

International Currencies and Capital Allocation^{*}

Matteo Maggiori[†] Brent Neiman[‡] Jesse Schreger[§]

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Abstract

We establish that global portfolios are driven by an often neglected aspect: the currency of denomination of assets. Using a dataset of \$27 trillion in security-level investment positions, we demonstrate that investor holdings are biased toward their own currencies to such an extent that each country holds the bulk of all securities denominated in their own currency, even those issued by foreign borrowers in developed countries. In fact, this home-currency bias almost entirely explains home-country bias in these data. While large firms can issue in foreign currency and borrow from foreigners, the vast majority of firms issue only in local currency and do not access foreign capital. These patterns hold broadly across countries with the exception of international currency issuers such as the US. The global willingness to hold the US dollar, or international currency bias, means that even small US firms that borrow exclusively in dollars have little difficulty borrowing from abroad. Global portfolios shifted sharply away from the euro and toward the dollar starting with the 2008 financial crisis, further cementing the dollar's international role and amplifying the benefit that its status brings to the US. We rationalize these findings in a framework with downward-sloping demand for bonds in each currency in which firms pay a fixed cost to borrow in foreign currency.

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[†]Maggiori: Harvard University, Department of Economics, NBER, and CEPR. Email: maggi@fas.harvard.edu.

[‡]Neiman: University of Chicago, Booth School of Business, and NBER. Email: brent.neiman@chicagobooth.edu.

[§]Schreger: Columbia University, Graduate School of Business, and NBER. Email: jesse.schreger@columbia.edu.

1 Introduction

Capital crosses international borders far more today than only a few decades ago. In the late 1970s, almost none of the total outstanding value of US corporate debt was held by foreigners. Today, more than one-quarter is held abroad. In part due to a lack of detailed data, however, surprisingly little is known about the determinants of cross-border investment. We introduce a novel security-level dataset with \$27 trillion in global investment positions to demonstrate that portfolios at both the macro and micro levels are driven by an often neglected aspect: the currency of denomination of assets.

We emphasize three findings. First, investors' bond portfolios exhibit extremely strong *home-currency bias* as they disproportionately hold bonds denominated in their own country's currency. This bias holds to such an extent that each country owns the vast majority of securities issued in their currency, even when the issuer is foreign and resides in a developed country. In fact, home-currency bias is so pervasive that it almost entirely explains the more well-known home-country bias. If one considers only the global supply of bonds denominated in a country's currency, that country's portfolio exhibits little if any bias away from securities issued by foreign borrowers. Similarly, if one focuses only on the global supply of foreign currency bonds, countries do not lend disproportionately to domestic borrowers. We identify this effect not only at the country level, but most importantly using micro data capable of disentangling the currency of denomination of an asset from possible confounding factors such as maturity, legal jurisdiction, and issuer's credit risk and sector of operation. Investors disproportionately hold bonds denominated in their home currency even when choosing among bonds issued in different currencies by the same firm. We overturn the classic finding of home bias in bonds by exposing the role of a critical omitted variable: domestic issuers supply most domestic currency bonds, so home-currency bias can easily be mistaken for home-country bias when not controlling for currency.

Second, this home-currency bias leads to a markedly different allocation of capital across firms. In each country, a small number of large firms issue debt denominated in foreign currency and borrow from foreigners. A large number of medium or smaller sized firms issue only in the local currency and borrow little or nothing from foreigners. The size-dependent ability to issue in foreign currency skews foreign capital away from the vast majority of issuers even in highly developed countries. We establish this result not only controlling for observable firm characteristics but also by using, in the case of publicly-listed firms, the foreigners' holdings of the firms' equity as a proxy for the firm's unobservable attractiveness to foreign investors. Among those firms that issue in multiple currencies there is a positive relationship between the foreigners' holdings of equity and bonds. For example, if foreigners are overweight the equity of one of these firms relative to domestic investors, then they are typically also overweight the bonds of the firm. Not so for local-

currency firms: foreigners might hold more or less of the equity of such firms, but they are always markedly underweight the bonds.

Third, the global willingness to hold the US dollar renders the United States the unique exception to the above patterns. In addition to their own currencies, foreigners are biased toward dollar-denominated securities, what we dub an *international-currency bias*, when they invest in all destination countries. This implies that when foreigners buy securities in the US, they predominantly buy dollar-denominated securities, thus behaving similarly to US domestic investors. Relatedly, US firms that borrow exclusively in dollars are able to place their bonds in domestic and foreign portfolios with comparable ease. This is not true for any other country in our data. Our work offers a novel perspective on the benefits that accrue to countries that issue an international currency like the dollar – these countries effectively open the capital account for their domestic firms that only borrow in local currency.¹

