a home bias in equity investment in developed economies by developing a measure of investors' optimism (relative and absolute) that is used to explain the behavioural component of investment decisions. They find that fund managers from the United States, the United Kingdom, continental Europe and Japan show a significant relative optimism towards their home equity markets. Institutional factors have largely failed to explain the home bias. Their data comes from the Merrill Lynch Fund Manager Survey: a survey of 250 large fund managers from USA, UK, continental EU and Japan, constituted by questions concerning mainly prospects for international equity markets. The survey has a monthly frequency and covers the period October 1995-October 2001.

Edison and Warnock (2004) report empirical evidence that US portfolio holdings of emerging markets securities tend to be biased towards firms that are larger, with fewer restrictions on foreign ownership or cross-listed on a US exchange. In particular, they show that the effect of the cross listing is very strong. The authors therefore conclude that information asymmetries play an important role in equity home bias. They use confidential security-level data on US holdings of emerging market stocks from comprehensive benchmark surveys conducted by the US Treasury Department and the Federal Reserve Board as of March 1994 and December 1997, for nine emerging economies (Argentina, Brazil, Chile, Mexico, Indonesia, Korea, Malaysia, Philippines, Thailand).

Suh (2005) assesses the role of information asymmetries in investment decisions. He looks at the portfolio holdings of different countries as well as portfolio adjustments: in the latter case he assumes that the more frequently a country adjusts its portfolio, the better it is informed. His results suggest that home bias can arise from unobservable factors such as information asymmetry and investor optimism. Data for portfolio holdings are from the Economist magazine's 'Our Quarterly Portfolio Poll' for the period Q1/89 to Q2/99, while data for portfolio performance are from Datastream. Countries classified as: US, rest of America, UK, Germany, France, rest of Europe, Japan and rest of Asia.

Aggarwal, Klapper and Wysocki (2005) examine the investment allocation choices of actively-managed US mutual funds in emerging market equities since the market crises of the 1990s. They find that at the country level, US funds invest more in open emerging markets with stronger accounting standards, shareholder rights, and legal frameworks. At the firm level, US funds are found to invest more in firms that adopt discretionary policies such as greater accounting transparency and the issuance of an American Depositary Receipt (ADR). Their data comes from the February 2002 release of the Morningstar database for US mutual funds.

Chan *et al* (2005) analyse six possible determinants of home bias in the equity market allocation of mutual funds in 26 countries. The authors check for: (i) economic development, (ii) capital controls, (iii) stock market development, (iv) familiarity[2], (v) investor protection and (vi) other factors. There is evidence of a significant impact of stock market development and familiarity variables on both domestic and foreign bias, whereas economic development and capital controls influence only the foreign bias. Chan *et al's* data on mutual fund holdings from 26 countries in 1999 and 2000 are from the TFS Database, created by The Investex Group, Securities Data Company and CDA/Spectrum. Data are at the fund level.

Hau and Rey (2008) analyse firm-level data from mutual funds to draw out some stylised facts on the distribution of home bias at the fund level in different countries. Empirical evidence shows that there is a high level of heterogeneity across mutual funds. They also find that (i) large countries tend to be more closed than small ones, implying a higher level of home bias; (ii) bigger funds tend to be more home-biased than smaller ones, perhaps because smaller funds are usually able to offer more customised investments and are able to circumvent some barriers to foreign investments; (iii) the more a fund has a diversified portfolio in geographical terms, the broader the portfolio will be in terms of sectors. The main data source is TFS (Thomson Reuters Financial Securities). It provides disaggregated firm level data for mutual funds in 16 countries for the years from 1997 to 2002.

Anderson *et al* (2011) focus on the role of cultural variables on international diversification of institutionally managed portfolios. They find that countries with a high level of uncertainty avoidance[3] show a higher home bias, countries characterised by a high level of masculinity[4] and long-term orientation tend to have more internationally diversified portfolios, and countries with higher cultural distance[5] tend to diversify less. Therefore, according to this study, culture directly impacts investor behaviour and not merely though indirect channels such as the legal and regulatory framework. The data includes information at the fund level for over 60 countries and securities held in more than 80 countries. Sources are different public filings plus CRSP, Datastream and WorldScope. Data are for year 2006 and the methodology follows a cross section approach.

Rubbaniy, Van Lelyveld and Verschoor (2014) study the home bias of Dutch pension fund investment behaviour. A decline in the level of home bias was observed among Dutch pension funds from 1997 to 2006, which might be due to a relaxation of the strict regulation and a continued increase in the size of pension funds' assets relative to Dutch GDP (see Figure 2). A large increase in managed assets may imply lower home bias – the key hypothesis we test– partly because managers of large funds tend to be more professional and thereby recognise more the benefits of risk diversification, and partly because the supply of the desired securities at home becomes relatively small compared to the assets managed by institutional investors.

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[2] Familiarity is specified as common language, geographic distance and bilateral trade (the sum of bilateral exports and imports as a share of the total sum of exports/imports).

[3] One of the dimensions of national culture based on research on values by Geert Hofstede, Gert Hofstede and Michael Minkov; defined as "*the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity*" (https://geert-hofstede.com/national-culture.html).

[4] "*Masculinity…represents a preference in society for achievement, heroism, assertiveness and material rewards for success. Society at large is more competitive. Its opposite, femininity, stands for a preference for cooperation, modesty, caring for the weak and quality of life. Society at large is more consensus-oriented.*"

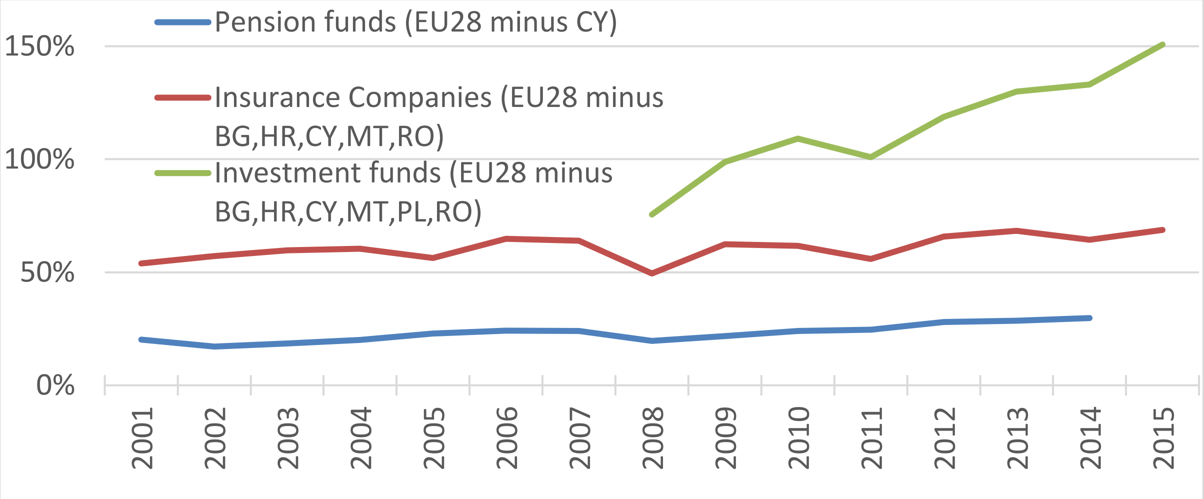
[5] Cultural distance indices are computed by taking a simple average of the difference of scores in "values" between the investor and the target country, normalized by the total variance of the scores. These values are: future orientation, assertiveness, collectivism and uncertainty avoidance as per GLOBE; individualism, masculinity, uncertainty avoidance and long-term orientation as per Hofstede.

The empirical evidence of Rubbaniy, Van Lelyveld and Verschoor (2014) also shows that the preference for domestic portfolio holdings (home bias) seems to be determined also by some fund characteristics, like liability-structure and size. They use a panel dataset of more than 600 Dutch pension funds between 1992 and 2006. The data source is the supervisory dataset of the Dutch National Bank (DNB): this is an entity-level dataset with detailed information on portfolios and balance sheets with an exceptionally high coverage (95 percent).

3. Evolution of institutional investment and the supply of securities

Assets managed by institutional investors (defined as pension funds, insurance companies and investment funds) have increased in the past fifteen years in the EU, both in absolute value and as a share of EU GDP (Figure 1)[6]. Pension fund assets increased from 18 percent of GDP to 29 percent from 2001-14, while insurance funds assets expanded from 57 percent of GDP to 68 percent from 2001-15. The fastest growth is observed for investment funds, where unfortunately a much shorter period is available: their assets increased from 99 percent of GDP to 151 percent from 2008-15.

Figure 1: Assets managed by institutional investors in the EU (% of EU GDP), 2001-2015



Source: Bruegel based on data listed in the data annex. Note: we use constant country-composition EU aggregates and thereby approximate the missing data points. For example, for pension funds, there are 22 countries for which data is available in the full period of 2001-2014. We first calculate the sum of these 22 countries. Data for Luxembourg is available for 2004-2014: we calculated the share of Luxembourg in the sum of assets of the 22 countries and approximate the missing data for 2001-2003 by assuming that Luxembourg's share in the sum of 22 countries 2001-2003 is the same as in 2004. We then calculate the sum of assets of 23 countries: the initial 22 plus Luxembourg. Data for Lithuania is available for 2008-14 and we approximate the missing data for 2001-2007 by assuming that Lithuania's share in the combined assets of the 23 countries was the same in this period as in 2008. Finally, we add Malta similarly, for the 2010-2014 period. We follow the same approach for aggregating insurance corporations and investment fund assets. Note that we calculate these EU aggregates to be able to show constant-country composition values on the chart, but we will not use such approximated data in our regression analysis.

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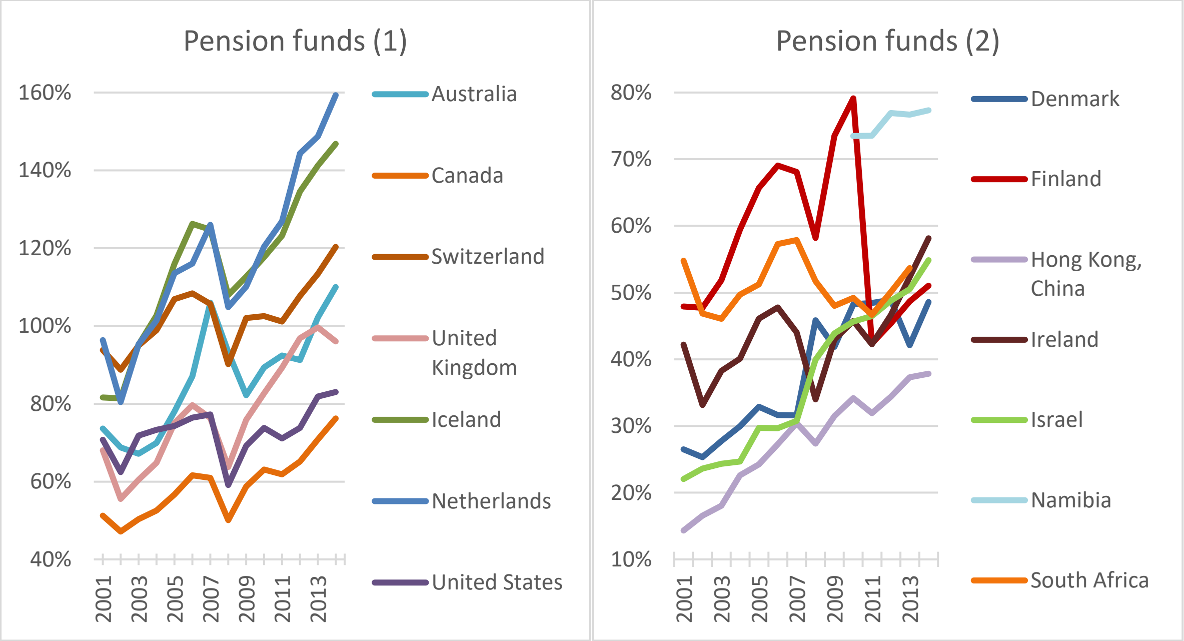
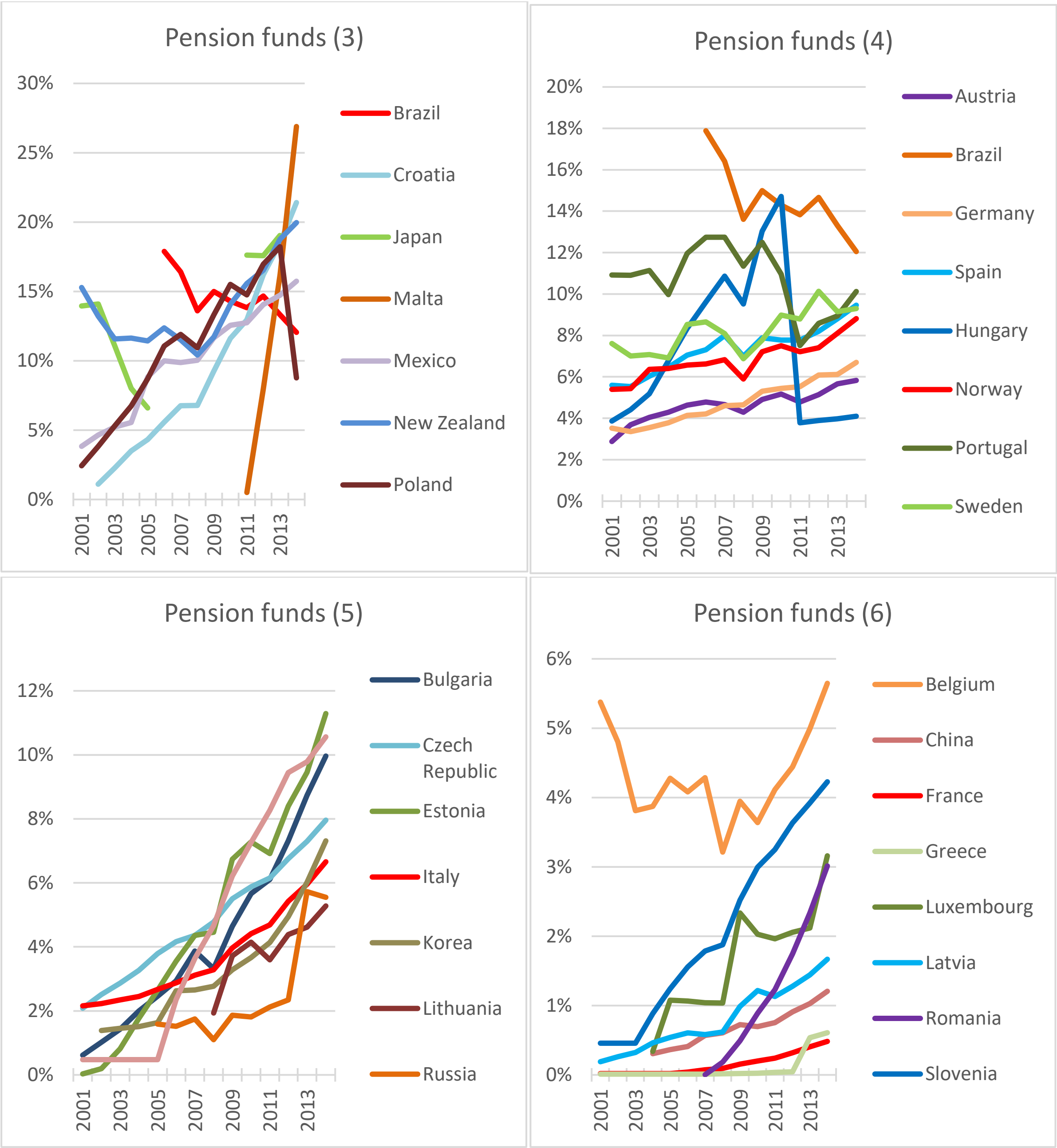
[6] We note that assets of the three types of investors are not additional, because of cross-sectoral holdings, for example pension funds holding of investment fund shares.

Beyond the general increasing trend in the EU, the size of the three types of institutional investors and their increase through time vary a lot in different EU member states.

Pension funds' assets-to-GDP ratios range from 160 percent, the highest in the Netherlands to virtually 0 percent for France and Greece in 2015 (Figure 2). The Netherlands together with the UK are the two EU member states that, along with Australia, Canada, the US, Iceland and Switzerland are home to the largest pension fund industries, compared to the sizes of their economies (Figure 2, Panel 1). Most EU countries have moderately-sized or even small pension fund industries in the context of a global comparison. Note the large number of countries where pension funds' assets to GDP are below 10 percent and that the vast majority of them are EU countries. In France and Greece, pension funds are essentially non-existent (Panel 6). That was also the case for most of the countries that joined the EU in the accession waves from 2004 onwards. Nevertheless, in many of these member states, Croatia, Estonia, Malta and Slovakia to mention a few, there has been a rapid expansion of the industry in the last 14 years. On the other hand, pension funds in large continental member states such as Germany, Italy and Spain have remained relatively small over this period. Regardless of the value of the ratio in 2001, the size of the pension fund industry relative to the size of the economy has tended to increase. However, growth has not been uniform over the years, because the 2008-09 financial crisis caused a contraction in the value of assets relative to GDP, especially in those countries that are home to large pension fund sectors. Finally, it is worth noting the sharp drop in the assets to GDP ratio of pension funds in Hungary from 15 percent of GDP to 4 percent in 2011, which was the result of a reversal of the mandatory private pension funds system which was introduced in the late 1990s. There was also a very significant drop in Finland from 79 percent of GDP in 2010 to 42 percent a year later.

Figure 2: Pension fund assets (% of GDP), selected countries, 2001-14

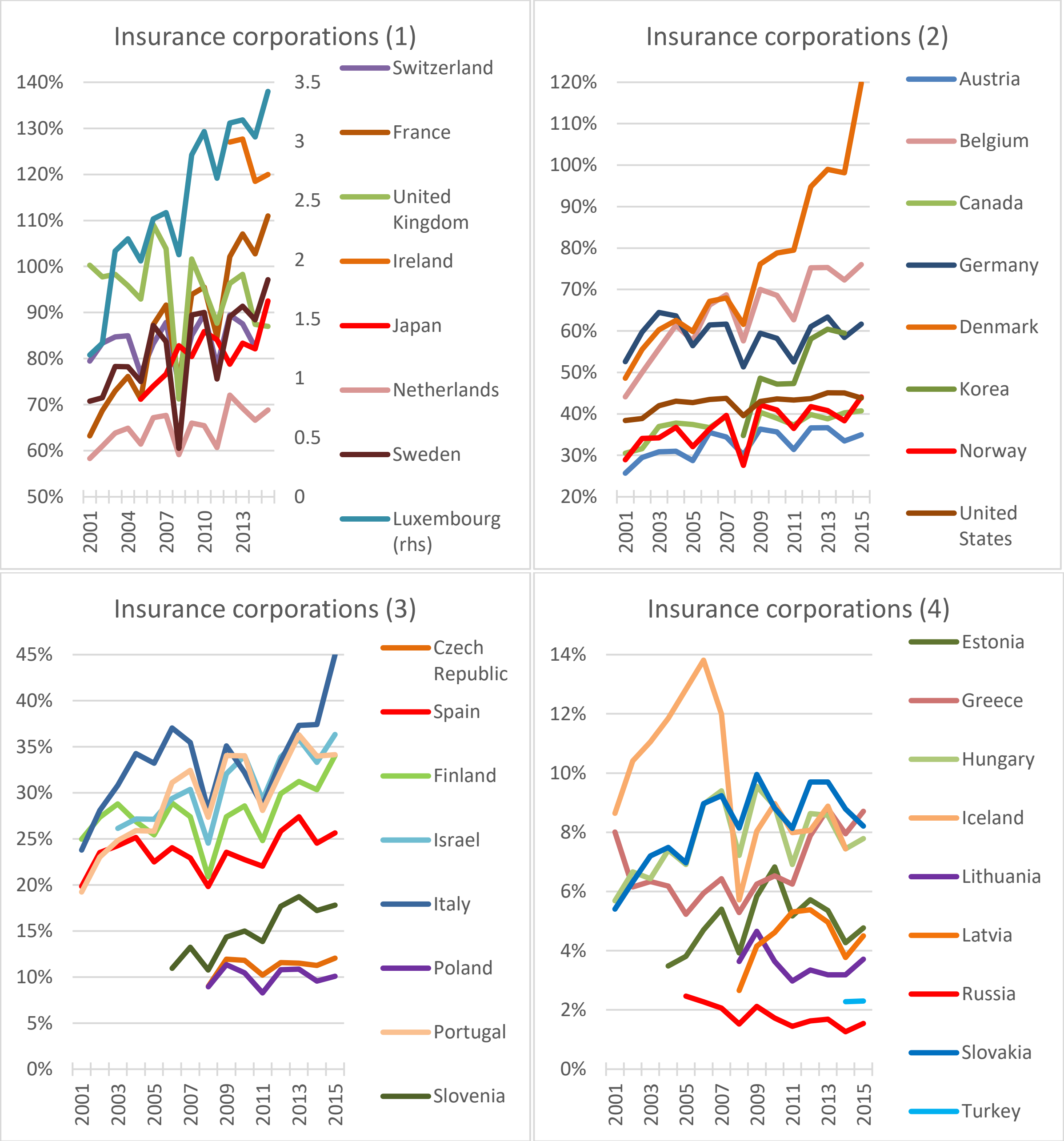




Source: see data annex.

Data on the asset-to-GDP ratios of insurance corporations is available for a more restrictive set of countries. Figure 3 reports values for selected economies. A comparison with the equivalent charts for pension funds reveals that insurance companies are more mature at the beginning of the 2000s and the size of their balance sheet relative to the size of the economy is more stable over the period 2001-15. The second observation is less true for large insurance industries, such as the Luxembourgish and the French (Figure 3, Panel 1), but also the Danish (Figure 3, Panel 2), where the asset ratio has more than doubled in the last 15 years. Another general pattern is the drop in the value of total assets relative to GDP in 2008, and less so in 2011, once again more so where insurance corporations tend to be larger (Luxembourg, France, Sweden). The fourth panel also captures the financial collapse of Iceland, as it impacted the insurance sector. In terms of cross-country comparison, Luxembourg has by far the largest insurance industry relative to its size. France and the UK, joined by Ireland and the Nordic member states also have relatively large insurance sectors. By contrast, insurance corporations in Greece, the Baltics and the countries of central Europe are rather small. The other member states are home to insurance sectors that are closer in size to the average of the distribution and comparable to those of other advanced economies, such as the US, Canada and South Korea. It should be noted that Figure 3 and Figure 4 are to some extent complementary. The large share of insurance assets and low share of pension fund assets in France, for example, can be explained by the fact that life insurance policies are the main vehicle for pension savings in France.

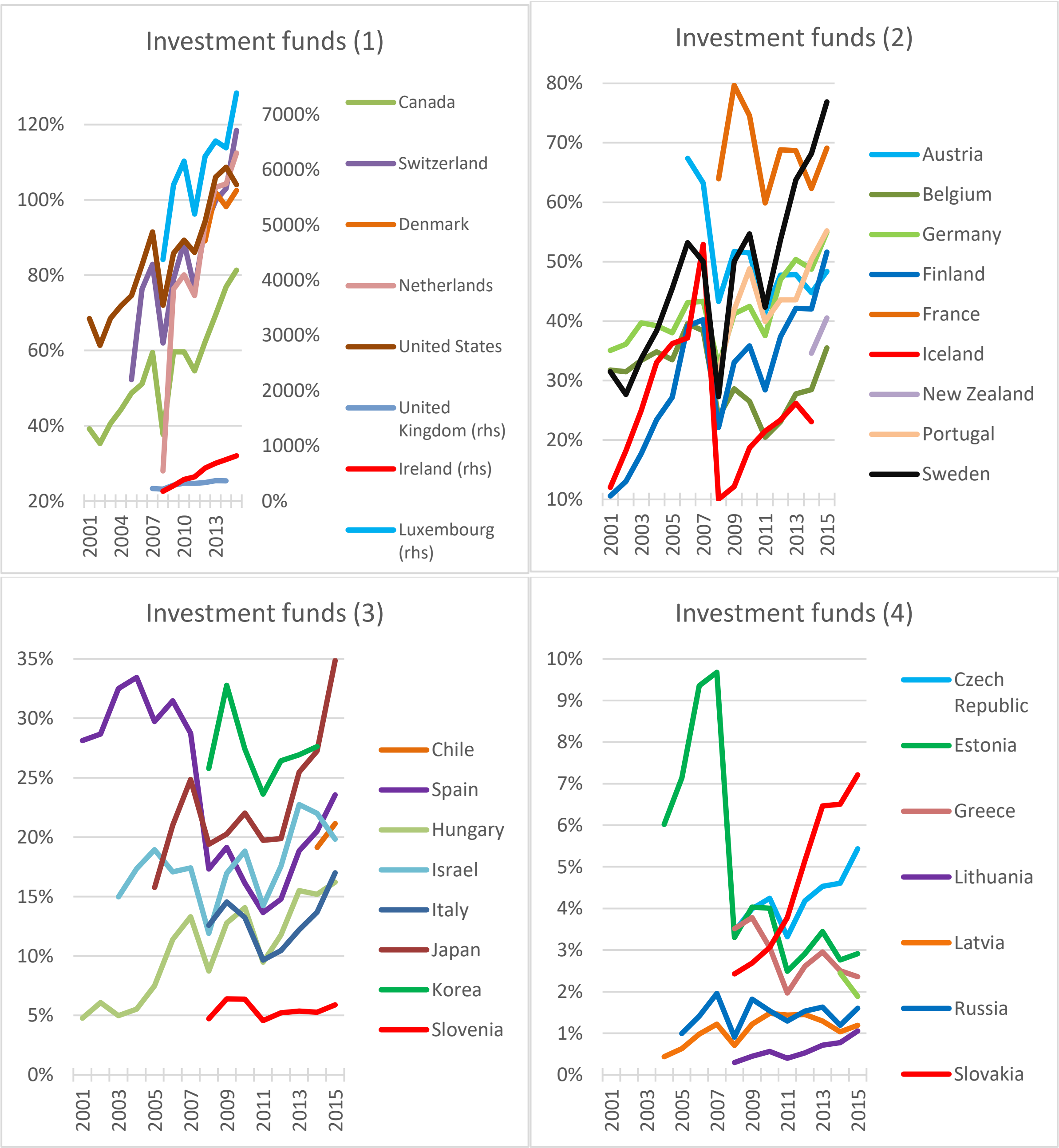
Figure 3: Insurance corporation assets (% of GDP), 2001-2015



Source: see data annex.

Unfortunately, data for investment funds cover much shorter periods and, crucially, begin in the year 2008 for most countries (Figure 4). However, for some countries the data goes back before 2008 and helps to show the extent to which the value of investment funds' assets suffered during the financial crisis. The range and the dispersion of countries' ratios are larger than for the other two types of institutional investors. Specifically, Luxembourg, whose investment funds industry size is a staggering 70 times its GDP, Ireland and the UK are the clear outliers in the distribution. The UK, US, Netherlands, Denmark and Sweden also have relatively large investment funds, with a ratio closer to 100 percent. Again, investment funds are developed the least in the Baltics, central Europe and Greece. Most of the continental EU states (including France and Germany) fall in between and closer to the median. Finally, one can notice that, at least since 2008, assets of investment funds have grown faster than GDP in particular in those countries where they were already relatively developed (those in panel 1, Sweden in panel 2, of Figure 4).

Figure 4: Investment fund assets (% of GDP), 2000 and 2014



Source: see data annex.

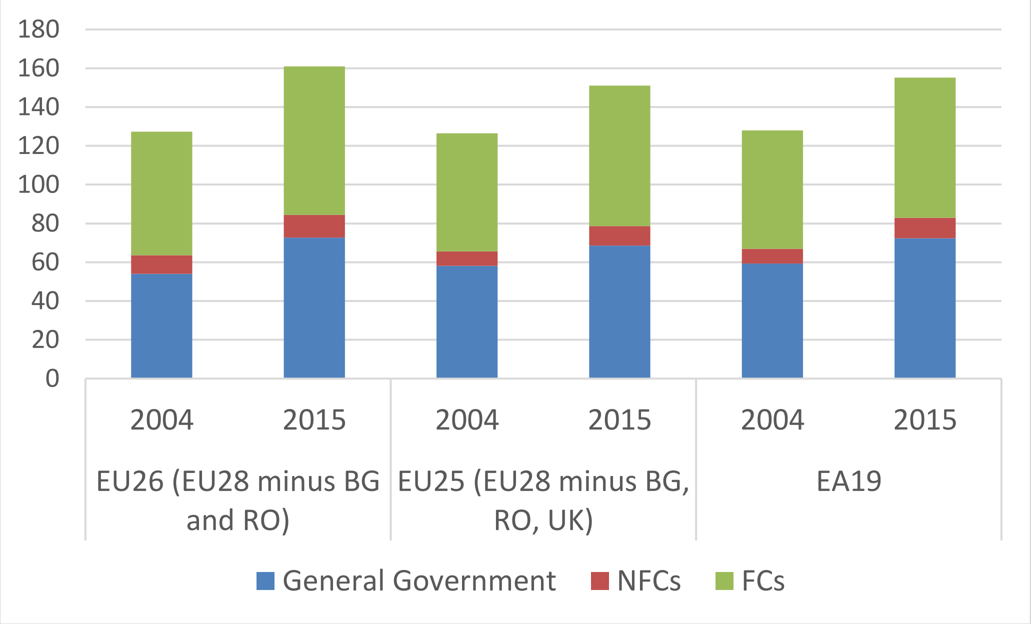
Institutional investment is expected to increase further, in particular from pension funds. While some countries have well developed pension fund schemes, others have very small or no private pension funds. The main drivers of pension fund development are ageing and safeguarding of pension entitlements (by separating pension liabilities from corporate balance sheets into independent pension funds).

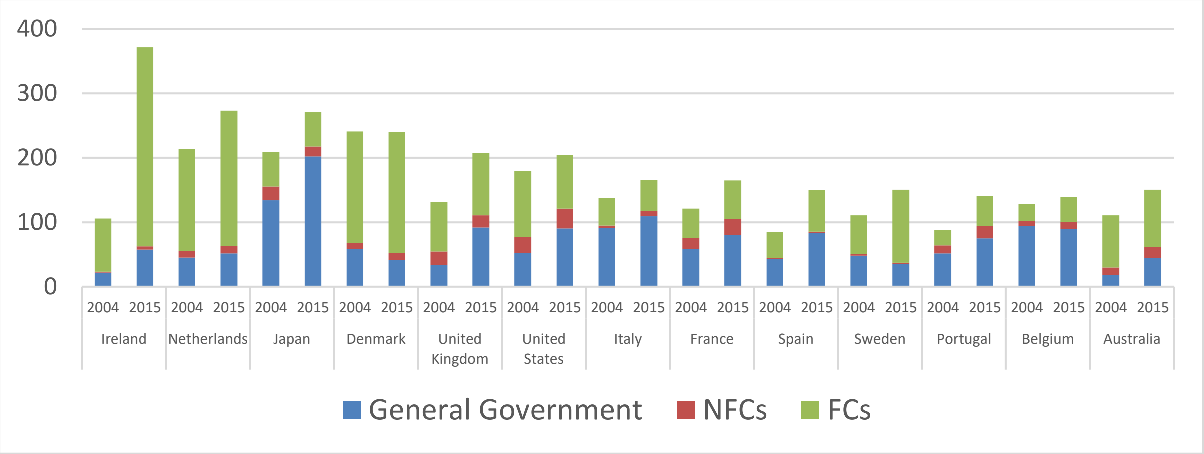
The increasing demand for marketable securities (equities and bonds) by institutional investors could be satisfied by the increasing issuing of equity and bonds by corporates, as well as government bonds. Figure 5 shows that the outstanding stock of debt securities as percent of GDP increased from 2004 to 2015 by all three major issuers, the general government, non-financial corporations (NFCs) and financial corporations (FCs). In the EU as a whole (excluding Bulgaria and Romania due to data availability issues) debt securities issued by general governments and financial corporations are broadly similar in size, while non-financial corporations have a relatively small, but increasing share. The EU aggregate excluding the UK (see the centre of Figure 5) is somewhat smaller as a percentage of GDP.

In most countries, debt securities relative to GDP increased from 2004 to 2015, the exceptions being Austria, Argentina, Cyprus, Germany, Greece, Turkey and Saudi Arabia. In Cyprus and Greece, the deep economic crisis of the past few years reduced private sector issuance, while official loans replaced debt securities in general government financing.

We plot Luxembourgish data on a separate panel, given the extraordinary large stock of debt securities issued by financial institutions (about 15 times annual GDP in 2015).

Figure 5: Debt securities by issuer, selected countries (% of GDP), 2004 and 2015

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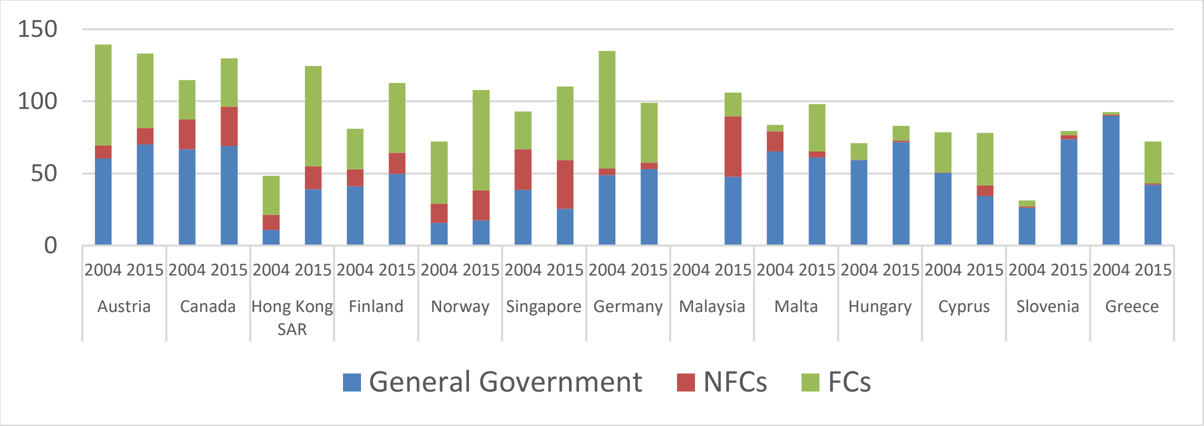
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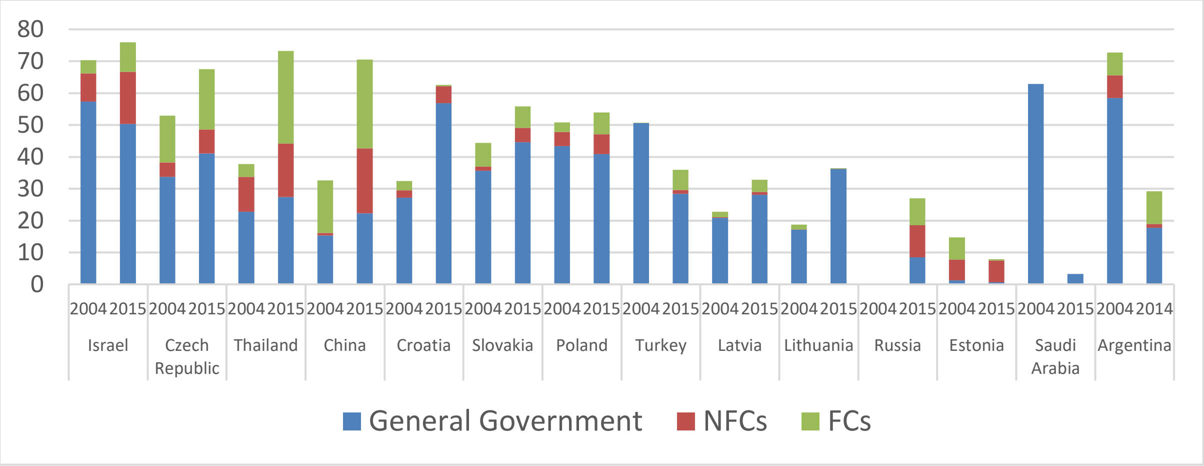
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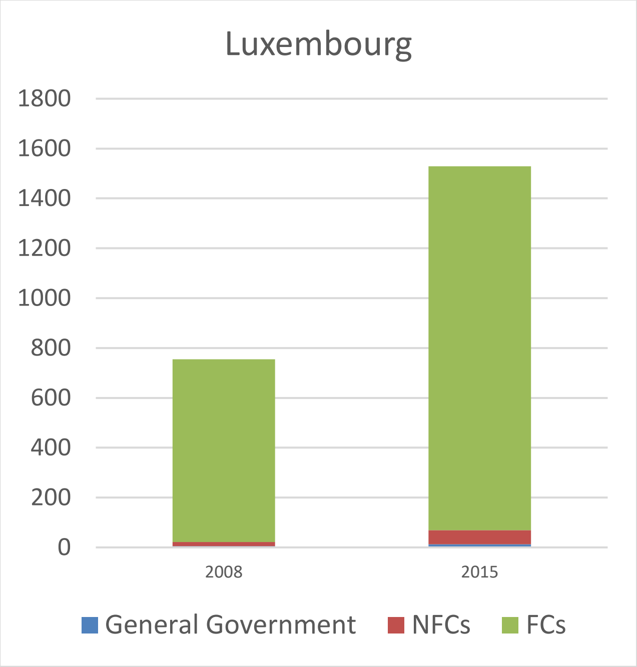
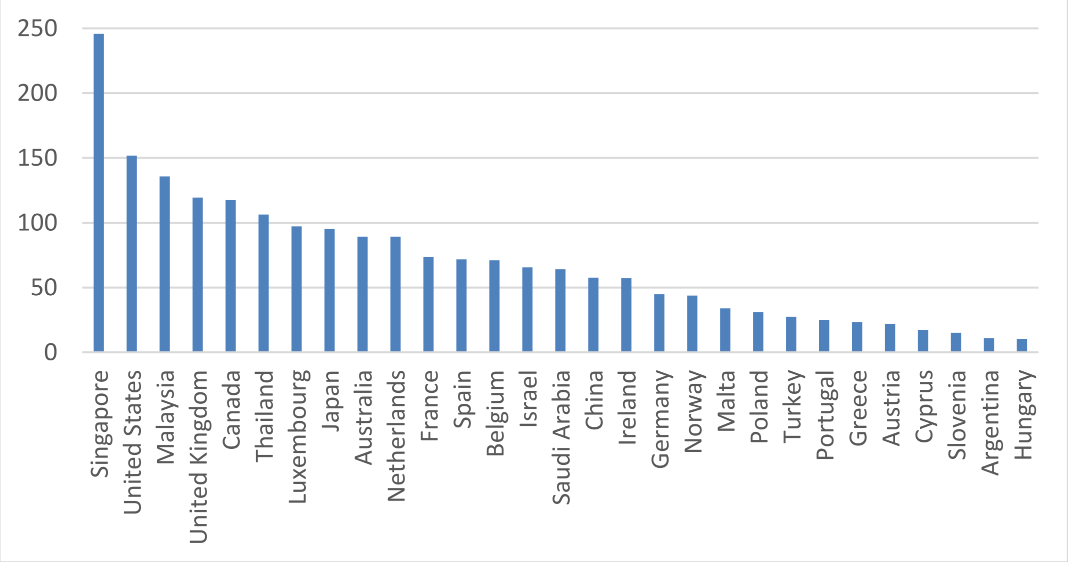


Source: see data annex.