Finally, we uncover a striking shift in the time-series of global portfolios. The US dollar appears today to be the world's only international currency. As recently as ten years ago, however, this was not the case. The dollar was the currency of denomination for roughly half of global cross-border holdings of corporate debt in our data in 2004, but the euro also accounted for a substantial amount, about 35 percent. These shares were essentially stable until the global financial crisis of 2008, after which the euro's share rapidly declined to below 20 percent, while the dollar's share rose to nearly 70 percent. This massive international portfolio reallocation is not only interesting in its own right, but also offers us a unique opportunity to assess how the above cross-sectional stylized facts changed in response to variation in the international status of the dollar and the euro.²

We organize and rationalize our findings in the context of a simple and tractable framework in which investors have an exogenous preference for a currency. In each country the majority of investors has a preference for the domestic currency. In the context of the model, the US dollar is special because there is a disproportionately large mass of investors in countries other than the US that have a preference for the US dollar. Investors are specialists in the debt of particular firms in specific currencies and so firms face different interest rate schedules depending on the currency in which they borrow. While this set-up immediately matches our facts on home-currency and international-currency bias, it leaves open for future work to provide the deeper foundations for

¹The benefits of being an international currency analyzed in this paper are distinct from, and complementary to, the mechanisms more commonly emphasized in the literature such a lower risk-free rate and the safe-haven properties of the exchange rate (Caballero et al. (2008), Gourinchas et al. (2011), Maggiori (2017), Farhi and Maggiori (2017)).

²International-currency status is typically a persistent phenomenon with few instances of switches, the last occurring between the US dollar and the British pound during the 1920-1950 period. The deeper causes of this shift, which might include fluctuations in the relative credibility of European and US monetary and fiscal institutions, are beyond the scope of this paper.

the reduced-form preferences that we simply assume.³ Instead, the model takes these preferences as given and explores the implications of this investor currency preference for the global allocation of capital and the pattern of production across firms.

We employ a standard linear-demand framework that allows for market segmentation and links the depth of each market to the wealth of the specialist investors in that market. The deeper the currency market the less the interest rate on the debt of a firm increases as the firm issues more debt in that currency.⁴ Firms issue bonds to finance production and are heterogeneous in their productivities and start-up capital. We assume that the bonds are currency-hedged by the issuer, so issuance is purely opportunistic and exploits the presence of limits to arbitrage in the international corporate bond market. Firms would in principle like to issue in all currencies until their borrowing costs, on a hedged-basis, are equalized across all currencies. Doing so would involve issuing more in the currencies with deeper markets and flatter demand curves. To match the empirical regularity that firms that issue in foreign currency tend to be large we assume that, while all firms can borrow in local currency, firms must pay a fixed cost to issue in foreign currency. We think of this fixed cost as representing the need to build an infrastructure capable of complying with enhanced accounting standards and arranging for and paying costs of currency hedges, including establishing a more sophisticated corporate treasurer's department.

Much like the Melitz (2003) model of trade, in which a fixed cost leads firms to select into exporting based on their productivity and size, the fixed cost in our framework implies that those firms that select into borrowing in foreign currency are, all else equal, larger, more productive, and more levered. Furthermore, the model predicts that selection into foreign currency borrowing should vary across countries with the depth of their domestic currency markets. In countries that issue an international currency, such as the US, most firms prefer to only borrow in domestic currency and save the fixed cost of issuing in foreign currency. They can access foreign capital (and thus maintain low interest rates on their debt) almost as easily when borrowing only in local currency as when borrowing in multiple currencies. This not true in countries with shallow local-currency markets like Canada, where firms quickly outgrow the capacity of markets to absorb their Canadian dollar debt and so switch to borrowing in multiple currencies. The model implies that firms in countries whose currencies are used to denominate larger shares of global assets will have their local currency borrowers attract more foreign financing and represent a larger share of total borrowing than in other countries. We find empirical evidence supportive of these predictions.

Our security-level dataset covers holdings of mutual funds around the world. We must therefore confront some common but thorny issues in international financial data as well as challenges

³Such foundations might include behavioral inattention to foreign currency, a rational preference for one's own currency, or frictions that make it costly to hold foreign currency assets.

⁴Our theoretical framework with specialist investors and linear demand is in the spirit of the segmented models of De Long et al. (1990); Gromb and Vayanos (2002); Jeanne and Rose (2002), and Gabaix and Maggiori (2015).

specific to our data. We unwind issuance in fiscal paradises and opaque international ownership structures in order to attribute securities to the ultimate parent firm (and its country of operation) whose revenues are used to repay the debt. We offer evidence that mutual funds domiciled in a particular country invest on behalf of domestic residents, an assumption maintained throughout our analysis.

Finally, we benchmark our mutual fund data against other aggregates to verify that our core results are externally valid and are informative of patterns in the broad set of portfolio investment. In the interest of focusing on the main economics of our paper, however, we only provide a brief introduction to our data in Section 2 and relegate a more detailed discussion of these issues to the Appendix.