Stock market capitalisation as a share of GDP (Figure 6) varies significantly in different countries. In smaller and in emerging countries, its share in GDP is rather low at a few dozen percent. In Germany stock market capitalisation is about 50 percent and in the Netherlands, France and Belgium it is about 90-100 percent, still below the US value of about 140 percent of GDP.

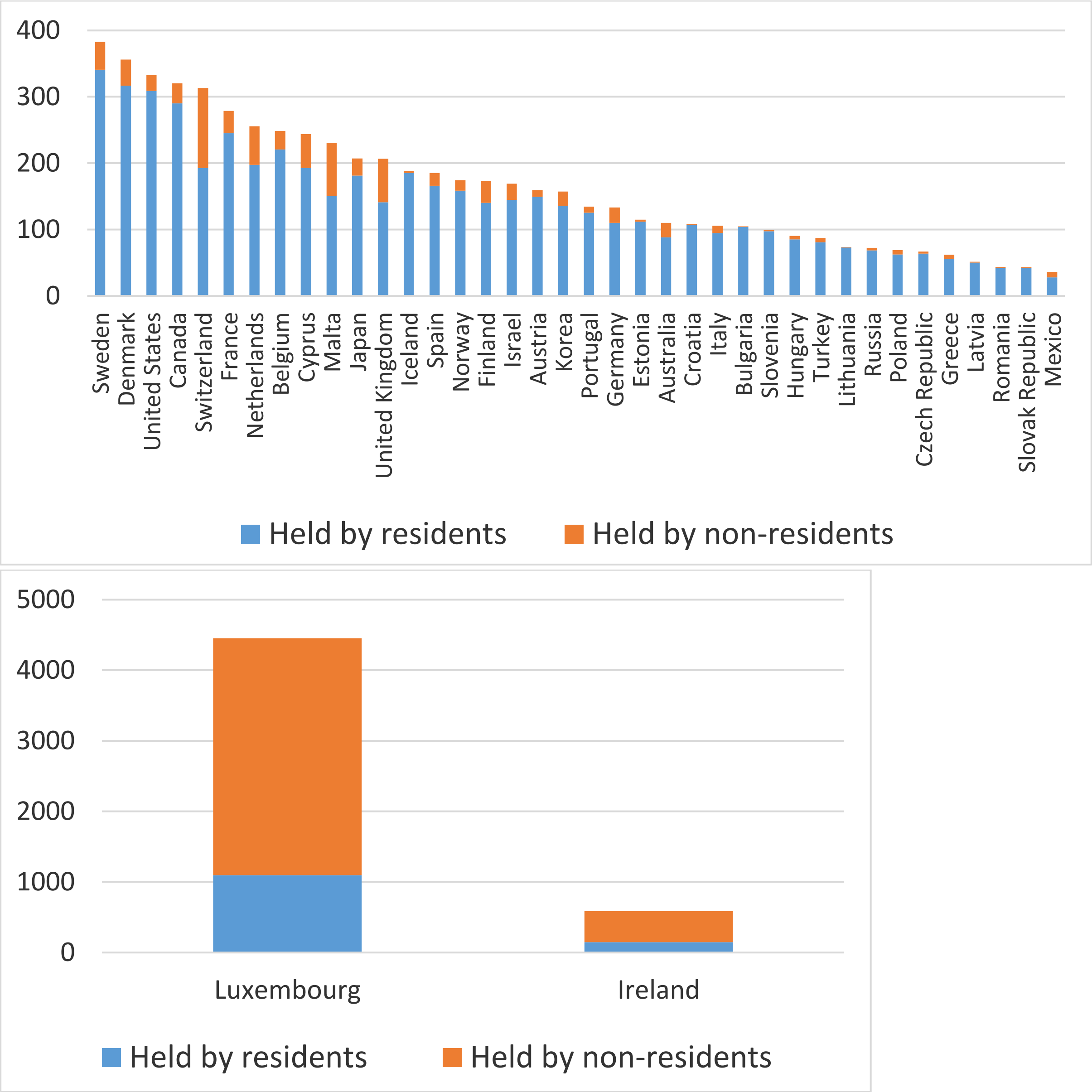
Figure 6: Stock market capitalisation of listed companies in 2015, selected countries, % of GDP



Source: World Bank, Market capitalisation of listed companies.

However, stock market capitalisation does not include all domestic equity investment opportunities. The financial balance sheet data of the national accounts dataset also includes, beyond listed shares, unlisted shares, other equity and investment fund shares/units. Figure 7 shows huge variations in different countries, from a value of less than 100 percent of GDP in several countries to 45 times GDP in Luxembourg (therefore, we plotted Luxembourg, along with Ireland, on a second panel). There is also a great diversity in the share of non-resident holdings of total domestic equity: non-residents have dominant roles in Luxembourg, Ireland, Switzerland, Malta, and the UK, while their share is very low for example in Lithuania, Bulgaria, Croatia, Iceland and Slovakia.

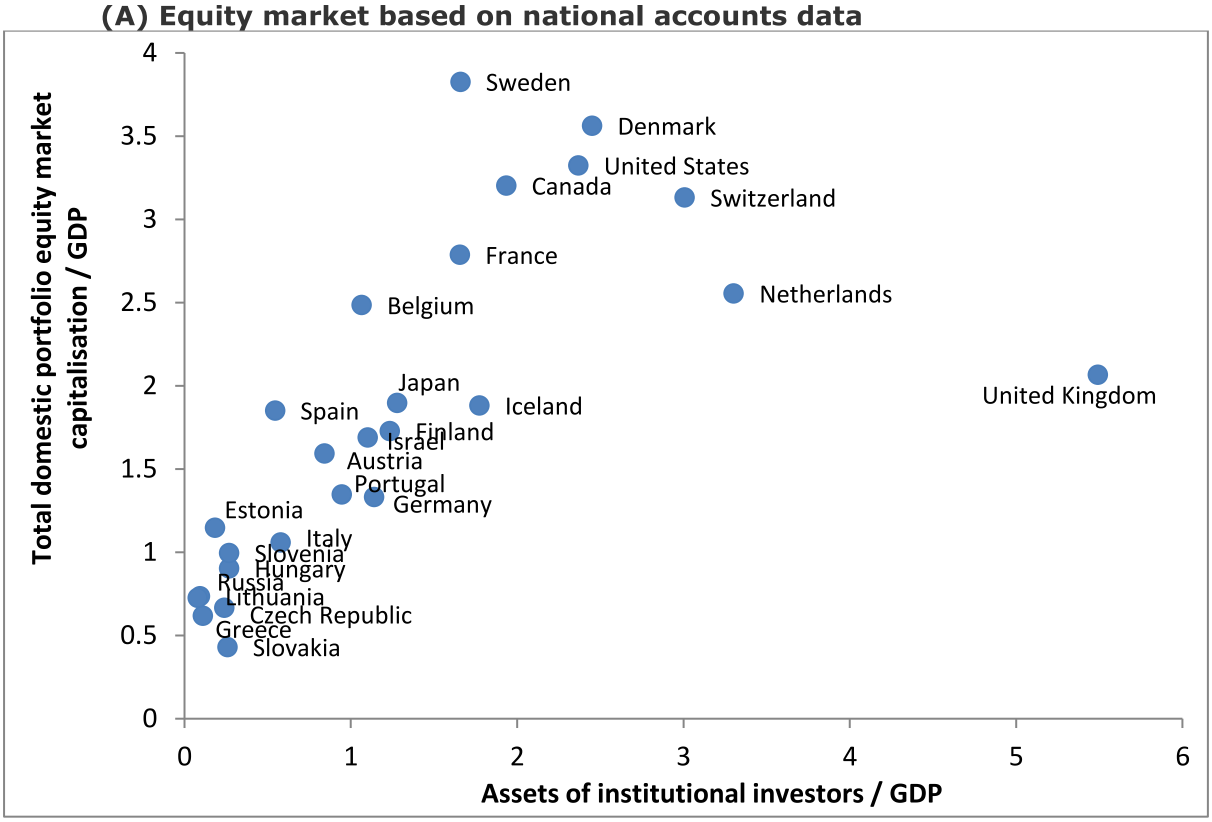
Figure 7: Total domestic portfolio equity market capitalisation held by residents and non-resident (from the national accounts dataset), selected countries, 2014, % of GDP



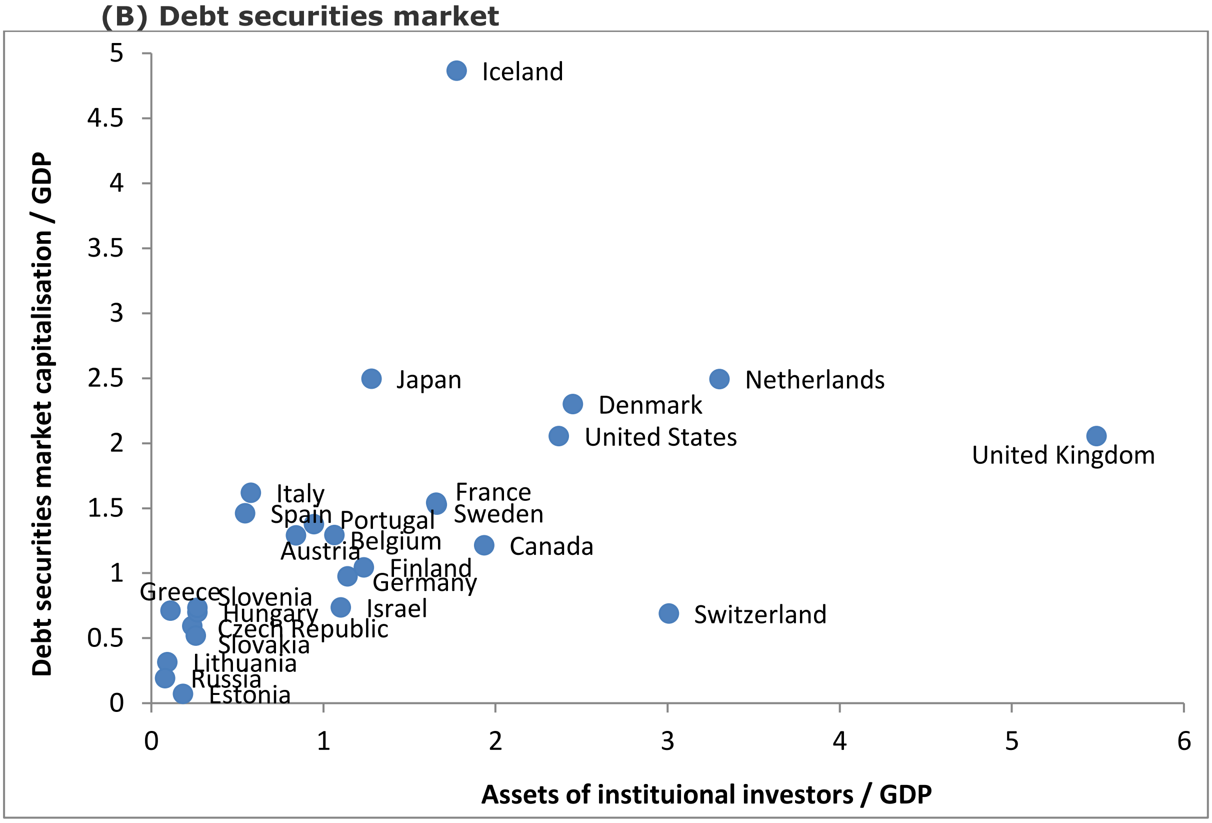
Source: see data annex. Note: Financial balance sheet data of the national accounts dataset includes four categories: (1) listed shares, (2) unlisted shares, (3) other equity and (4) investment fund shares/units. In order to focus on portfolio investment and to exclude foreign direct investment, 'total domestic portfolio equity market capitalisation' is the sum of domestic equity holdings of residents plus the domestic portfolio equity holdings of foreigners from CPIS. See the data annex for further information. Data for Switzerland is for 2013.

Finally, we consider whether the size of assets managed by institutional investors is associated with higher market capitalisation. Figure 8 shows a clear relationship: for both equity and debt, countries with larger assets (relative to GDP) managed by institutional investors tend to have larger markets (relative to GDP).

Figure 8: Assets managed by institutional investors and market capitalisation (2014 or most recent data), % of GDP



(A) Equity market based on national accounts data


(B) Debt securities market

Source Bruegel based on data sources listed in the annex.
Note: assets of institutional investors plotted on the horizontal axis are the sum of assets managed by pensions funds, insurance corporations and investment funds. In order to focus on portfolio investment and to exclude foreign direct investment, 'Total domestic portfolio equity market capitalisation' plotted on the vertical axis of Panel A is the sum of domestic equity holdings of residents plus the domestic portfolio equity holdings of foreigners from CPIS. See the data annex for further information.

4. A new pension fund foreign investment restrictions index

An important factor in investment behaviour is whether prudential regulations allow institutional investors to diversify across borders. Some countries still have investment limits, while others apply the prudent person principle (appropriate diversification). Unfortunately, no numerical indicators have been published to summarise regulatory restrictions. Since we would like to include such restrictions as an explanatory variable in our regressions, we create a new index that we call 'Pension fund foreign investment restrictions index'. Unfortunately, we could not find any underlying dataset for insurance companies and investment funds and thereby we can calculate our index only for pension funds.

4.1. Description of the new index

We construct the index using data from the Annual Survey of Investment Regulation of Pension Funds of the OECD:

http://www.oecd.org/finance/private-pensions/annualsurveyofinvestmentregulationofpensionfunds.htm

The survey covers years 2001 and 2005 to 2014 for most countries in our regression sample; however, for some countries coverage is not complete. The exact series we used is the "Restriction on foreign investment (code R2), All asset classes (code A8)". We calculate the index for 42 countries: 24 EU countries and 18 non-EU countries. The index cannot be calculated for four EU countries: Latvia, Cyprus and Croatia are not included at all in the OECD dataset, while for France there is no data on restrictions on foreign investment[7]. The availability of the index is reported in Table 1.

We define an index of regulatory restrictions on foreign investment of pension funds in country i for year t as q_{it} where:

$$q_{it} = 1 - s_{it}$$

and s_{it} is the maximum allowed share of foreign assets in the pension fund portfolio of country i for year t. The index can be understood as measuring the extent to which limits on foreign investment constrain diversification. It ranges from 0 to 1 and higher values correspond to more stringent regulatory restrictions.

The information in the OECD dataset provides a qualitative description of restrictions on the assets pension funds are permitted to hold, which includes quantitative limits. These limits correspond to the maximum share of foreign assets pension funds in each country are permitted to hold in their portfolio, but more often than not they do not apply uniformly across all world assets. This makes the task less straightforward and calls for some simplifying assumptions, which are presented below.

The most common way limits are defined is on the basis of location. In certain cases, different restrictions apply to OECD and non-OECD countries. Since the bulk of global securities were issued in OECD countries, we only consider restrictions (or the lack thereof) on securities issued in OECD countries and ignore restrictions applying to non-OECD countries. Therefore, 'no restrictions on assets holdings within the OECD' is equivalent to allowing 100 percent of assets to be 'foreign', thus implying potential for 'full diversification'. When there is no discrimination among OECD countries, we define maximum allowed share of foreign assets simply as:

$$s_{it} = s_{it}^{OECD}$$

However, in some countries separate limits are placed on holdings of assets within the EU/EEA and in those OECD members that are not in the EU/EEA. In those cases, we opt for a weighted average of the two limits, applying equal weights. In these cases we define the maximum allowed share of foreign assets as:

$$s_{it} = 0.5 s_{it}^{EEA/EU} + 0.5 s_{it}^{OECD\ NON\ EEA/EU}$$

Thus, if a country's regulations allow investment without limit within the EU but forbid the holding of assets of other OECD countries, it is assumed that the pension fund can achieve only half the diversification it could potentially achieve without any limit imposed on the OECD as a whole.
Likewise, when the quantitative limit is expressed in terms of the currency in which assets are denominated, it is weighted by a proxy of the currency's importance. Specifically, if the limits refer to the US dollar or the euro, then the weight is 0.5, if it is foreign currency in general then the weight is 1:

$$s_{it} = 0.5 s_{it}^{EUR} + 0.5 s_{it}^{USD}$$

For one country (Israel) in our sample restrictions take the form of minimum credit ratings. A relatively high credit rating restriction limits the share of eligible foreign assets. We make the following assumptions:

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[7] We note that some further non-EU countries could be added.