Related Literature. Our work relates to a large empirical literature linking net foreign asset dynamics to the differential composition of gross assets and gross liabilities, including important contributions by Lane and Milesi-Ferretti (2007), Gourinchas and Rey (2007), and Curcuru et al. (2008).⁵ Our finding that foreigners avoid local-currency debt to such an extent that the external debt liabilities of countries are in large part denominated in foreign currency complements the work by Lane and Shambaugh (2010) and Bénétrix et al. (2015). Our finding that home-country bias is largely a reflection of home-currency bias expands upon the message in Burger et al. (2017), who first found using TIC data that the US foreign investment across destination countries does not appear home-country biased in the subset of debt that is dollar denominated and suggested it might apply more generally across countries and debt markets. Boermans and Vermeulen (2016) find that a common currency is an important explanatory variable in a gravity portfolio setting for European investors.

Our results on which firms select into foreign currency borrowing and the heterogeneity across countries in such selection have analogies both with the international corporate finance literature (Gozzi et al. (2010, 2015); Larrain and Stumpner (2017)) and the trade literature following Melitz (2003). The model of Salomao and Varela (2016) also features an endogenous funding choice by heterogeneous firms that must pay a fixed cost to borrow in foreign currency. They apply their framework to data on Hungarian firms and study the link between their borrowing and investment decisions.

⁵Other recent work includes Alfaro et al. (2008); Bertaut et al. (2013); Du and Schreger (2016), and Lane and Milesi-Ferretti (2017). These papers make use of the IMF's International Investment Position (IIP) and Coordinated Portfolio Investment Survey (CPIS), the TIC data, and the BIS's Debt Security Statistics and Locational Banking Statistics. A related literature studied international mutual fund data, but typically concentrated on equity flows or included only a small subset of countries (Chan et al. (2005), Hau and Rey (2004, 2008a,b), Forbes et al. (2011), Jotikasthira et al. (2012), Raddatz and Schmukler (2012), Didier et al. (2013)). Hau and Lai (2016) focus on European money market funds to study monetary policy. Choi and Kronlund (2016) study Morningstar data on US corporate bond mutual funds.

Our findings offer a challenge and new guidance for international macro models. Most international macro models would not match our data either because they generate no bond trading (Lucas (1982)) or because they predict that foreign investors, conditional on investing in a country, tend to take on direct exposure to the borrower’s local currency (Alvarez et al. (2009); Bacchetta and Van Wincoop (2010); Pavlova and Rigobon (2012), and Lustig and Verdelhan (2016)).⁶ A class of modern models generates home-currency bias in bonds either endogenously because these securities are a good hedge for domestic investors’ marginal utility (Solnik (1974), Adler and Dumas (1983), Engel and Matsumoto (2009), Coeurdacier and Gourinchas (2016)) or exogenously by postulating that households invest abroad in bonds denominated in their own domestic currency (Gabaix and Maggiori (2015)). Frictionless portfolio models, even those few that generate home-currency bias, struggle to match the skewed foreign capital allocation across domestic issuers that we show is a critical feature of our data.⁷

2 Mutual Fund Investment Data

Morningstar, Inc., one of the world’s largest providers of investment research to the asset management industry, provided us with their complete position-level data collected from mutual funds domiciled in over 50 countries. These data are collected from open-end funds that invest in equities, fixed income, and a variety of other asset classes including commodities, convertible bonds, and housing properties.⁸ The funds report all positions including stocks, bonds, cash, and alternative investments.⁹ The reporting is commonly done at the monthly frequency and, when not, is nearly always done at the quarterly frequency. Positions include a 9-digit identifier (the CUSIP) which allows us to match with information on the security’s characteristics such as currency, maturity, coupon or dividend, and the security issuer’s geographic location and industry. At the most disaggregate level, our dataset contains millions of individual positions. For example, in December 2015 we observe 2.2 million unique positions held by approximately 8,000 US mutual funds and 4.1 million unique positions held by the approximately 47,000 mutual funds domiciled in the rest

⁶See also: Corsetti et al. (2008); Tille and Van Wincoop (2010); Devereux and Sutherland (2011); Dou and Verdelhan (2015); Colacito and Croce (2011); Colacito et al. (2015); Hassan (2013); Hassan et al. (2015).

⁷In perfect markets, investors would not distort their corporate debt and equity portfolio due to currency preferences, rather they would adjust any undesired currency exposure resulting from their desired corporate and equity portfolio using a long-short position in short-term risk-free bonds in the different currencies.

⁸Mutual fund managers are not required by law to report their holdings to Morningstar but choose to do so in order to be included in Morningstar’s ratings and reviews. Given Morningstar’s large market share in the investment research industry, most mutual funds opt into this process. In principle, fund managers might not wish to correctly report their positions to Morningstar in order to “window dress”. Morningstar’s internal procedures verify the accuracy of the data against publicly available returns of the funds. Our own independent checks of the data against regulatory filings, voluntary disclosures, and other datasets of investment fund positions revealed the data to be accurate.

⁹In some cases funds also report derivatives, but the reporting and accounting often appears to be fund specific. We therefore exclude all derivatives positions from our analysis.

of the world.

Our data account for a substantial fraction of all worldwide open-end mutual fund assets under management (AUM).¹⁰ The Investment Company Institute (ICI), a major association of mutual funds and other regulated investment vehicles, reports that the US mutual fund industry has about \$16 trillion of AUM as of 2015 across equity, fixed income, allocation, and money market funds.¹¹ The total market value of securities held by all US-domiciled mutual funds in our data is only marginally below this aggregate number. Figure 1 compares the total value of assets under management in US-domiciled mutual funds in our dataset and in the ICI data. From very low levels of AUM in the 1980s, the industry grew at a rapid pace in the 1990s. AUM declined in value in the 2001 and 2008 recessions but rapidly recovered and expanded to their present levels. Our data, displayed as a dashed line in Figure 1(a), exhibit meaningful coverage of US-domiciled funds starting in the mid-1990s and by 2015 account for 97 percent of the value reported by ICI. Figures 1(b), 1(c), and 1(d) plot equivalent comparisons for the value of AUM broken down by funds specializing in equities, fixed income, and allocation (or hybrid), respectively. By the end of the sample, the coverage of our data is nearly complete across all major types of funds.¹²

Our data also include holdings of mutual funds domiciled in 50 other countries. ICI reports that these countries together have \$16 trillion of AUM in 2015. Substantial coverage of these funds in our data starts in the early-to-mid 2000s. Figures 2(a) and 2(b) show that over the last decade our data capture between half and two-thirds of equity and fixed-income funds outside the US. Figures 2(c) and 2(d) further show that our data on funds domiciled in the European Monetary Union (EMU) and the UK closely track over time the equivalent aggregates provided by ICI.¹³

To ensure that analyses are not influenced by domiciles for which Morningstar data are unrepresentative, our benchmark analysis in the rest of the paper is performed on a subsample of the data. We drop country-quarters for which Morningstar's coverage of fixed-income funds is less than one-quarter of (or, rarely, twice as large as) the scale of those reported by ICI. Our criteria select a final sample of 25 countries that have sufficient coverage to meet our standard, and about half of which are subsumed into the EMU. Table 1 lists the remaining 14 effective countries, ranked by the order of their AUM in 2015 in our data. While the US and EMU clearly account for the bulk of

¹⁰They exclude closed-end funds and exchange traded funds (ETFs).

¹¹These numbers exclude funds-of-funds to avoid double counting the AUM. The ICI statistics are essentially identical to AUM reported for the mutual fund sector in the US Flow of Funds data by the Federal Reserve.

¹²Fund classifications as equity, bond, or allocation vary across our data and ICI so it is entirely plausible that some allocation funds, a category for which AUM in our data exceed those reported by ICI, are classified as either bond or equity funds in ICI. ICI only reports country aggregates, so that it is not possible to reconcile the differences at the individual fund level.

¹³The ICI data for non-US domiciled funds are available quarterly on their web page when they release their "Worldwide Public Tables". We were able to obtain these tables for most quarters since the first quarter of 2005 using the Internet Archive (<https://web.archive.org/>). We log-linearly interpolate between the ICI values in the first quarter of 2005 and their values in the second quarter of 2002, which we obtained from Khorana et al. (2005).

global AUM, we observe about \$1 trillion or more in AUM for each of the the UK, China, Brazil, and Canada.¹⁴ We focus our analysis on the set of developed countries in the dataset.

In the appendix we benchmark our data against publicly available datasets, such as TIC and CPIS, to confirm their suitability for analyzing global capital allocations. Our data account directly for a sizable share of cross-border portfolio security investment (e.g. 30-40% of all outward US portfolio investment) and are representative of non-mutual fund portfolio investment in important dimensions such as country of destination and currency of denomination. Of course, our data misses some important patterns occurring outside of mutual funds such as the large official Chinese holdings of US debt securities.

Our data include information on the domicile of each mutual fund, but we do not have information on the residency of the individual investors in each fund. In general, tax optimization and regulatory restrictions make it unlikely that investors buy mutual funds domiciled in other countries. Based on this principle, we assume that the domicile of a mutual fund is also the country of residency of the investors in that fund. The appendix provides direct evidence in support of this assumption in the case of United States, for which publicly available official data show minimal foreign holdings of US mutual funds.

A notable exception are funds domiciled in Ireland and Luxembourg, which include a large number of Undertakings for Collective Investment in Transferable Securities (UCITS) funds that are designed to be sold throughout the European Union under a harmonized regulatory regime. As a result, these countries are two of the world's largest mutual fund centers and violate our assumption that all mutual fund AUM should be attributed to local residents. Given our focus on currency, we pool all data for countries within the EMU, including Luxembourg and Ireland, and treat the EMU itself as a single consolidated country in all our analyses.