- Credit rating of BB-, i.e. below investment grade: we assume there is no restriction, i.e. $s_{it} = 1$.
- Credit rating of BBB-, i.e. investment grade: we assume there is no restriction, i.e. $s_{it} = 1$.
- Credit rating of A-: we assume that $s_{it} = 0.7$.
- Credit rating of A: we assume that $s_{it} = 0.6$.

If there is a quantitative limit expressed as a percentage of the pension fund assets on top of a minimum credit rating requirement, we simply multiply that limit by the assumed share of eligible assets implied by the rating. For example, in 2007 the restriction in Israel required that at most 70 percent of assets can be invested in any country which is BB-rated at least: in this case $s_{it} = 0.7$, because (as we list above) we treat the BB- credit rating as not constraining foreign investments.

Finally, when the description lists different restrictions for different pension funds/options in a country (see Table 2 for these cases), the index is calculated for each one and a simple average over the funds/options is calculated:

$$s_{it} = \frac{1}{N}\sum\nolimits_{j=1}^{N} s_{jit}$$

where s_{jit} is the limit for the jth pension fund/option in country i out of a total of N pension funds/options. Note that if there is more than one pension funds/options, calculating the average is the last step in obtaining s_{it}. We first construct each of the s_{jit} according to the same guidelines as above. In some cases, where for each option or plan the limits are the same, the single limit is used. Table 2 summarises for which countries there were more than one limits, the funds'/options' names and the way the limit is calculated.

Table 1: Our new pension fund foreign investment restrictions index

Country	code	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	AU	0				0	0	0	0	0	0	0	0	0	0
Austria	AT	0.25				0.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Belgium	BE	0.35				0	0	0	0	0	0	0	0	0	0
Bulgaria	BG											0	0	0	0
Canada	CA	0.7				0	0	0	0	0	0	0	0	0	0
Chile	CL						0.7	0.6	0.4	0.4	0.35	0.2	0.2	0.2	0.2
Colombia	CO						0.8	0.8	0.6	0.6	0.6	0.475	0.475	0.475	0.475
Czech Republic	CZ	0				0	0	0	0	0	0	0	0		
Denmark	DK	0.8				0	0	0	0	0	0	0	0	0	0
Estonia	EE						0	0	0	0	0	0	0	0	0
Finland	FI	0.475				0.45	0.45	0.225	0.225	0.225	0.225	0	0	0	0
Germany	DE	0.835				0.35	0.35	0.35	0	0	0	0	0	0	0
Greece	GR	0				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Hong Kong (China)	HK											0.3	0.3	0.3	0.3
Hungary	HU	0.75				0	0	0	0	0	0	0	0	0	0
Iceland	IS	0.5				0	0	0	0	0	0	0.5	0.5	0.5	0
India	IN												1	1	1
Ireland	IE	0				0	0	0	0	0	0	0	0	0	0
Israel	IL						0.5	0.3	0.3	0.3	0.4	0.3	0	0	0
Italy	IT	0				0	0	0	0	0	0	0	0	0	0
Japan	JP	0				0	0	0	0	0	0	0	0	0	0
Korea	KR	0.9				0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.65	0.25	0.25
Lithuania	LT													0	0
Luxembourg	LU	0.9				0	0	0	0	0	0	0	0	0	0
Malta	MT											0	0	0	0
Mexico	MX	1				0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Netherlands	NL	0				0	0	0	0	0	0	0	0	0	0
New Zealand	NZ	0				0	0	0	0	0	0	0	0	0	0
Norway	NO	0				0	0	0	0	0	0	0	0	0	0
Poland	PL	0.95				0.95	0.95	0.825	0.825	0.825	0.825	0.825	0.825	0.475	0.8
Portugal	PT	0.8				0	0	0	0	0	0	0	0	0	0
Romania	RO											0	0	0	0
Russia	RU							0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8
Slovak Republic	SK	0				0.3	0.3	0.3	0.3	0	0	0	0	0	0
Slovenia	SI											0	0	0	0
South Africa	ZA						0.85	0.8	0.8	0.8	0.8	0.8	0.75	0.75	0.75
Spain	ES	0				0	0	0	0	0	0	0	0	0	0
Sweden	SE	0.9				0	0	0	0	0	0	0	0	0	0
Switzerland	CH	0.7				0.7	0.7	0.7	0.7		0.7			0	0
Turkey	TR	0				0	0	0	0	0	0	0	0	0	0
United Kingdom	GB	0				0	0	0	0	0	0	0	0	0	0
United States	US	0				0	0	0	0	0	0	0	0	0	0

Note: not available data are highlighted with yellow.

Table 2: Countries where different restrictions apply for different pension funds/options

Country		Funds/options	Years	Method	N (for average)
AT	Austria	Pensionskassen; Support funds	2013-2014	Same limits	-
BG	Bulgaria	Mandatory universal pension funds (UPF); Mandatory professional pension funds (PPF); Voluntary pension funds with occupational schemes (VPFOS); Voluntary pension funds (VPF)	2013-2014	Same limits	-
CL	Chile	Five anonymized funds; joint limit reported and used	2006-2014	Joint limit	-
CO	Colombia	Four anonymized funds	2011-2014	Average	4
DE	Germany	Pensionskassen; Pensionsfonds	2005*-2014	Average	2
FI	Finland	Voluntary pension plans; Statutory pension plans	2007-2014**	Average	2
HU	Hungary	Voluntary pension funds (VPF); Mandatory pension funds (MPF)	2001	Average	2
JP	Japan	EPF; TQP	2001	Same limits	-
KR	Korea	Personal pension; corporate pension (average of limits for DB and DC)	2005-2014	Average	2
LT	Lithuania	Conservative funds; Other funds; Supplementary accumulation for pension	2013-2014	Same limits	-
LU	Luxembourg	SEPCAV and ASSEP; CAA supervised pension funds	2007-2014	Same limits	-
MT	Malta	Occupational Retirement Schemes; Personal Retirement Schemes	2013-2014	Same limits	-
MX	Mexico	All Afores, (Siefore) Basic Fund 1; All Afores, (Siefore) Basic Fund 2; All Afores, (Siefore) Basic Fund 3; All Afores, (Siefore) Basic Fund 4	2013-2014	Same limits	-
PL	Poland	Open Pension Funds; Employee Pension Funds	2001-2014	Average	2
PT	Portugal	Closed pension funds; Open pension funds; Personal retirement saving schemes (PPR)	2013-2014	Same limits	-
RO	Romania	Private pension fund - second pillar; Private pension fund - third pillar	2013-2014	Same limits	-
RU	Russia	Mandatory funded pillar, default option; Mandatory funded pillar, conservative option; Mandatory funded pillar, Non-state pension funds and Investment	2010-2014	Average	4
SK	Slovak Republic	Privately managed mandatory pension system - Bonds Guaranteed Fund; Privately managed mandatory pension system - Equity Non-Guaranteed Fund; Privately managed mandatory pension system - Other types of funds; Voluntary personal	2013-2014	Same limits	-

* Pensionskassen are not mentioned at all in 2005, but is included anyway with the same limit as 2006

** The names are somewhat different for years 2013 and 2014, but essentially refer to the same funds

4.2. Developments in pension fund restrictions

Our index suggests that many countries apply very limited if any, restrictions on foreign investment (Table 1). Many of them, including but not limited to Italy, Japan, Netherlands, Spain, the United Kingdom and the United States, did not apply any specific limits as early as 2001, the first year the survey is conducted.

However, some other countries imposed substantial limits in 2001 and gradually relaxed these barriers in recent years. This set of countries includes Denmark, Finland, Germany, Hungary, Romania and Sweden in the EU, and Canada, Chile and Switzerland outside the EU.

Yet there is also a group of countries where considerable constraints have persisted over time. This is the case in Austria and Poland, which retain currency restrictions for pension fund assets, Greece, which limits pension fund foreign investment within the EEA. Outside the EU, Mexico, Russia and South Africa apply rather restrictive limits that have proved persistent, while India outright forbids foreign investment.

5. Home bias and euro-area bias

Institutional investors, as professional parties, typically hold geographically diversified portfolios of marketable securities. In that way, institutional investors contribute to financial integration and risk sharing across Europe’s Capital Markets Union and beyond. As institutional investors increase in size, they become more professional and may reduce the home bias in their investments. This is the key hypothesis we test using our dataset.

5.1. Data issues

We describe our data in detail in the data annex, but we highlight here a few key issues related to the comparability of data.

Unfortunately, it is rather difficult to obtain time series on assets held by institutional investors separated as domestically and non-domestically issued.

- While the OECD's Institutional Investors' Assets and Liabilities dataset may seem to be a straightforward data source, unfortunately it is not suitable for our purposes. This dataset includes country-wide data for three types of institutional investors (pension funds, insurance corporations, investment funds) and various asset types[8], separated depending on whether issued by residents or not. However, we realised that a major double-counting problem raises serious questions about the usefulness of this dataset. Specifically, some pension funds and insurance companies moved away from the direct purchase of securities and instead purchased investment fund shares. After such a change, all holdings of investment fund shares are regarded as ‘domestic’ if the investment fund is registered in the home country. However, since these investment funds hold a diversified portfolio including foreign assets, such a change from direct investment to investment fund shareholdings seemingly increases the home bias, even if there was no effective change in home bias.

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[8] The dataset also includes data on liabilities of institutional investors.

Unfortunately, it is not possible to approximate the investment fund's home/foreign holding division (which can be calculated from the OECD dataset) to allocate the pension fund holdings of investment fund shares, because pension fund investment fund shares are not broken down by the residency of the issuer. Only the aggregate of 'equity and investment fund shares' holdings of pension funds is available according to the residency of the issuer, but since pension funds likely hold domestic equities too, it is not possible to obtain information from the OECD dataset on the pension funds' holding of resident investment fund shares.

- We therefore use the IMF's Coordinated Portfolio Investment Survey (CPIS) for cross-border positions and we consider the total economy asset and liability positions. Unfortunately, the sectoral data of this dataset (which include data for 'insurance corporations and pension funds') includes too many missing data and we are also unsure whether this sectoral data suffers or not from the same double-counting problem as the OECD's dataset.

Therefore, we use the IMF's CPIS dataset on foreign assets and liabilities of the total economy. Clearly, we use indicators of home bias that represent the total economy, while we wish to assess the impact of institutional investors on home bias. Consequently, there is a discrepancy between the sectoral composition of our dependent variable (total economy home bias) and explanatory variable (assets managed by institutional investors). This discrepancy will likely disturb our regression results. We note, however, that in countries in which institutional investors manage relatively large assets, the home biases of institutional investors have a significant influence on the home bias of the total economy. A reasonable strategy for our estimations would therefore be to consider only those countries in which institutional investors manage assets which are relatively large compared to the country's GDP.

In order to calculate home and euro-area biases, we also need data on the total volume of outstanding debt and stock or equity market capitalisation.

For equities, a possible indicator is stock market capitalisation. Many related studies rely on this indicator. A key advantage of this indicator is the consistent definition across countries and availability for most countries of the world. However, stock market capitalisation may include foreign direct investment holdings of non-residents, if the total value of the listed companies are considered, not just the shares traded publicly.

Another problem with the use of stock market capitalisation data is its possible incompatibility with the CPIS portfolio holdings data. Mutual funds are classified as equity in the CPIS, but some of them are bond funds. For this reason, world stock market capitalisation is an insufficient match for CPIS equity data.

An alternative to the use of stock market capitalisation data is the use of the equity data from the financial balance sheet statistics of the national accounts dataset. Financial balance sheet data includes four categories: (1) listed shares, (2) unlisted shares, (3) other equity, and (4) investment fund shares/units. A problem with this data is the possibility of double counting: investment funds may hold listed and unlisted shares and other equity and thereby the sum of the four categories may overstate the actual equity supply.

A further issue with the use of equity data from the national accounts dataset (that we believe we are able to address properly) is that we are interested in portfolio equity holdings of institutional investors, while national accounts data include all kinds of equity, including foreign direct investment claims on the home country. To address this issue, we subtracted all foreign equity claims (ie both portfolio and foreign direct investment claims) on the country in question to arrive at an indicator of domestic equity holdings of residents. Then, using the CPIS dataset, one can identify the domestic equity portfolio holdings of non-residents and add it up to domestic equity holdings of residents to obtain the total stock of domestic (portfolio) equity.

Since neither stock market capitalisation nor equity data from the national accounts dataset is perfect, we derive our home bias indicator using both of these versions and study both of them in our regressions analysis.

Finally, debt securities data is from BIS, ECB and for two countries (Switzerland and Iceland) from national accounts data. Comparing the three data sources, it appears that the data is practically identical for those countries that are included in all three datasets. We use debt securities (ie bonds, bills and other commercial papers) issued by all sectors of the economy (ie the general government, financial corporations and non-financial corporations).

5.2. Our home bias and euro-area bias indicators

Following Ahearne *et al* (2004), we use a simple indicator of home bias in portfolio investments (ie we do not consider foreign direct investments). The International Capital Asset Pricing Model (ICAPM) suggests that when asset markets are integrated, implying that investors can buy and sell foreign securities without any restriction and without extra transaction costs, all investors should hold the world market portfolio in which each country portfolio is weighted by its market capitalisation. A simple indicator of home bias measures the deviation from the ICAPM benchmark, that is, one minus the ratio of the share of foreign equities in the home and world portfolios:

$$EHB_i = 1 - \frac{S(FE)_i}{S(FE)_{W-i}}$$

EHB_i: Equity home bias of country *i* (i.e. the indicator calculated by us) [9],
$S(FE)_i$: Share of foreign equity securities in country *i*'s total equity portfolio (which is in turn 1 minus the share of domestic portfolio equity),
$S(FE)_{W-i}$: Share of foreign equity in world portfolio available to country *i* (which is 1 minus the share of country *i* in total world stock/equity market capitalisation).

Since we are using two sources for domestic portfolio equity, the alternative definitions of country *i*'s total portfolio equity portfolio are the following:

1. When using stock market capitalisation: sum of portfolio equity assets held abroad (CPIS data) and domestic stock market capitalisation (see sources in the annex) minus the domestic portfolio equity held by foreigners (CPIS data);
2. When using national accounts data: sum of portfolio equity assets held abroad (CPIS data) and domestic portfolio equity holdings of residents (national account's equity data minus all foreign equity claims on the country).

EHB_i is not larger than 1. Its values can be interpreted as follows:

- $EHB_i = 1$: Domestic investors invest 100 percent in domestic equity, which is the case of complete home bias;
- $0 < EHB_i < 1$: Domestic investors have some home bias for domestic equities, but they invest part of their portfolio in foreign equities (the closer to 1, the higher the home bias);

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[9] We note again that we consider only portfolio equity holdings and do not consider foreign direct investment holdings.

- $EHB_i = 0$: A neutral portfolio, in which there is no home bias: domestic investors invest in foreign equity securities proportionally to the share of foreign equity in world portfolio, in line with the ICAPM prediction;

- $EHB_i < 0$: In theory, domestic investors may have a bias for holding foreign debt securities. Eg hypothetically, if a country that issues 10 percent of global equities (implying that $S(FE)_{W-i} = 0.9$) keeps 95 percent of its assets in foreign equities, then $EHB_i = 1 - \frac{0.95}{0.9} = -0.056$.

We also define an indicator measuring the euro-area bias in portfolio equity investments (again, we do not consider foreign direct investment). This indicator aims to measure whether the share of investments in the euro area (for non-euro area countries) or the share of investments in the rest of the euro area (for euro-area countries) in the foreign portfolio is larger than the share of euro-area assets (except home-issued securities in the case of euro countries) in total foreign equity portfolio which is available for the country in question. The total foreign equity portfolio which is available for the country in question is the sum of equity securities of all countries of the world excluding the country in question.

Formally,

$$EEAB_i = 1 - \frac{S(Non - EAFE)_i}{S(Non - EAE)_{W-i}}$$

$EEAB_i$: indicator of equity euro-area bias of country *i* (i.e. the indicator calculated by us)*;*
$S(Non - EAFE)_i$: share of non-euro area equity holdings in the total foreign portfolio equity holdings of country *i*;
$S(Non - EAE)_{W-i}$: share of non-euro area equity (and non-home equity in the cases of non-euro area countries) in the total foreign equity holdings of all countries of the world excluding country *i*.

That is, while the home bias indicator above considers the total portfolio of the country, the euro area bias indicator considers only the foreign equity holdings.

$EEAB_i$ can take the following values:

- $EEAB_i$=1: This is the case of complete euro-area bias, that is, the country does not hold any non-euro area equity in its foreign portfolio, but only euro-area portfolio equity;
- $0 < EEAB_i < 1$: There is some bias for euro-area equities, ie when such securities are held in a larger proportion than their relative supply;
- $EEAB_i$=0: A neutral portfolio, in which there is no euro-area bias: the two shares are equal, that is, the holdings of non-euro area portfolio equity in the foreign equity portfolio of country *i* is proportional to the supply of non-euro area portfolio equities;
- $EEAB_i < 0$: A bias for non-euro area securities, which is the case when a country holds more non-euro area securities than their relative supply.

Portfolio debt securities home and euro-area biases can be defined similarly, for which we consider debt securities (ie bonds, bills and other commercial papers) issued by all sectors of the economy (ie the general government, financial corporations and non-financial corporations; see detailed data sources in the Annex).

The country-composition of the euro area is not constant in our sample period because of new members joining between 2006 and 2015. However, a constant-composition euro-area aggregate is preferable. We therefore consider the only the first 12 members of the euro area (EA12)[10], which are the countries anyway strongly dominating equity and debt securities issuance in the euro area. Furthermore, there are many missing values in the assets held in the newer euro members and therefore their inclusion would limit our sample period.

Finally, we note that the countries considered for the definition of world supply differ for the two portfolio equity home bias indicators and for the portfolio debt securities home bias indicator:

- Equity based on stock market capitalisation: we use 'world total' as published by the World Federation of Exchanges;
- Equity based on national accounts data: sum of 38 countries;
- Debt securities: sum of 42 countries.

5.3. Home bias and euro-area bias developments

Table 3 summarises the average level of home and euro-area bias indicators in four main country groups in 2014. The equity home bias in the euro area and in the other three older EU member states is lower than in the newer EU member states and in non-EU advanced countries, while the euro-area bias is comparably high in the euro-area and newer EU member states, but low in the other three older EU member states and in advanced countries. The euro area is most special concerning debt securities: home bias is the lowest and euro-area bias is the highest among the country groups.

Therefore, it seems that euro-area membership may have promoted a lower home bias and higher a euro-area bias in debt securities, while EU membership may have been a driving force for equities. This latter observation is in line with the findings of Beakert *et al* (2013), who concluded, using industry valuation differentials across European countries, that membership in the EU significantly lowers discount rate and expected earnings growth differentials across countries (which are indicators of financial integration), but the adoption of the euro is not associated with increased integration.