One benefit of working with security-level data is that we can trace issuers to their ultimate parent company, which allows us to associate security issuance with the industry and country that faces the economic liability and deploys the borrowed capital. For example, Petrobras is a Brazilian energy firm that issues some debt securities through subsidiaries in the Cayman Islands, some of which are routinely classified as financial firms. Whereas naive aggregate statistics would likely classify this type of borrowing as done by Cayman Island financials, our matching procedure attributes the borrowing to Brazil's energy sector, which for our purposes is a more economically meaningful mapping.¹⁵

¹⁴The Chinese mutual fund industry has grown very rapidly in recent years. The industry is mostly composed of money market funds that invest domestically and target Chinese retail clients. Hachem and Song (2016) point out that these funds are akin to shadow banking and their AUM growth has been spurred by regulatory tightening in traditional credit sectors.

¹⁵Our matching procedure is described in detail in the appendix. We rely on several different data sources (CUSIP/CINS_db Combined Master Issue File, the CUSIP/CINS_db Combined Master Issuer File, the CUSIP Global Services Associated Issuer Master File, and the Capital IQ and SDC Platinum datasets) to compile a comprehensive

In summary, our data tracks well the best publicly available information on the aggregate scale of mutual fund assets, domiciled inside and outside the US. These data clearly represent only a subset of cross-border investment positions but a comparison with public aggregate data suggests that they are informative about many facets of non-mutual fund intermediated portfolio positions, such as those held by insurance companies and hedge funds. Importantly, our data offer a unique security-level detail of domestic and foreign investment by the same type of investors in over 50 countries.

3 Investor Home-Currency Bias

In this section we demonstrate the strength of investor home-currency bias and show that it largely subsumes the more well know home-country bias. We also introduce the notion of international-currency bias: the tendency in our data of investors to disproportionately hold securities denominated in an international currency. We start by introducing the notation for portfolio shares used throughout the paper.

Denote the US dollar value of a position held by a mutual fund domiciled in country j and invested in country i at time t as:

$$Q'_{i,j,k},$$

where the index k denotes the security type. The index k takes the values B (all bonds), BC (corporate bonds), BS (sovereign bonds), and E (equities). We add a subscript to k to specify, whenever necessary, the security's currency. For example, $k = BS_{EUR}$ denotes euro-denominated sovereign bonds, and $k = BC_i$ denotes destination country i local currency denominated corporate bonds, $k = BC_j$ denotes corporate bonds that are denominated in the investor country's currency.

We denote the complement of X by using $-X$ in the relevant subscript such that $k = B_{-i}$ denotes bonds denominated in a currency other than the local currency of country i , and $k = B_{-USD}$ denotes bonds denominated in a currency other than the US dollar. If we sum over all elements of an index, we replace the index with Ω . For example, bond positions by all EMU funds in 2010 are denoted by $Q_{\Omega,EMU,B}^{2010}$, UK funds' foreign equity positions in 2015 are denoted by $Q_{-GBR,GBR,E}^{2015}$, and US funds' positions in Mexico in 2005 are denoted by $Q_{MEX,USA,\Omega}^{2005}$.

Portfolio positions are denoted with uppercase Q 's and portfolio shares are denoted with lowercase q 's. For example, the share of the EMU bond portfolio that is invested in the US in 2010 is denoted by:

$$q_{USA/\Omega,EMU,B}^{2010} = \frac{Q_{USA,EMU,B}^{2010}}{Q_{\Omega,EMU,B}^{2010}} = \frac{Q_{USA,EMU,B}^{2010}}{\sum_i Q_{i,EMU,B}^{2010}},$$

list that associates each CUSIP 9-digit code of a security with the unique CUSIP 6-digit code of the ultimate parent firm.

and the share of EMU holdings of EMU sovereign bonds that are dollar denominated in 2005 is denoted by:

$$q_{EMU,EMU,BS_{USD}/BS}^{2005} = \frac{Q_{EMU,EMU,BS_{USD}}^{2005}}{Q_{EMU,EMU,BS}^{2005}}.$$

A number of our security-level analyses require additional subscripts to denote the specific borrowing firm p (for parent, identified with its CUSIP 6-digit code) within an (i, j, k) bundle and to denote a specific security c (identified with its CUSIP 9-digit code) within an (i, j, k, p) bundle. In these cases, we add subscript p to i to capture the country of the borrowing firm and add subscript c to k to capture the currency of the security. For example, consider a firm p , which is a US firm, so $i_p = USA$ in this case. We would use $q_{i_p,EMU,BC,p/\Omega,\Omega}^t$ to denote firm- p 's share of the EMU portfolio of US corporate bonds, and we would use $q_{i_p,EMU,BC,p/\Omega,c/\Omega}^t$ to capture the share of a particular firm- p security – bond c – in that same portfolio.

3.1 Country Level Results

We find that domestic bond investments are almost always denominated in the domestic currency. For example, when Canadian investors buy bonds issued by Canadian issuers, the bonds are almost always denominated in Canadian dollars. However, foreigners invest differently. When Australians buy bonds issued by Canadian issuers, the bonds are very rarely denominated in Canadian dollars. Using the notation introduced above, this fact can be described as:

$$q_{i,i,B_i/B} > q_{i,-i,B_i/B}.$$

Figure 3(a) plots this statistic for the bond portfolios in our data as of December 2015. The shaded red bars on the left plot for each country the share of all lending by that country's investors to that country's borrowers that is denominated in the local currency, $q_{i,i,BC_i/BC}$. For example, the third red shaded bar shows that about 95 percent of lending by Canadian investors to Canadian borrowers is denominated in Canadian dollars, as per the example above. The bars are all above 0.8 and most are quite close to 1.0. Unsurprisingly, and consistent with conventional modeling assumptions in the literature, all countries invest overwhelmingly in local currency bonds when lending to domestic borrowers.