A possible lack of a euro effect on home bias in equities is worrisome, because equities are more important in cross-country risk sharing than bonds, and in the euro area the exchange rate is not available to compensate idiosyncratic shocks.

Table 3: Average level of home bias and euro-area bias in four country groups, 2014

	EHB1	EHB2	DHB	EEAB1	EEAB2	DEAB
Euro-area 12*	0.49	0.73	0.46	0.65	0.50	0.54
Old EU 3	0.47	0.79	0.70	0.21	0.09	0.30
New EU 5	0.75	0.96	0.86	0.68	0.63	0.26
Advanced 4	0.65	0.84	0.82	0.04	-0.17	-0.16

Note: The average of country-specific values is reported. ***EHB1****: portfolio equity home bias based on stock market capitalisation;* ***EHB2****: portfolio equity home bias based on national accounts data;* ***DHB****: debt securities home bias;* ***EEAB1****: portfolio equity euro-area bias based on stock market capitalisation;* ***EEAB2****: portfolio equity euro-area bias based on national accounts data;* ***DEAB****: debt securities euro-area bias.* ***Euro-area 12*****: first 12 euro members; yet EHB1 and EEAB1 excludes Ireland and Luxembourg given the larger than 1 EHB1 estimate, which likely reflect data errors, as we discussed earlier;* ***Old EU 3****: Denmark, Sweden and the United Kingdom;* ***New EU 5****: Bulgaria, Czech Republic, Hungary, Poland and Romania;* ***Advanced 4****: Canada, Israel, Japan and the United States.*

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[10] The first twelve members of the euro area were Austria, Belgium, Finland, France, Germany, Greece, Italy, Ireland, Luxembourg, the Netherlands, Portugal and Spain.

Country-specific developments in portfolio equity home and euro-area biases are reported in Figure 9, while Figure 10 presents home and euro-area debt securities bias indicators.

Figure 9: Portfolio equity: home and euro-area biases

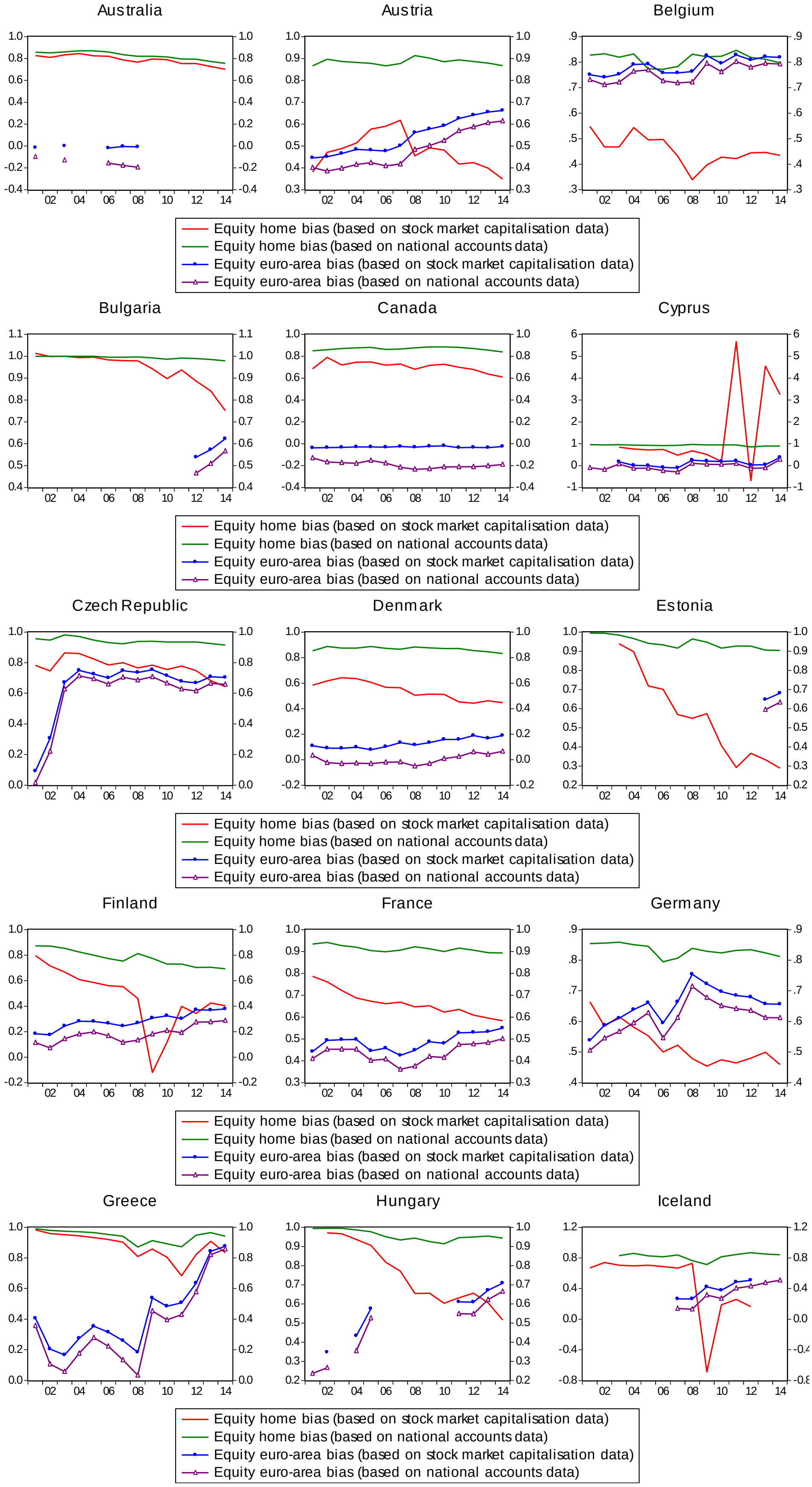


Figure 9 continued, Portfolio equity and debt: home and euro-area biases

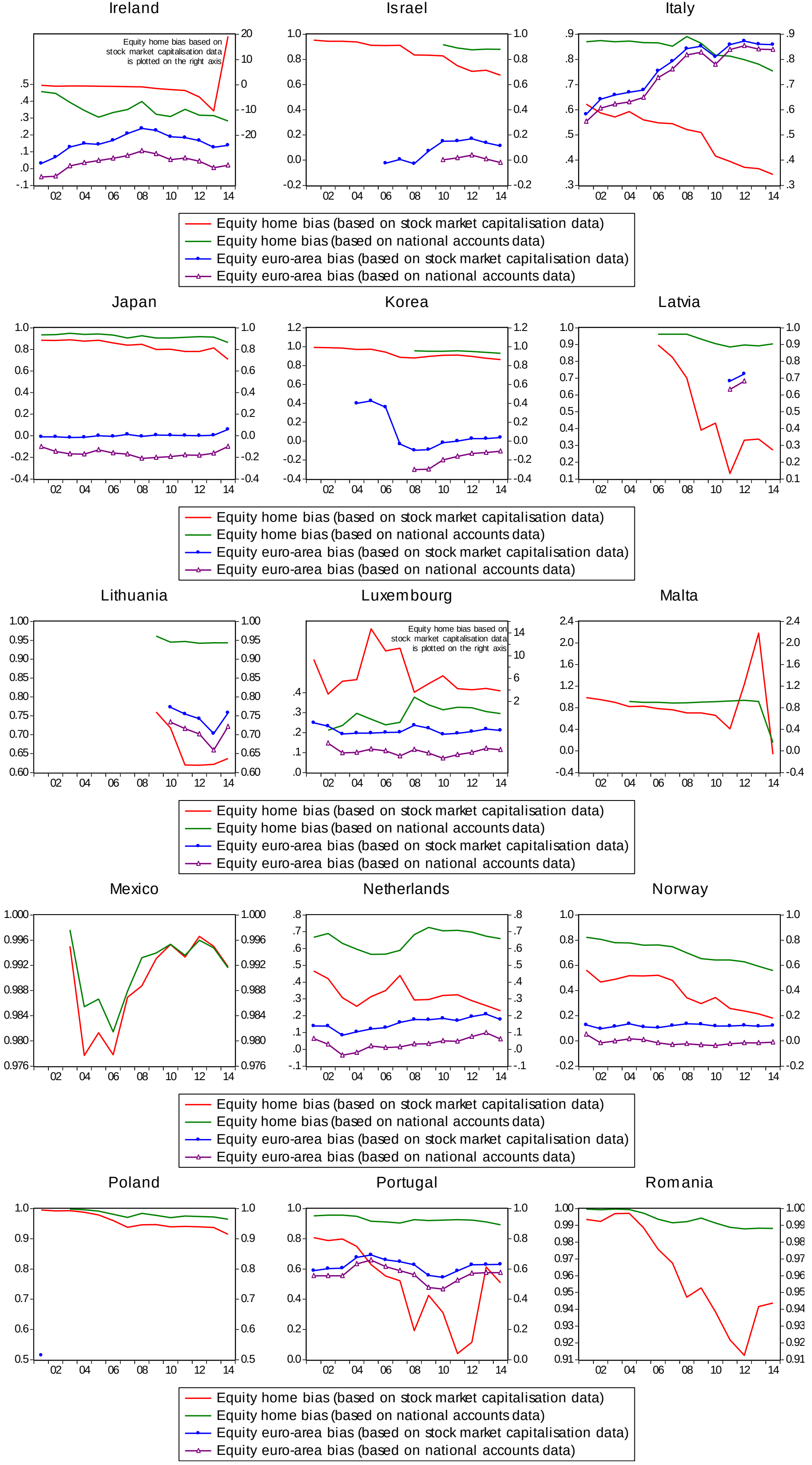
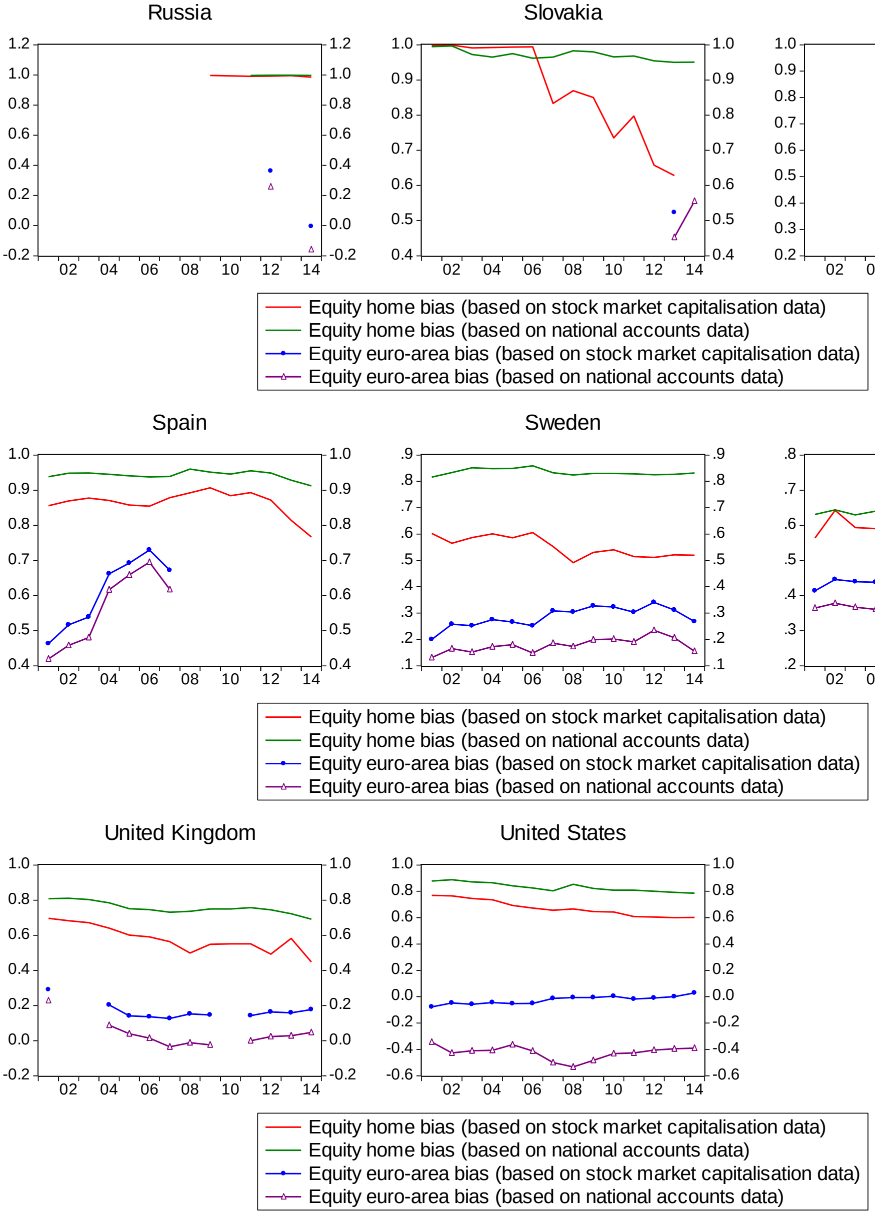


Figure 9 continued, Portfolio equity: home and euro-area biases



Source: Bruegel as discussed in the main text.

Figure 10: Portfolio debt securities: home and euro-area biases

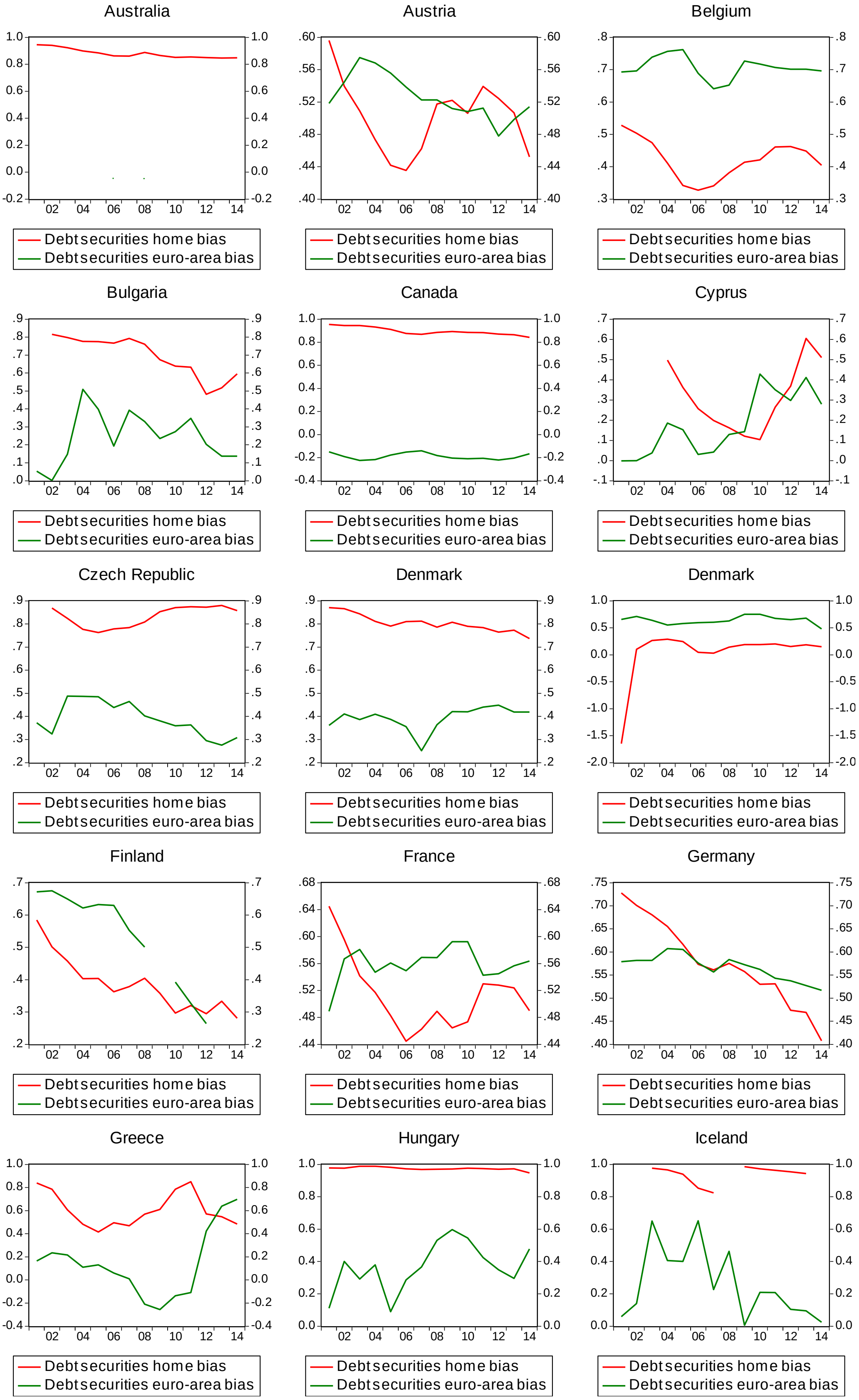


Figure 10 continued, Portfolio debt securities: home and euro-area biases

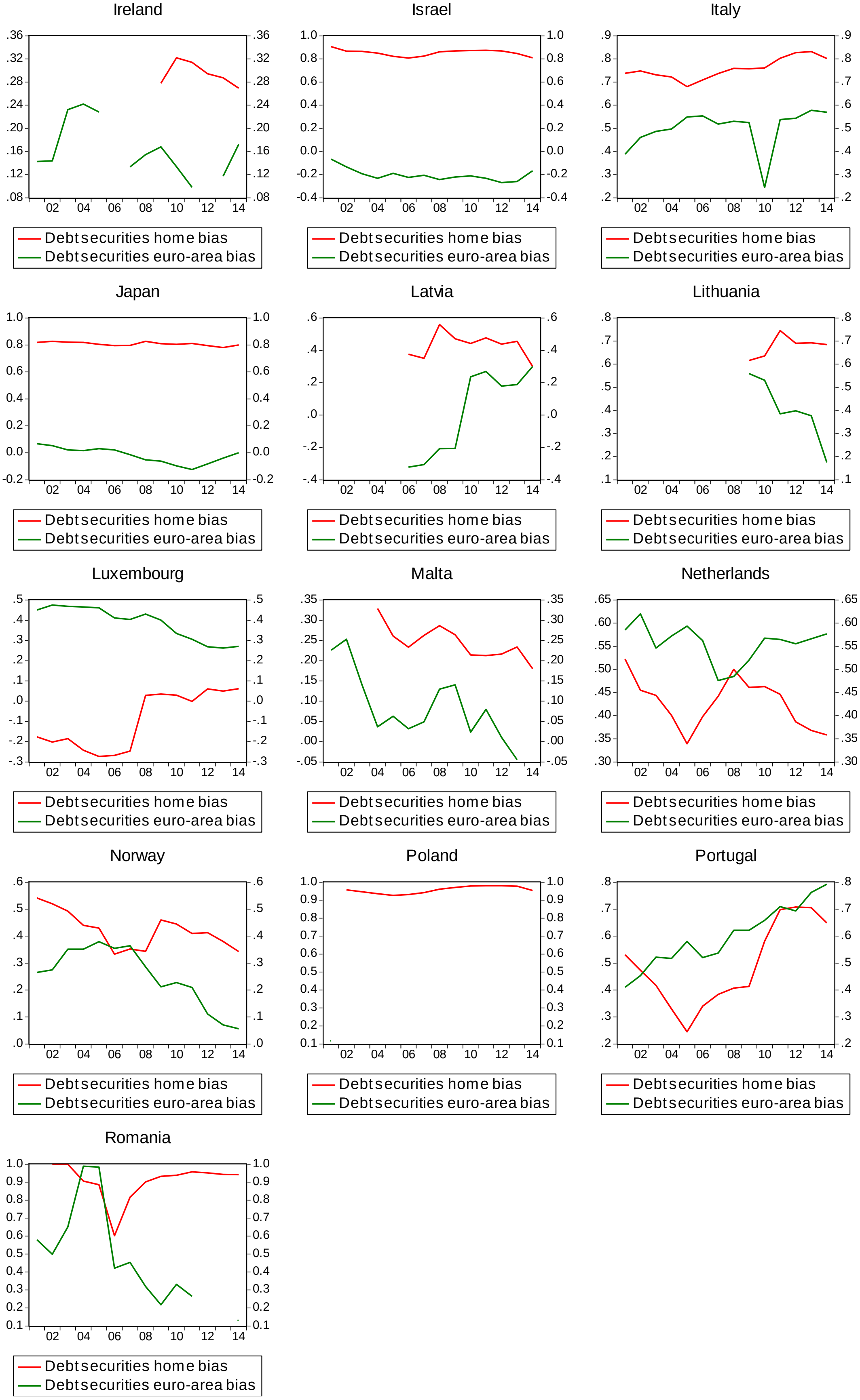
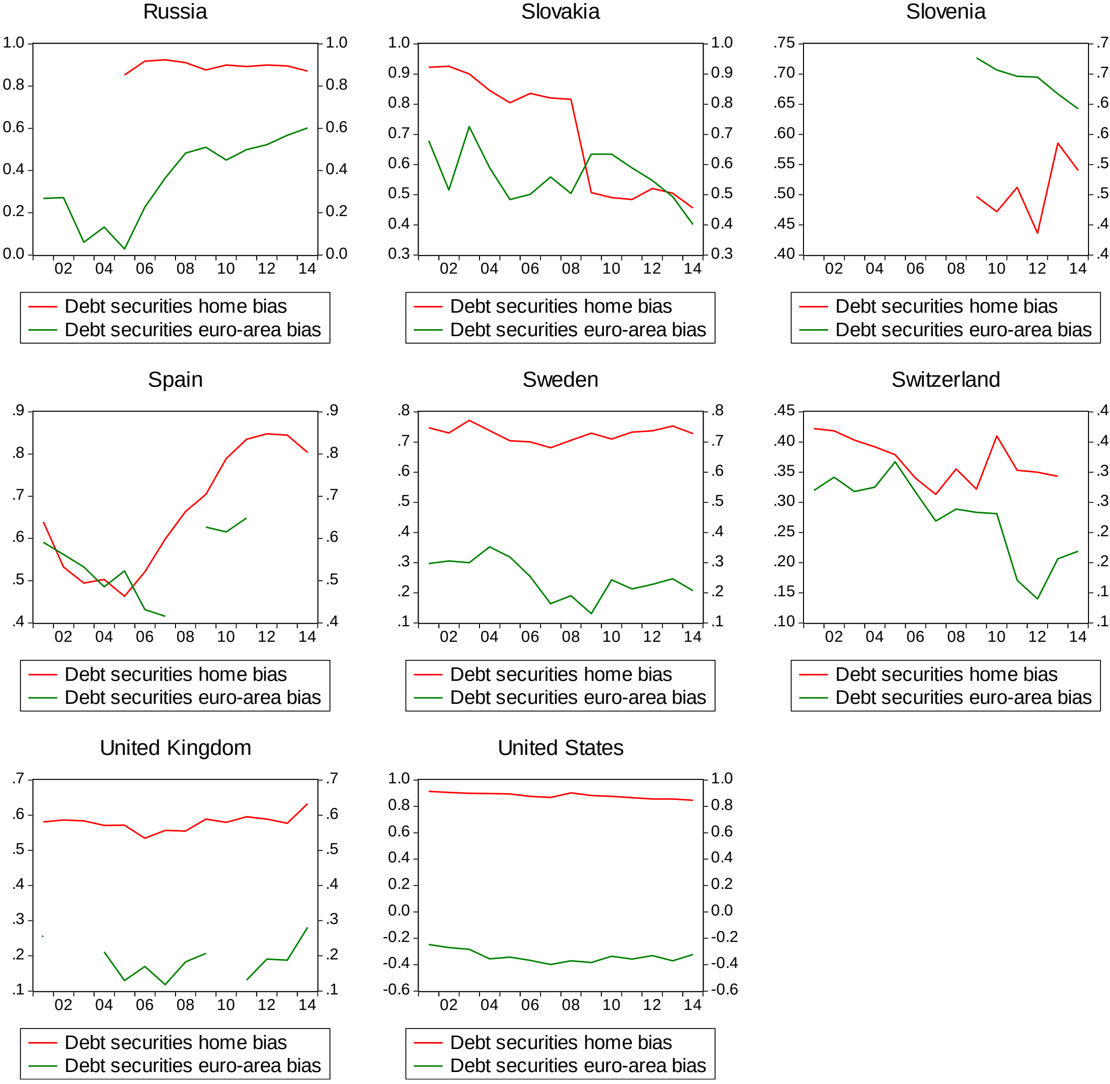


Figure 10 continued, Portfolio debt securities: home and euro-area biases



Source: Bruegel as discussed in the main text.

Figure 9 and Figure 10 show rather diverse levels of, and varying developments in, both home and euro-area biases.

In some euro members the equity euro-area bias has increased throughout the sample period of 2001-14 (Austria, Greece, Italy), while in others this bias is already high at the beginning of our sample period (Belgium, Germany, Portugal) and changes little. Yet in Finland and the Netherlands equity euro-area bias remains relatively low and therefore there is no uniform development within the euro area in terms of portfolio equity euro-area bias.

While the home bias is much higher in the central and eastern European non-euro members of the European Union, there is a high level of euro-bias in these countries (Bulgaria, Czech Republic and Hungary; unfortunately much data is missing for Poland and Romania). This probably reflects that political, economic and financial links also boost the share of euro area in foreign asset holdings.

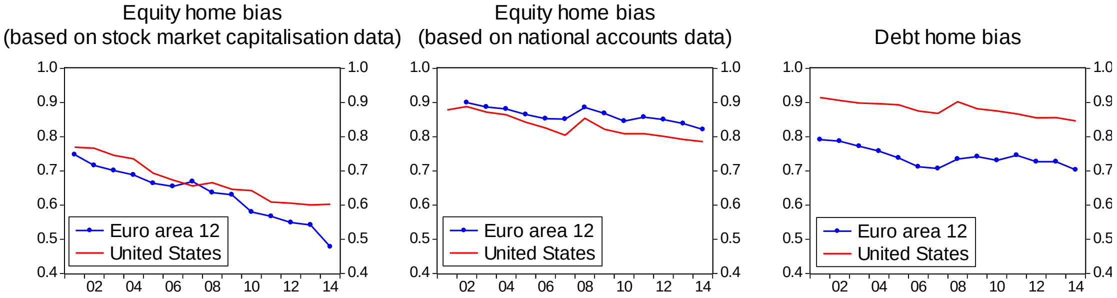
In the three other EU countries, Denmark, Sweden and the United Kingdom, there is a low level of euro-area bias, while home bias in terms of portfolio equity is broadly similar to most euro-members, while debt home bias is much higher than in the euro-area.

Non-EU countries are generally characterised by a higher level of home bias than EU countries. This suggests that EU membership fosters financial integration and perhaps reduces information barriers which sometimes limit cross-country diversification, which is in line with the findings of Beakert *et al* (2013) as we highlighted before. It is also notable that the euro-area bias of non-EU countries is relatively close to zero. Key exceptions are Russia's meaningful debt euro-area bias, Turkey's fluctuating but generally positive equity and debt euro-are bias, and Argentina's and the US's negative debt euro-area bias. These differences likely indicate that regional proximity is a factor in allocating the foreign securities portfolio.

We highlight that so far we reported indicators on the home bias of each country as a whole, but not risk sharing within a country. For example, in the introduction to this chapter we summarised a number of articles concluding that there is considerable risk-sharing within the United States, while our indices are informative on the domestic/foreign division of assets holdings of the United States (and all other countries). In order to compare better the home bias of the United States and the euro area relative to the rest of the world, we calculate the home bias of the euro area as if the euro area was a single country. That is, we consolidate intra-euro area claims and regard those claims as 'domestic claims' from the perspective of the euro-area 12 aggregate and consider only non-euro foreign claims as 'foreign' claims from the perspective of the euro area 12 aggregate. We do the same consolidation for intra-euro area liabilities. The total market capitalisation of the euro area 12 aggregate is simply the sum of market capitalisations of the 12 countries. By calculating these 'consolidated' euro-area 12 aggregates, we can calculate the home bias of the euro-area 12 group using our expressions, as if the euro-area 12 was a single country.

Figure 11 reports remarkable similarity of the euro-area 12 as a whole and the United States in terms of equity home bias, while there is a higher level of debt home bias in the United States than in the euro-area 12 group. As expected, the home bias of the euro-area 12 as a whole is higher than the average of country-specific home biases of the 12 countries (see the latter in Table 3).

Figure 11: Home bias in the euro area as a whole and in the United States



6. Panel regression analysis: the determinants of home bias

Our regression estimates explore if the size of the assets managed by institutional investors contributes to the home bias. Our main hypothesis is that the larger the assets managed by institutional investors, the smaller the home bias and thereby the larger the scope for risk sharing, *ceteris paribus*.

We estimate variants of the following regression:

$$f(EHB_{i,t}) = \alpha + \gamma_i + \delta_t + \beta ASSETS_{i,t} + \boldsymbol{\theta X_{i,t}} + \varepsilon_{i,t},$$

where: $EHB_{i,t}$ is one of the two indicators of the equity home bias of country *i* in time t, $ASSETS_{i,t}$ is the share of institutional investors' assets in the GDP of country *i* in time t, $\boldsymbol{X_{i,t}}$ denotes control variables, and $\varepsilon_{i,t}$ is the residual. α is the general constant, γ_i is the country-specific fixed effect, δ_t is the time-specific fixed effect, β and the vector $\boldsymbol{\theta}$ are parameters to be estimated.

$f(.)$ indicates a function to transform the home bias indicator. We note that $EHB_{i,t}$ typically takes values between zero and one, while the bulk of the explanatory variables are in principle unbounded from above, which may render a standard specification invalid. However, in our assessment the consequences of the limited range of the dependent variable is not so important and we note that many published articles did not address this problem. We therefore estimate two versions, one which does not consider this problem and one which addresses it, and we will compare the results between these two options:

- In one version the (untransformed) home bias indicator is the dependent variable, i.e. $f(x) = x$;
- In a second version we use a logistic transformation, $f(x) = log\left(\frac{x}{1-x}\right)$. By definition, the logistic transformation disregards cases when $EHB_{i,t} \leq 0$ (which cases are rare in our dataset) and $EHB_{i,t} \geq 1$. We note that $EHB_{i,t} = 1$ is a theoretical possibility, but it does not appear in our dataset, while in a few cases $EHB_{i,t} > 1$ (Cyprus, Ireland and Luxembourg equity home bias based on stock market capitalisation), which probably reflects data problems.

We estimate the same model for debt securities home bias.

We use the total assets managed by all three types of institutional investors, that is, the sum of assets managed by pension funds, insurance corporations and investment funds. The relative importance of these funds varies across countries. For example, as demonstrated Figure 2, the share of pension fund assets in GDP is very close to zero in France, while France has the third highest insurance corporations' assets relative to GDP after Luxembourg and Ireland (Figure 3). The sum of the assets of the three types of investors represents the total volume of assets that might influence the country-wide home bias, which is our dependent variable in the regressions.

We consider the following control variables:

- GDP per capita relative to the US: it measures the level of development, which may proxy several factors influencing the ability of a country to diversify its asset holding, such as economic development, institutional quality, investor protection or average education level in the country. The expected sign of the estimated parameter is negative.
- Financial Development Index, which is a sub-component of the World Economic Forum's Global Competitiveness Index: it may proxy the many factors that influence the size of capital markets. A higher financial development may encourage investors to invest nationally rather than abroad, thereby the expected sign of the parameter estimate is positive.
- The share of exports of goods and services to GDP: it measures the openness of the country to trade. More trade openness may influence cross-border asset diversification and hence the expected sign of the estimated parameter is negative.
- Domestic market capitalisation relative to home GDP: the availability of domestically issued securities may also influence home bias: a country with larger home stock of securities may diversify less, and therefore the expected sign of

the estimated parameter is positive. For the three home bias indicators we use the corresponding domestic market capitalisation data:
    - Equity based on stock market: stock market capitalisation;
    - Equity based on national accounts: equity data from national accounts;
    - Debt securities: total outstanding stock of domestic debt securities by all sectors (government, financial corporations, and non-financial corporations).
- Foreign market capitalisation relative to home GDP: the availability of foreign issued securities may also influence home bias, eg the foreign supply of securities is smaller from the perspective of United States than from the perspective of Estonia. The expected sign of the estimated parameter is negative. For the three home bias indicators we use the corresponding foreign market capitalisation data:
    - Equity based on stock market: stock market capitalisation;
    - Equity based on national accounts: equity data from national accounts;
    - Debt securities: total outstanding stock of domestic debt securities by all sectors (government, financial corporations, and non-financial corporations).
- Pension fund foreign investment restrictions index: more restrictive financial regulation should lead to home bias, and thereby the expected sign of the estimated parameter is positive. While this index refers to pension funds only, it may be indicative on possible restrictions for insurance corporations and investment funds too.
- Euro-area bias: since Figure 9 suggested that euro-area bias is important for euro-area countries and its increase went hand-in-hand with the decline of home bias, we include the euro-area bias only for euro-area countries. A negative estimated parameter would indicate that euro-area bias reduces home bias.

In order to test the marginal contribution of the euro-area bias to the regression result, we estimate a version of the regression without this variable and another version with this variable.

An important consideration relates to the use of fixed effects. Without fixed effects, the explanatory variables are bound to explain all cross-country and cross-time variation. However, there could be important country-specific factors not included in the model, and there could be general trends through time across all countries, which can be controlled by the addition of country and period fixed effects. We therefore estimate model variants both with and without fixed effects.

We include in the regression 25 countries:

- 18 European Union countries: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, Germany, Greece, Hungary, Italy, Lithuania, Netherlands, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom;
- 7 non-EU countries: Canada, Iceland, Israel, Japan, Russia, Switzerland, United States.

Among the EU countries, we do not include in the regression:

- Four countries for which the pension fund restriction index cannot be calculated: Croatia, Cyprus, France and Latvia;
- Four additional countries for which assets of insurance corporations and/or investment funds are not available: Bulgaria, Malta, Poland and Romania (we note that data on assets is not available for Cyprus either);
- Ireland and Luxembourg, given that these countries are financial centres and have asset ratios to GDP which are several factors higher than in other countries and therefore these countries are special cases.

For three types of home bias indicator and two types of functional form, the following six tables include the result, starting with the portfolio equity home bias, which is our main focus. For each of these six options we report eight versions of the regression (depending on whether euro area-bias, financial development index and fixed effects are included or not). Thereby, we report the results of 48 regression estimates.

Table 4: Panel regression results: untransformed portfolio equity home bias based on stock market capitalisation data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Assets	**-0.07**	**-0.08**	**-0.06**	**-0.015**	**-0.08**	**-0.09**	**-0.08**	**-0.04**
[t-ratio]	*[-9.7]*	*[-9.4]*	*[-1.6]*	*[-0.4]*	*[-11]*	*[-10.3]*	*[-2.4]*	*[-1.3]*
(p-value)	*(0.000)*	*(0.000)*	*(0.117)*	*(0.673)*	*(0.000)*	*(0.000)*	*(0.016)*	*(0.180)*
GDP per capita	**-0.76**	**-0.51**	**-0.28**	**-0.09**	**-0.72**	**-0.52**	**-0.58**	**-0.44**
[t-ratio]	*[-11.6]*	*[-6.3]*	*[-1.2]*	*[-0.3]*	*[-11]*	*[-6.7]*	*[-3.2]*	*[-1.9]*
(p-value)	*(0.000)*	*(0.000)*	*(0.220)*	*(0.759)*	*(0.000)*	*(0.000)*	*(0.001)*	*(0.065)*
Financial market dev.	**0.02**	**0.01**	**-0.02**	**-0.001**				
[t-ratio]	*[1.2]*	*[0.7]*	*[-0.6]*	*[0]*				
(p-value)	*(0.233)*	*(0.493)*	*(0.526)*	*(0.983)*				
Exports	**-0.19**	**-0.22**	**-0.38**	**-0.37**	**-0.27**	**-0.28**	**-0.48**	**-0.50**
[t-ratio]	*[-4.1]*	*[-5.7]*	*[-2.5]*	*[-2.5]*	*[-6]*	*[-7.6]*	*[-4.9]*	*[-5.1]*
(p-value)	*(0.000)*	*(0.000)*	*(0.013)*	*(0.013)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
Home market cap.	**0.24**	**0.15**	**0.21**	**0.15**	**0.25**	**0.17**	**0.22**	**0.16**
[t-ratio]	*[8.5]*	*[5.3]*	*[4.2]*	*[3.9]*	*[10.9]*	*[8]*	*[5.1]*	*[5]*
(p-value)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
World market cap.	**-0.56**	**-0.81**	**-0.43**	**-0.62**	**-0.36**	**-0.60**	**-0.33**	**-0.60**
[t-ratio]	*[-5.2]*	*[-6]*	*[-0.7]*	*[-1]*	*[-3.3]*	*[-5.1]*	*[-0.7]*	*[-1.3]*
(p-value)	*(0.000)*	*(0.000)*	*(0.476)*	*(0.315)*	*(0.001)*	*(0.000)*	*(0.493)*	*(0.210)*
Pension fund restriction	**0.13**	**0.14**	**-0.03**	**-0.02**	**0.09**	**0.10**	**-0.02**	**-0.04**
[t-ratio]	*[3.6]*	*[5]*	*[-0.6]*	*[-0.4]*	*[3.3]*	*[3.7]*	*[-0.6]*	*[-1.4]*
(p-value)	*(0.000)*	*(0.000)*	*(0.558)*	*(0.716)*	*(0.001)*	*(0.000)*	*(0.524)*	*(0.154)*
Euro-area bias (for euro area countries only)		**-0.24**		**0.19**		**-0.21**		**0.10**
		[-6]		*[1.6]*		*[-6]*		*[1.1]*
(p-value)		*(0.000)*		*(0.105)*		*(0.000)*		*(0.252)*
fixed effects	no	no	yes	yes	no	no	yes	yes
R2	0.66	0.66	0.90	0.90	0.64	0.64	0.91	0.91
N.o. time periods	9	9	9	9	14	14	14	14
N.o. countries	25	25	25	25	25	25	25	25
N.o. total observations	178	168	178	168	225	215	225	215

Note: OLS with robust standard errors. The dependent variable is portfolio equity home bias based on stock market capitalisation data. Four explanatory variables are included relative to (home) GDP: (1) assets of institutional investors; (2) exports of goods and services; (3) home stock market capitalisation; (4) world stock market capitalisation excluding the home stock market. World stock market capitalisation excluding the home stock market relative to home GDP is divided by 10000. GDP per capita at purchasing power parity is relative to the United States. Where indicated, both cross-section and period fixed effects are included. The values in squared brackets below the parameter estimates are the t-ratios (rounded to one digit after the decimal), and in round brackets are the p-values (rounded to three digits after the decimal).