More surprisingly, however, is our finding that foreigners invest differently. The hollow blue bars on the right of Figure 3(a) show the share of foreign investment in country i 's bonds that is denominated in i 's currency, $q_{i,-i,BC_i/BC}$.¹⁶ For example, the third blue hollow bar shows that less

¹⁶The hollow blue bars on the right are calculated by simply adding up positions over multiple countries $j \neq i$ that invest in i . The relative weight of each country j therefore implicitly relates to its scale of AUM in our data and therefore may differ from equivalent values reported by national statistical agencies. We have disaggregated the

than 10 percent of lending by non-Canadian investors to Canadian borrowers is denominated in Canadian dollars. If foreign and domestic investors held similar portfolios in each market, then the length of red and blue bars would be identical in each row. On the contrary, Figure 3(a) shows that the blue bars are systematically (much) smaller than the red bars for each row. Domestic investment is almost always in the local currency. Excluding (for now) investment in the United States, foreign investment in corporate bonds is rarely in the local currency.

Figure 3(b) performs the analysis separately for sovereign bonds, where this pattern still holds but is more muted. Most developed country sovereigns issue a very limited supply of foreign currency bonds (the US government, for example, does not issue in foreign currency). While we show that foreigners are disproportionately likely to buy those few foreign-currency denominated sovereign bonds, we also show that they buy substantial amounts of local-currency bonds.¹⁷

The picture for corporate bonds, however, is extremely stark. As seen in Figure 4, which conducts the analysis for corporate bonds, foreigners are very unlikely to hold local currency corporate debt. Whereas roughly 20 percent of foreign investment in all Canadian bonds was in Canadian dollars, less than 10 percent of foreign investment in Canadian corporate bonds is in Canadian dollars. Unlike sovereigns, many corporations issue a substantial fraction of their debt in multiple foreign currencies, thus in principle offering the possibility to investors to buy bonds, from the same issuer, in the currency of their choice. Since our focus is precisely on this currency choice, both from the investor and the issuer perspective, we focus our results in the rest of the paper on the corporate bond market.¹⁸

Rather than holding local currency bonds, foreigners tend to hold bonds either in their own domestic currency or in an international currency, such as the US dollar.¹⁹ Figure 5(a) shows the currency composition of the foreign bond investments held by investors resident in each country. We exclude investment in the United States to focus purely on the international role of the dollar. The vast majority of all foreign investment is either denominated in the investing country's

hollow blue bars into the portfolios from individual investor countries and verified that these patterns hold robustly across bilateral pairs. The bilateral graphs are reported in the appendix.

¹⁷It is beyond the scope of this paper to establish why developed countries sovereigns do not issue (more) in foreign currency. In our data foreigners are also increasing over time their holdings of local-currency sovereign bonds in emerging markets. It remains true, however, that foreigners underinvest compared to locals in local-currency sovereign bonds, in both emerging and developed markets. For an analysis of determinants of the currency composition of sovereign debt, see Perez et al. (2016), Engel and Park (2016), and Du et al. (2016).

¹⁸We rule out that the stark currency selection in corporate bonds is purely an artifact of rules preventing mutual funds from investing in foreign currency. In fact, we have shown that the same class of investors, open-end mutual funds, buys sovereign bonds predominantly in foreign currency.

¹⁹Foreigners' holdings of dollar-denominated securities do not explain their low holdings of local-currency securities. To see this, Figure 5(b) simply replicates the results in Figure 4 after dropping all dollar-denominated holdings. By construction, all bars grow toward one since the numerators for both sides, Q_{i,i,BC_i} and $Q_{i,-i,BC_i}$, are unaffected but the denominators are lowered by the amounts $Q_{i,i,BC_{USD}}$ and $Q_{i,-i,BC_{USD}}$, respectively. The bars on the right hand side all remain strikingly smaller than the bars on the left.

currency or in US dollars.²⁰

Our results imply a strong sorting of foreigners' purchases of bonds away from local currency bonds, despite the fact that these type of bonds constitute the bulk of the corporate bond market in each country. This sorting stresses the importance of studying portfolio holdings and not just the stock of securities outstanding to understand the external positions of countries. For example, a naive assumption that foreign and domestic investors buy securities in each country according to market weights would imply that developed countries have external liabilities denominated in their own currency and external assets denominated in foreign currency. Our work opens up the surprising possibility that, instead, the external liabilities of developed countries, such as the EMU or Canada, are disproportionately (compared to market weights) denominated in foreign currency and the external assets are disproportionately denominated in domestic currency.²¹ An important consequence is that a domestic currency depreciation might not have as much of a positive wealth effect as commonly conjectured, or might even have a negative wealth effect.²²