Table 5: Panel regression results: logistic transformation of portfolio equity home bias based on stock market capitalisation data

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Assets	**-0.35**	**-0.37**	**-0.33**	**-0.09**	**-0.38**	**-0.39**	**-0.41**	**-0.18**
[t-ratio]	*[-8.9]*	*[-8.4]*	*[-1.7]*	*[-0.5]*	*[-10.3]*	*[-10.2]*	*[-2.4]*	*[-1.2]*
(p-value)	*(0.000)*	*(0.000)*	*(0.093)*	*(0.597)*	*(0.000)*	*(0.000)*	*(0.019)*	*(0.213)*
GDP per capita	-4.49	-4.24	-2.36	-1.21	-4.61	-4.40	-3.68	-2.66
[t-ratio]	*[-9.8]*	*[-10]*	*[-2]*	*[-0.9]*	*[-9.3]*	*[-8.9]*	*[-3.5]*	*[-2.1]*
(p-value)	*(0.000)*	*(0.000)*	*(0.053)*	*(0.386)*	*(0.000)*	*(0.000)*	*(0.001)*	*(0.035)*
Financial market dev.	**0.00**	**0.00**	**-0.01**	**0.09**				
[t-ratio]	*[0]*	*[0]*	*[0]*	*[0.5]*				
(p-value)	*(0.974)*	*(0.977)*	*(0.970)*	*(0.623)*				
Exports	**-1.17**	**-1.24**	**-1.15**	**-1.10**	**-1.52**	**-1.55**	**-2.89**	**-2.95**
[t-ratio]	*[-4.2]*	*[-4.2]*	*[-1.5]*	*[-1.5]*	*[-5.9]*	*[-6]*	*[-4]*	*[-4.1]*
(p-value)	*(0.000)*	*(0.000)*	*(0.125)*	*(0.131)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
Home market cap.	**1.26**	**1.15**	**1.12**	**0.81**	**1.26**	**1.16**	**1.18**	**0.87**
[t-ratio]	*[6.3]*	*[6]*	*[4.2]*	*[3.9]*	*[8.9]*	*[8.9]*	*[5]*	*[4.9]*
(p-value)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
World market cap.	**-3.27**	**-3.41**	**-1.04**	**-2.25**	**-2.45**	**-2.60**	**-0.24**	**-1.65**
[t-ratio]	*[-5.5]*	*[-5.4]*	*[-0.4]*	*[-0.8]*	*[-4.7]*	*[-4.8]*	*[-0.1]*	*[-0.8]*
(p-value)	*(0.000)*	*(0.000)*	*(0.707)*	*(0.416)*	*(0.000)*	*(0.000)*	*(0.909)*	*(0.416)*
Pension fund restriction	**1.51**	**1.52**	**-0.06**	**0.03**	**1.15**	**1.12**	**0.03**	**-0.06**
[t-ratio]	*[4.5]*	*[4.8]*	*[-0.2]*	*[0.1]*	*[4.2]*	*[4.2]*	*[0.2]*	*[-0.3]*
(p-value)	*(0.000)*	*(0.000)*	*(0.824)*	*(0.899)*	*(0.000)*	*(0.000)*	*(0.877)*	*(0.746)*
Euro-area bias (for euro area countries only)		**-0.25**		**0.26**		**-0.19**		**0.20**
		[-3.2]		*[2.1]*		*[-2.8]*		*[2]*
(p-value)		*(0.002)*		*(0.040)*		*(0.006)*		*(0.045)*
fixed effects	no	no	yes	yes	no	no	yes	yes
R2	0.59	0.59	0.93	0.93	0.57	0.57	0.92	0.92
N.o. time periods	9	9	9	9	14	14	14	14
N.o. countries	25	25	25	25	25	25	25	25
N.o. total observations	178	168	178	168	225	215	225	215

Note: The dependent variable is the logistic transformation of portfolio equity home bias based on stock market capitalisation data. A logistic transformation is applied to the euro-area bias indicator too. See other notes to Table 4*.*

Table 6: Panel regression results: untransformed portfolio equity home bias based on national accounts equity data

	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Assets	**-0.04**	**-0.04**	**-0.02**	**-0.004**	**-0.04**	**-0.05**	**-0.03**	**-0.02**
[t-ratio]	*[-12.9]*	*[-13.2]*	*[-1.6]*	*[-0.4]*	*[-14.6]*	*[-14.1]*	*[-2.4]*	*[-1.5]*
(p-value)	*(0.000)*	*(0.000)*	*(0.105)*	*(0.681)*	*(0.000)*	*(0.000)*	*(0.017)*	*(0.137)*
GDP per capita	**-0.33**	**-0.30**	**0.02**	**0.19**	**-0.31**	**-0.28**	**-0.10**	**0.03**
[t-ratio]	*[-12]*	*[-10.6]*	*[0.1]*	*[1.4]*	*[-12.4]*	*[-11]*	*[-1]*	*[0.4]*
(p-value)	*(0.000)*	*(0.000)*	*(0.895)*	*(0.154)*	*(0.000)*	*(0.000)*	*(0.318)*	*(0.724)*
Financial market dev.	**0.001**	**0.0004**	**-0.01**	**-0.0004**				
[t-ratio]	*[0.2]*	*[0.1]*	*[-0.6]*	*[0]*				
(p-value)	*(0.864)*	*(0.955)*	*(0.570)*	*(0.981)*				
Exports	**-0.05**	**-0.05**	**0.07**	**0.07**	**-0.08**	**-0.08**	**0.06**	**0.03**
[t-ratio]	*[-3.1]*	*[-3.5]*	*[1.6]*	*[1.5]*	*[-5.5]*	*[-6]*	*[1.5]*	*[0.8]*
(p-value)	*(0.003)*	*(0.001)*	*(0.102)*	*(0.136)*	*(0.000)*	*(0.000)*	*(0.143)*	*(0.400)*
Home market cap.	**0.02**	**0.02**	**0.04**	**0.03**	**0.02**	**0.02**	**0.05**	**0.05**
[t-ratio]	*[4.8]*	*[4.1]*	*[6.3]*	*[5.9]*	*[4.6]*	*[3.8]*	*[6.4]*	*[5.7]*
(p-value)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
World market cap.	**-0.01**	**-0.03**	**0.15**	**0.19**	**-0.01**	**-0.03**	**0.20**	**0.23**
[t-ratio]	*[-0.7]*	*[-1.6]*	*[2.3]*	*[2.6]*	*[-0.7]*	*[-1.7]*	*[2.9]*	*[3.2]*
(p-value)	*(0.500)*	*(0.117)*	*(0.025)*	*(0.012)*	*(0.469)*	*(0.083)*	*(0.004)*	*(0.002)*
Pension fund restriction	**0.03**	**0.03**	**0.03**	**0.04**	**0.01**	**0.01**	**0.01**	**0.00**
[t-ratio]	*[2]*	*[1.8]*	*[1.2]*	*[1.2]*	*[0.9]*	*[0.6]*	*[0.6]*	*[0]*
(p-value)	*(0.047)*	*(0.073)*	*(0.252)*	*(0.234)*	*(0.354)*	*(0.577)*	*(0.541)*	*(0.982)*
Euro-area bias (for euro area countries only)		**-0.04**		**0.16**		**-0.04**		**0.12**
		[-3.8]		*[5.3]*		*[-4.3]*		*[3.8]*
(p-value)		*(0.000)*		*(0.000)*		*(0.000)*		*(0.000)*
fixed effects	no	no	yes	yes	no	no	yes	yes
R2	0.79	0.79	0.96	0.96	0.77	0.77	0.95	0.95
N.o. time periods	9	9	9	9	14	14	14	14
N.o. countries	25	25	25	25	25	25	25	25
N.o. total observations	176	166	176	166	221	211	221	211

Note: The dependent variable is portfolio equity home bias based on national accounts equity data. World market capitalisation is also based on national accounts data. See other notes to Table 4*.*

Table 7: Panel regression results: logistic transformation of portfolio equity home bias based on national accounts equity data

	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
Assets	**-0.26**	**-0.25**	**-0.13**	**-0.08**	**-0.26**	**-0.26**	**-0.18**	**-0.12**
[t-ratio]	*[-13.7]*	*[-10.6]*	*[-1.2]*	*[-0.8]*	*[-13.7]*	*[-11.4]*	*[-1.6]*	*[-1]*
(p-value)	*(0.000)*	*(0.000)*	*(0.218)*	*(0.419)*	*(0.000)*	*(0.000)*	*(0.115)*	*(0.306)*
GDP per capita	-4.08	-4.11	-1.72	-0.17	-4.32	-4.29	-2.66	-1.22
[t-ratio]	*[-8.8]*	*[-8.7]*	*[-1.3]*	*[-0.1]*	*[-9.1]*	*[-8.9]*	*[-2.2]*	*[-1.2]*
(p-value)	*(0.000)*	*(0.000)*	*(0.196)*	*(0.882)*	*(0.000)*	*(0.000)*	*(0.030)*	*(0.238)*
Financial market dev.	**-0.02**	**0.02**	**-0.11**	**-0.09**				
[t-ratio]	*[-0.2]*	*[0.3]*	*[-1.1]*	*[-0.8]*				
(p-value)	*(0.833)*	*(0.764)*	*(0.275)*	*(0.427)*				
Exports	**-0.39**	**-0.35**	**-0.27**	**-0.33**	**-0.63**	**-0.62**	**-2.00**	**-2.17**
[t-ratio]	*[-2]*	*[-1.6]*	*[-0.6]*	*[-0.7]*	*[-3.4]*	*[-3.1]*	*[-2.9]*	*[-3.1]*
(p-value)	*(0.043)*	*(0.108)*	*(0.558)*	*(0.511)*	*(0.001)*	*(0.002)*	*(0.004)*	*(0.003)*
Home market cap.	**0.21**	**0.20**	**0.31**	**0.29**	**0.19**	**0.19**	**0.38**	**0.36**
[t-ratio]	*[3.8]*	*[3.4]*	*[5.1]*	*[4.8]*	*[3.7]*	*[3.6]*	*[5]*	*[4.5]*
(p-value)	*(0.000)*	*(0.001)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
World market cap.	**-0.52**	**-0.47**	**0.75**	**0.91**	**-0.49**	**-0.49**	**2.45**	**2.68**
[t-ratio]	*[-3]*	*[-2.6]*	*[1]*	*[1.1]*	*[-3.4]*	*[-3.4]*	*[3]*	*[3.1]*
(p-value)	*(0.003)*	*(0.010)*	*(0.333)*	*(0.261)*	*(0.001)*	*(0.001)*	*(0.004)*	*(0.002)*
Pension fund restriction	**1.18**	**1.22**	**0.37**	**0.42**	**0.86**	**0.86**	**0.33**	**0.28**
[t-ratio]	*[3.5]*	*[3.7]*	*[1.5]*	*[1.6]*	*[3.3]*	*[3.3]*	*[1.6]*	*[1.3]*
(p-value)	*(0.001)*	*(0.000)*	*(0.131)*	*(0.115)*	*(0.001)*	*(0.001)*	*(0.105)*	*(0.185)*
Euro-area bias (for euro area countries only)		**-0.01**		**0.24**		**-0.01**		**0.25**
		[-0.2]		*[4.6]*		*[-0.3]*		*[4.5]*
(p-value)		*(0.848)*		*(0.000)*		*(0.771)*		*(0.000)*
fixed effects	no	no	yes	yes	no	no	yes	yes
R2	0.69	0.69	0.97	0.97	0.67	0.67	0.94	0.94
N.o. time periods	9	9	9	9	14	14	14	14
N.o. countries	25	25	25	25	25	25	25	25
N.o. total observations	176	166	176	166	221	211	221	211

Note: The dependent variable is the logistic transformation of portfolio equity home bias based on national accounts equity data. World market capitalisation is also based on national accounts data. A logistic transformation is applied to the euro-area bias indicator too. See other notes to Table 4*.*

Table 8: Panel regression results: untransformed portfolio debt securities home bias

	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)
Assets	**-0.06**	**-0.10**	**-0.06**	**-0.063**	**-0.05**	**-0.10**	**-0.07**	**-0.06**
[t-ratio]	*[-5.8]*	*[-9]*	*[-2.5]*	*[-2.4]*	*[-5.2]*	*[-9.3]*	*[-2.7]*	*[-2.3]*
(p-value)	*(0.000)*	*(0.000)*	*(0.014)*	*(0.017)*	*(0.000)*	*(0.000)*	*(0.008)*	*(0.023)*
GDP per capita	**-0.67**	**-0.43**	**-0.38**	**-0.55**	**-0.54**	**-0.38**	**-0.76**	**-0.76**
[t-ratio]	*[-5.8]*	*[-5.9]*	*[-1.6]*	*[-1.8]*	*[-5.7]*	*[-6.5]*	*[-3.1]*	*[-2.6]*
(p-value)	*(0.000)*	*(0.000)*	*(0.118)*	*(0.067)*	*(0.000)*	*(0.000)*	*(0.002)*	*(0.010)*
Financial market dev.	**0.03**	**-0.01**	**-0.03**	**-0.030**				
[t-ratio]	*[1.5]*	*[-0.4]*	*[-1.3]*	*[-1.3]*				
(p-value)	*(0.141)*	*(0.691)*	*(0.203)*	*(0.204)*				
Exports	**-0.21**	**-0.10**	**0.06**	**0.04**	**-0.29**	**-0.16**	**0.06**	**0.04**
[t-ratio]	*[-2.7]*	*[-1.8]*	*[0.5]*	*[0.3]*	*[-4.1]*	*[-3.1]*	*[0.8]*	*[0.6]*
(p-value)	*(0.008)*	*(0.069)*	*(0.651)*	*(0.752)*	*(0.000)*	*(0.002)*	*(0.435)*	*(0.559)*
Home market cap.	**0.16**	**0.20**	**0.18**	**0.17**	**0.14**	**0.19**	**0.11**	**0.10**
[t-ratio]	*[8]*	*[11.3]*	*[4.9]*	*[5]*	*[7.6]*	*[10.8]*	*[3.6]*	*[3.2]*
(p-value)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.001)*	*(0.001)*
World market cap.	**-0.86**	**-1.42**	**-0.96**	**-0.90**	**-0.66**	**-1.25**	**-0.98**	**-0.82**
[t-ratio]	*[-5.1]*	*[-9.6]*	*[-3.1]*	*[-3]*	*[-3.8]*	*[-7.4]*	*[-2.9]*	*[-2.4]*
(p-value)	*(0.000)*	*(0.000)*	*(0.002)*	*(0.004)*	*(0.000)*	*(0.000)*	*(0.005)*	*(0.015)*
Pension fund restriction	**0.03**	**-0.02**	**0.15**	**0.13**	**0.04**	**0.03**	**0.09**	**0.07**
[t-ratio]	*[0.6]*	*[-0.8]*	*[2.1]*	*[1.9]*	*[0.9]*	*[0.9]*	*[2.3]*	*[1.7]*
(p-value)	*(0.567)*	*(0.445)*	*(0.039)*	*(0.060)*	*(0.351)*	*(0.367)*	*(0.022)*	*(0.086)*
Euro-area bias (for euro area countries only)		**-0.51**		**-0.08**		**-0.49**		**-0.06**
		[-10.5]		*[-1.1]*		*[-12.1]*		*[-0.6]*
(p-value)		*(0.000)*		*(0.287)*		*(0.000)*		*(0.549)*
fixed effects	no	no	yes	yes	no	no	yes	yes
R2	0.69	0.69	0.96	0.96	0.66	0.66	0.95	0.95
N.o. time periods	9	9	9	9	14	14	14	14
N.o. countries	25	25	25	25	25	25	25	25
N.o. total observations	182	175	182	175	228	221	228	221

Note: The dependent variable is portfolio debt securities home bias based. World market capitalisation is based on debt securities data. See other notes to Table 4.