3.2 Security Level Results

The above results suggest that investors exhibit “home-currency bias”, in that they disproportionately hold securities denominated in their domestic currency, and “international-currency bias”, in that they disproportionately hold securities denominated in a particular third-country currency, like the US dollar in our sample. To demonstrate that currency is the critical factor driving this pattern, we must overcome the concern that correlated and omitted factors such as the borrower's sector, participation in international trade, and credit worthiness, or the security's maturity, coupon, legal jurisdiction, and place of issuance are in fact the true drivers of the bias and are simply correlated with the security's currency. Our security-level dataset offers significant joint variation across all these elements and allows us to affirmatively demonstrate that currency itself is the key factor.

We start by exploiting security-level variation in the currency of denomination of multiple

²⁰For the most recent years for a subset of countries, CPIS reports the aggregate currency composition of external portfolio debt investment. In the Appendix, we benchmark our data to CPIS whenever possible. Overall, our message is consistent with the CPIS data. We benchmark our EMU currency composition estimates against data provided by the ECB. We find a larger share of foreign investment of the EMU to be in dollars than does the ECB.

²¹A large literature on “Original Sin” such as Eichengreen and Hausmann (1999) and Eichengreen and Hausmann (2005) has emphasized the similar fact that emerging market borrow from foreigners in “hard” currencies like the US dollar, presumably due to their inflation risk, weaker institutions, or less developed internal capital markets. We show, however, that even rich and developed economies that do not suffer from these problems borrow in foreign currency from foreigners to a surprising extent. Our inference on the currency composition of external positions also relates to the work of Lane and Shambaugh (2010) and Bénétrix et al. (2015) who provided early and important estimates by mixing national statistics and gravity regressions for capital flows.

²²The wealth effect would also be affected by the extent of hedging of the bonds and the residency of the counterparties with whom the bonds are hedged. If the firms hedge the bonds with domestic counterparties, then from a country aggregate perspective a currency depreciation has a negative wealth effect (but it accrues to the counterparties and not the firms). If the firms hedge with foreign counterparties, then there is no negative wealth effect at the country level.

bonds offered by the same issuer. After all, a given issuer such as British Petroleum (BP), a UK firm, has the identical nationality, industry, trade exposure, and very similar default risk, regardless of which currency its debt is denominated in. Further, we can control for each security's maturity and coupon payment. If Canadians, for instance, are much more likely to hold BP's long-term Canadian dollar debt than BP's long-term British pound debt, this would support the conclusion that currency is the true underlying factor driving capital allocations.

Recall that $q_{i_p,j/\Omega,BC,p,c}$ denotes the share of the total worldwide market capitalization of a corporate bond c , issued by parent firm p from country i_p , that is held by investors from country j . We pool all individual corporate bonds in our data and estimate the following regression separately for each investing country j :

$$q_{i_p,j/\Omega,BC,p,c} = \alpha_{j,BC,p} + \beta_j \mathbf{1}_{\{\text{Currency}_c = \text{Currency}_j\}} + \text{Controls} + \varepsilon_{i_p,j,BC,p,c}, \quad (1)$$

where $\mathbf{1}_{\{\text{Currency}_c = \text{Currency}_j\}}$ is an indicator variable that equals one when security c is denominated in the currency of country j . The coefficient of interest is the estimate of β_j , which reports the extent to which a country disproportionately holds securities denominated in its home currency. If country j had no home-currency bias then β_j would be zero.²³ Our benchmark estimates are run using data for 2015, are weighted by the outstanding value of each security, and control for maturity and coupon payment.²⁴ Table 2 reports our estimates of equation (1) focusing, for illustration purposes, on a subset of our countries.

Looking across the top row of Table 2, the β_j coefficients are uniformly positive, statistically significant, and large in magnitude. For example, the top row of column one shows that if a security is denominated in Canadian dollars, Canadian mutual funds hold a share of the global capitalization of this security that is 92 percentage points larger than what they hold of securities that are not denominated in Canadian dollars. This implies that Canadian investors hold the vast majority of Canadian dollar securities that are issued around the world. A similar effect holds for

²³It is common in the literature to express portfolio bias (PB) as the ratio of the share that a security accounts for in the country's portfolio relative to the share that a security accounts for in the global portfolio. In our notation this would be $PB_{i,j,BC,p,c} \equiv q_{i,j,BC,p/\Omega,c}/q_{i,\Omega,BC,p/\Omega,c}/\Omega$. This measure and the security share measure $q_{i_p,j/\Omega,BC,p,c}$ that we use in our benchmark regression in equation (1) are linear transformations of each other within countries and, therefore, the regression results, when run country-by-country at each point in time, contain the same information.