Table 9: Panel regression results: logistic transformation of portfolio debt securities home bias

	(41)	(42)	(43)	(44)	(45)	(46)	(47)	(48)
Assets	**-0.31**	**-0.37**	**-0.30**	**-0.28**	**-0.25**	**-0.36**	**-0.42**	**-0.37**
[t-ratio]	*[-5.5]*	*[-5.9]*	*[-2.3]*	*[-2]*	*[-4.4]*	*[-5.5]*	*[-2.7]*	*[-2.2]*
(p-value)	*(0.000)*	*(0.000)*	*(0.022)*	*(0.045)*	*(0.000)*	*(0.000)*	*(0.007)*	*(0.026)*
GDP per capita	-3.89	-3.97	-2.38	-3.70	-3.35	-3.48	-4.24	-4.69
[t-ratio]	*[-5.1]*	*[-5.6]*	*[-1.7]*	*[-2.2]*	*[-5]*	*[-5.8]*	*[-3]*	*[-2.9]*
(p-value)	*(0.000)*	*(0.000)*	*(0.093)*	*(0.032)*	*(0.000)*	*(0.000)*	*(0.003)*	*(0.004)*
Financial market dev.	**0.18**	**0.10**	**-0.14**	**-0.06**				
[t-ratio]	*[1.5]*	*[0.8]*	*[-1]*	*[-0.5]*				
(p-value)	*(0.125)*	*(0.420)*	*(0.331)*	*(0.633)*				
Exports	**-0.49**	**-0.36**	**1.36**	**1.14**	**-0.99**	**-0.71**	**0.56**	**0.40**
[t-ratio]	*[-1]*	*[-0.7]*	*[1.4]*	*[1.2]*	*[-2.2]*	*[-1.6]*	*[0.9]*	*[0.6]*
(p-value)	*(0.338)*	*(0.472)*	*(0.165)*	*(0.215)*	*(0.029)*	*(0.113)*	*(0.361)*	*(0.535)*
Home market cap.	**0.99**	**1.08**	**0.97**	**0.65**	**0.86**	**1.01**	**0.46**	**0.22**
[t-ratio]	*[7.3]*	*[7.9]*	*[4.9]*	*[3]*	*[6.7]*	*[7.6]*	*[2.1]*	*[1.2]*
(p-value)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.003)*	*(0.000)*	*(0.000)*	*(0.033)*	*(0.229)*
World market cap.	**-4.47**	**-5.57**	**-1.12**	**0.95**	**-3.16**	**-4.60**	**-1.19**	**0.96**
[t-ratio]	*[-3.9]*	*[-4.7]*	*[-0.7]*	*[0.7]*	*[-2.6]*	*[-3.6]*	*[-0.5]*	*[0.5]*
(p-value)	*(0.000)*	*(0.000)*	*(0.491)*	*(0.515)*	*(0.010)*	*(0.000)*	*(0.605)*	*(0.632)*
Pension fund restriction	**0.34**	**0.26**	**0.35**	**0.10**	**0.43**	**0.46**	**0.32**	**0.18**
[t-ratio]	*[1.3]*	*[0.9]*	*[1.1]*	*[0.3]*	*[1.6]*	*[1.8]*	*[1.4]*	*[0.8]*
(p-value)	*(0.206)*	*(0.350)*	*(0.269)*	*(0.743)*	*(0.102)*	*(0.075)*	*(0.162)*	*(0.435)*
Euro-area bias (for euro area countries only)		**-1.15**		**0.33**		**-1.27**		**0.33**
		[-3.2]		*[2.8]*		*[-4.2]*		*[3.1]*
(p-value)		*(0.001)*		*(0.005)*		*(0.000)*		*(0.002)*
fixed effects	no	no	yes	yes	no	no	yes	yes
R2	0.42	0.42	0.97	0.97	0.38	0.38	0.96	0.96
N.o. time periods	9	9	9	9	14	14	14	14
N.o. countries	25	25	25	25	25	25	25	25
N.o. total observations	182	171	182	171	228	217	228	217

Note: The dependent variable is the logistic transformation of debt securities home bias. World market capitalisation is based on debt securities data. A logistic transformation is applied to the euro-area bias indicator too. See other notes to Table 4*.*

The results provide strong support for our main hypothesis: the larger the assets managed by institutional investors the lower the home bias and thereby the greater the scope for risk sharing. All 48 estimated parameters have a negative sign and most of them are statistically significantly different from zero.

The parameter estimates of the control variables are in line with our expectations.

- Higher GDP per capita seems to reduce home bias: only three of the 48 estimates have a positive sign and none of these positive estimates are significant, while most of the negative parameter estimates are statistically significant.
- On the other hand, results for the Financial Development Index (which may capture effects similar to GDP per capita) are less encouraging: the parameter estimate is never significant and the sign of the estimated parameter varies. The most likely reason for this result is the strong correlation between the Financial Development Index and GDP per capita relative to the United States. In a simple panel regression, in which the Financial Development Index is regressed on GDP per capita relative to the US, the estimated parameter is very significantly positive with a t-ratio of 12.7. This suggests that there is high level of multicollinearity between these two variables and therefore it is not wise to include both of them in the same regression. Since GDP per capita proved to be a more robust explanatory variable than the Financial Development Index, we

included the latter variable in the first four versions of the regression in each table and dropped it from the final four versions.
- Higher trade openness is negatively associated with home bias: only twelve of the 48 parameter estimates are positive and none of these positive estimates are significant, while most of the negative parameter estimates are statistically significant. This finding is consistent with the argument that it is cross-border trade integration that drives financial integration.
- Home-market capitalisation is positively related to home bias: all 48 estimates have a positive sign and 47 estimates are statistically significant from zero. Therefore, the availability of domestically issued securities influences the home bias: countries with larger home stocks of securities diversify less.
- The results of the availability of rest of the world securities are more mixed: while the estimated parameter is negative (as expected) when portfolio equity home bias based on stock market capitalisation is used (Table 4 and Table 5) and more than half of these estimates are statistically significant, for the national accounts data based portfolio equity home bias parameter are sometimes negative and while sometime positive, and both of these signs are statistically significant (Table 6 and Table 7). The parameter tends to be negative (as expected) for debt home bias (Table 8 and Table 9).
- Our estimates tend to suggest that our new pension fund foreign restriction index is positively related to home bias, that is, in countries with more restrictions home bias is higher, as expected: only six of the 48 estimated resulted in a negative parameter.
- The results for euro-area bias are mixed: when fixed effects are not included, the parameter estimate of euro-area bias is always negative and statistically significant in most cases. However, when fixed effects are included, all but one of the euro-area bias parameter estimates turn to positive, which is not surprising given that country-fixed effects can capture euro-area specific effects too. Intuition suggests that the elimination of currency risk should boost cross-country investments, especially in debt securities.

7. Summary

Institutional investors, as professional parties, typically hold geographically diversified portfolios of marketable securities. In that way, institutional investors contribute to financial integration and risk sharing in Europe’s Capital Markets Union and beyond. Assets managed by institutional investors (defined as pension funds, insurance companies and investment funds) have increased significantly in the past fifteen years.

We use a simple indicator of home bias in portfolio investments based on the International Capital Asset Pricing Model (ICAPM). We highlight that existing indicators of equity home bias in the literature suffer from incomplete coverage because they consider only listed equities. We also consider unlisted equites and show that equity home bias is much higher than previous studies perceived. We also calculate and analyse the developments of home bias in debt securities holdings, and euro-area bias both in equity and debt securities holdings.

Our indicators show that in euro area countries and in Denmark, Sweden and the United Kingdom, home bias is lower than in the newer EU member states and non-EU advanced countries. Euro-area bias is comparably high in the euro-area and newer EU member states, but low in the other three older EU member states and in advanced countries. Furthermore, the euro area is unique in terms of debt securities: home bias is lowest and euro-area bias is highest among the country groups. Since non-EU countries are generally characterised by a higher degree of home bias than EU countries, we conclude that EU membership may foster financial integration and reduce information barriers, which sometimes limit cross-country diversification.

We also calculate our home bias indicators for the aggregate of the euro area as if the euro area was a single country, by consolidating intra-euro area assets and liabilities. We report remarkable similarity between the euro area as a whole and the United States in terms of equity home bias, while there is a higher level of debt home bias in the United States than in the euro area as a whole.

We develop a new pension fund foreign investment restrictions index to control for the impact of prudential regulations on the ability of institutional investors to diversify geographically across borders. Our index suggests that most EU countries today apply very limited, if any, restrictions on foreign investment. However, some EU countries imposed substantial limits in 2001 and have gradually relaxed these barriers in recent years (Denmark, Finland, Germany, Hungary, Romania and Sweden). In the EU, persistent barriers to cross-border investment are still present in Austria, Greece and Poland.

With panel regression estimates for 25 advanced and emerging countries in 2001-14, we test the hypothesis that the larger the assets managed by institutional investors, the smaller the home bias and thereby the greater the scope for risk sharing. Our results provide strong support for this main hypothesis. We also conclude that higher GDP per capita, the size of the home market and our new pension fund foreign restriction index are positively associated with home bias, while greater trade openness is negatively associated with home bias. The latter result is consistent with the argument that cross-border trade integration drives financial integration. We find mixed results on the possible impacts of euro-area bias and the availability of rest of the world securities on home bias, while a financial development index is statistically not significant when we control for other factors.

Data annex

Assets of institutional investors are collected from a variety of sources in order to achieve the widest coverage possible.

-Pension funds

Main source:

Global Pension Statistics, from the OECD; the data appears in the publication "Pension Markets in Focus, 2015 edition" (http://www.oecd.org/finance/private-pensions/globalpensionstatistics.htm).
Dataset: Funded Pensions Indicators; Pension Plan Type: Total, by pension plan type; Definition Type: Total, by definition type; Contract Type: Pension funds (autonomous); Variable: INVESTMENT; Indicator: Assets as a Share of GDP; Unit: Percentage.

Additional sources:

Institutional Investors' Assets and Liabilities, from the OECD (https://stats.oecd.org/Index.aspx?DataSetCode=QASA_7II).
Sector: Pension funds; Transaction: Financial assets; Measure: $, current prices, current exchange rates, end of period.
Structural Financial Indicators, from the ECB (https://sdw.ecb.europa.eu/browse.do?node=9691551).

SSI.A.XX.1252.T10.1.U6.Z01.E

Dataset name: Banking structural statistical indicators; Frequency: Annual; Structural statist indicator: Total assets; Data type: Outstanding amounts at the end of the period (stocks); Counterpart area: Domestic (home or reference area); Currency of transaction: All currencies combined; Series denominat/spec calcul: Euro

Insurance corporations and pension funds statistics, ECB (http://sdw.ecb.europa.eu/browse.do?node=9691121).

ICPF.A.XX.N.V.LE.N_F.S1252.A1.S.1.N.E.Z

Dataset name: Insurance Corporations & Pension Funds Statistics; Frequency: Annual; Adjustment indicator: Neither seasonally nor working day adjusted; Valuation: Current prices; Transactions and other flows: Closing balance sheet; Asset/instr classification: Total Assets (financial and non-financial); Counterpart area: World (all entities); Counterpart institution sector: Total economy including Rest of the World (all sectors); Uses and resources: Debit (uses/assets); Consolidation: Non-consolidated;
Denomination: Euro; Reference table number: Not applicable (Z)

-Insurance corporations

Main source:

Institutional Investors' Assets and Liabilities, from the OECD (https://stats.oecd.org/Index.aspx?DataSetCode=QASA_7II).
Sector: Insurance corporations; Transaction: Financial assets; Measure: $, current prices, current exchange rates, end of period.

Additional sources:

Structural Financial Indicators, from the ECB (https://sdw.ecb.europa.eu/browse.do?node=9691551). SSI.A.XX.1251.T10.1.U6.Z01.E

Dataset name: Banking structural statistical indicators; Frequency: Annual; Structural statist indicator: Total assets; Data type: Outstanding amounts at the end of the period (stocks); Counterpart area: Domestic (home or reference area); Currency of transaction: All currencies combined; Series denominat/spec calcul: Euro

Insurance corporations and pension funds statistics, ECB (http://sdw.ecb.europa.eu/browse.do?node=9691121). ICPF.A.XX.N.V.LE.N_F.S1251.A1.S.1.N.E.Z

Dataset name: Insurance Corporations & Pension Funds Statistics; Frequency: Annual; Adjustment indicator: Neither seasonally nor working day adjusted; Valuation: Current prices; Transactions and other flows: Closing balance sheet; Asset/instr classification: Total Assets (financial and non-financial); Counterpart area: World (all entities); Counterpart institution sector: Total economy including Rest of the World (all sectors); Uses and resources: Debit (uses/assets); Consolidation: Non-consolidated;
Denomination: Euro; Reference table number: Not applicable (Z)

-Investment Funds

Institutional Investors' Assets and Liabilities, from the OECD (https://stats.oecd.org/Index.aspx?DataSetCode=QASA_7II).
Sector: Investment Funds; Transaction: Financial assets; Measure: $, current prices, current exchange rates, end of period.

Additional sources:

Investment funds balance sheet statistics, ECB (http://sdw.ecb.europa.eu/browse.do?node=9691120).
IVF.Q.XX.N.T0.T00.A.1.Z5.0000.Z01.E

Dataset name: Investment Funds Balance Sheet Statistics; Frequency: Quarterly; Adjustment indicator: Neither seasonally nor working day adjusted; Investment funds reporting sector: Total investment funds; Investment funds item: Total assets/liabilities; Original maturity: Total; Data type: amounts at the end of the period (stocks); Counterpart area: World not allocated (geographically); BS counterpart sector: Unspecified counterpart sector; Currency of transaction: All currencies combined; Balance sheet suffix: Euro.

Swiss National Bank, Swiss open collective capital investments (https://data.snb.ch/en/topics/finma#!/cube/capcollvf).

Claims and liabilities: Total assets; Key figures: Total.
Asset Management Survey, the Investment Association (http://www.theinvestmentassociation.org/investment-industry-information/research-and-publications/asset-management-survey/previous-surveys.html). The series used is "Assets under management in the UK".

*Values in EUR and CHF are converted into USD using end of year exchange rates obtained from the ECB and SNB databases.

Debt Securities

Main Source:

Debt securities statistics, from the Bank of International Settlements (http://stats.bis.org/bis-stats-tool/org.bis.stats.ui.StatsApplication/StatsApplication.html).

Q:XX:3P:Y:1:1:A:A:TO1:A:A:A:A:A:I, where XX is the country code and Y stands for the sector: 2 for General Government, B for Financial corporations and J for Non-financial corporations.
Issue type: All issue types; Default risk: All credit ratings; Collateral type: All issues; Issuer nationality: All countries excluding residents; Issuer sector – ultimate borrower: All issuers; Issue markets: All markets; Issue currency: All currencies; Original maturity: All maturities; Remaining maturity: All maturities; Rate type: All rate types; Measure: Amounts outstanding.

For Iceland and Switzerland:

Financial Balance Sheets, ESA 2010 (Unconsolidated) from Eurostat [nasa_10_f_bs] (http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nasa_10_f_bs&lang=en).
UNIT: Million euro; CO_NCO: Non-consolidated; SECTOR: Total economy; FINPOS: Liabilities; NA_ITEM: Debt securities

Stock Market Capitalization

World Development Indicators, from the World Bank (original source in World Federation of Exchanges).

National Accounts (equity)

Main source:

Financial Balance Sheets, SNA 2008 (non-nconsolidated) from the OECD (http://stats.oecd.org/#).
Dataset: 720. Financial balance sheets - non consolidated - SNA 2008; Sector: Total economy; Measure: US $, current prices, current exchange rates, end of period; Transaction: Financial liabilities, Equity and investment fund shares/units (AF5).

Dataset: 720. Financial balance sheets - non consolidated - SNA 2008; Sector: Rest of the world; Measure: US $, current prices, current exchange rates, end of period; Transaction: Financial assets, Equity and investment fund shares/units (AF5).

Additional sources:

Financial Balance Sheets, ESA 2010 (Unconsolidated) from Eurostat [nasa_10_f_bs] (http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nasa_10_f_bs&lang=en).

UNIT: Million euro; CO_NCO: Non-consolidated; SECTOR: Total economy; FINPOS: Liabilities; NA_ITEM: Equity and investment fund shares
UNIT: Million euro; CO_NCO: Non-consolidated; SECTOR: Rest of the world; FINPOS: Assets; NA_ITEM: Equity and investment fund shares

Japan

Financial Balance Sheets, SNA 1993 (Unconsolidated) from the OECD (http://stats.oecd.org/#).

Dataset: 720. Financial balance sheets - non consolidated; Sector: Total economy; Measure: US $, current prices, current exchange rates, end of period; Transaction: Financial liabilities, Shares and other equity.

Dataset: 720. Financial balance sheets - non consolidated; Sector: Rest of the world; Measure: US $, current prices, current exchange rates, end of period; Transaction: Financial assets, Shares and other equity.

Australia

Financial Balance Sheets, SNA 2008 (Consolidated) from the OECD (http://stats.oecd.org/#).

Dataset: 710. Financial balance sheets - consolidated - SNA 2008; Sector(s): Non-financial corporations, Financial corporations, General Government, Households and NPISH (summed); Measure: US $, current prices, current exchange rates, end of period; Transaction: Financial liabilities, Equity and investment fund shares/units (AF5).

Dataset: 710. Financial balance sheets - consolidated - SNA 2008; Sector: Rest of the world; Measure: US $, current prices, current exchange rates, end of period; Transaction: Financial assets, Equity and investment fund shares/units (AF5).

Russia

Financial Balance Sheets, SNA 2008 (Unconsolidated) form the Bank of Russia (https://www.cbr.ru/eng/statistics/?PrtId=fafbs).

Sector: Total economy (S1); Liabilities, Equity and investment fund shares/units (AF5).

Sector: Rest of the World (S2); Financial assets, Equity and investment fund shares/units (AF5).

*For the stock market capitalization, we consider the item Listed (Equity) liabilities of the Total Economy sector.

*For domestic equity holdings of residents, we consider equity and investment fund shares/units liabilities of the total economy sector minus equity and investment fund shares/units assets of the rest of the world sector.

*Values in EUR are converted into USD using end of year exchange rates obtained from the ECB SDW database. Values in RUB are converted into USD using end of year exchange rates obtained from the IMF's International Financial Statistics.

Exchange Rates

RUB/USD: International Financial Statistics from the IMF (CD-ROM, August 2016).
[SERIES_CODE: 922..AG.ZF...]

USD/CHF: Foreign exchange rates from the Swiss National Bank (https://data.snb.ch/en/topics/ziredev#!/cube/devkum).
End of month (December).

EUR/USD: Exchange Rates from the ECB (https://sdw.ecb.europa.eu/browseSelection.do?type=series&ec=&rc=&oc=&df=&SERIES_KEY=120.EXR.A.USD.EUR.SP00.E&dc=&cv=&node=SEARCHRESULTS&q=EXR.A.USD.EUR.SP00.E&pb=&trans=N).

Dataset name: Exchange Rates; Frequency: Annual; Currency: US dollar; Currency denominator: Euro; Exchange rate type: Spot; Series variation - EXR context: End-of-period

GDP and GDP per capita

World Economic Outlook, International Monetary Fund (April 2016 edition) (https://www.imf.org/external/pubs/ft/weo/2016/01/weodata/weoselgr.aspx).

Gross domestic product, current prices; USD

Gross domestic product based on purchasing-power-parity (PPP) per capita GDP; Current international dollar

Exports

World Development Indicators, World Bank (http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators#).

Exports of goods and services (current US$)

Financial Development Index

The Global Competitiveness Index, World Economic Forum (http://reports.weforum.org/global-competitiveness-index/downloads/).
*The overall score in the “8th pillar: Financial market development” is considered.

Pension Fund regulation index

The index is based on the: Annual Survey of Investment Regulation of Pension Funds database from the OECD (http://www.oecd.org/finance/private-pensions/annualsurveyofinvestmentregulationofpensionfunds.htm).

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