Indeed, we can expand the expression for portfolio bias as $\left(\frac{Q_{i,j,BC,p,c}}{Q_{\Omega,j,BC,\Omega,\Omega}}\right) / \frac{Q_{i,\Omega,BC,p,c}}{Q_{\Omega,\Omega,BC,\Omega,\Omega}}$. This can then be rearranged as $\left(\frac{Q_{i,j,BC,p,c}}{Q_{i,\Omega,BC,p,c}}\right) / \left(\frac{Q_{\Omega,j,BC,\Omega,\Omega}}{Q_{\Omega,\Omega,BC,\Omega,\Omega}}\right)$. The first term here is the definition of the security share, and the second term measures the share of all investment in the dataset originating from country j .

²⁴We control for maturity with dummies corresponding to the categories: less than 2 years, between 2 and 5 years, between 5 and 10 years, and greater than 10 years. We treat coupon similarly, but use seven equally spaced buckets from below 1 percent to greater than 6 percent. We are proxying worldwide market capitalization with the total value of that security held in our data. If our data included all investors worldwide this value would correspond, by market clearing, to the market capitalization weight of the security.

all other countries. Even among bonds issued by the same issuer, investors disproportionately hold those bonds that are denominated in their home currency.

Table 3 demonstrates the robustness of this conclusion by reporting the same β_j coefficients from various alternative samples of our data.²⁵ The first specification estimates equation (1) when we restrict the sample to only those firms that issue in multiple currencies. The second through seventh specifications restrict the data to bonds issued by financial or non-financial borrowers, foreign firms, and various combinations thereof. The eighth specification includes borrowing by sovereigns, local governments and municipalities, sovranationals such as the World Bank, and various structured fixed income products, and the ninth specification simply pools all bonds in our data. Finally, our tenth specification distinguishing securities not only by issuer and currency, but also by residence (i.e. the country where the security is issued). By comparing dollar and non-dollar bonds issued in New York, say, or euro denominated bonds issued in London and Frankfurt, we can again ensure that our results are driven by currency and not an omitted but correlated factor. In all these analysis, despite the extensive variation in the tightness of the fixed effects and the sample of firms considered, the coefficient on home currency bias remain economically large, stable, and precisely estimated.

3.3 Home Country Bias or Home-Currency Bias?

A voluminous prior literature has documented the strength and pervasive presence of home-country bias, more commonly referred to as simply “home bias”. French and Poterba (1991); Lewis (1999); Sercu and Vanpée (2007); Bekaert and Wang (2009), and Coeurdacier and Rey (2013) find that investors dedicate shares of their portfolios to domestic borrowers that greatly exceed the share of those domestic borrowers in the global portfolio.²⁶ Home-country bias is to date the singularly effective force for empirically characterizing global portfolios and is essential for the quantitative performance of models in international macroeconomics and finance. Furthermore, home-country bias is routinely found to be higher in bonds than in equities.

Our results, however, offer the intriguing possibility that home-country bias is simply a reflection of home-currency bias, since the propensity to issue in local currency is greater for local borrowers. Indeed, Burger et al. (2017) first suggested this possibility by demonstrating with US TIC data that home bias measures greatly attenuate when excluding non-dollar securities from the measures. To distinguish a bias for home currency from a bias for home country, we cannot use the specification in equation (1) because it includes issuers’ fixed effects. Since any given issuer is associated with a single country, the fixed effects absorb any potential investor country preference.

²⁵We denote statistical significant at 1 percent using asterisks, but to improve the presentation, we do not report standard errors, all of which are smaller than 0.075.

²⁶See, also, Fidora et al. (2007); De Moor and Vanpée (2013b), and De Moor and Vanpée (2013a).

We therefore drop the issuers' fixed effects, add instead a home country indicator, and run three related regressions:

$$q_{i_p,j/\Omega,BC,p,c} = \alpha_{j,0} + \gamma_{j,0}\mathbf{1}_{\{i_p=j\}} + \mathit{Controls} + \varepsilon_{i_p,j/\Omega,BC,p,c}, \quad (2)$$

$$q_{i_p,j/\Omega,BC,p,c} = \alpha_{j,1} + \beta_{j,0}\mathbf{1}_{\{\text{Currency}_c=\text{Currency}_j\}} + \mathit{Controls} + \varepsilon_{i_p,j/\Omega,BC,p,c}, \quad (3)$$

$$q_{i_p,j/\Omega,BC,p,c} = \alpha_{j,2} + \gamma_{j,1}\mathbf{1}_{\{i_p=j\}} + \beta_{j,1}\mathbf{1}_{\{\text{Currency}_c=\text{Currency}_j\}} + \mathit{Controls} + \varepsilon_{i_p,j/\Omega,BC,p,c}. \quad (4)$$

Equation (2) is a univariate regression that identifies the extent to which a country is overweight securities issued by domestic firms. Panel A of Table 4 reports the estimates of the country dummy $\gamma_{j,0}$ in this regression. Consistent with the large literature on home-country bias, all these coefficients are positive and range from about 20 percent to slight more than 50 percent depending on the country, thus confirming that countries are overweight securities that issued by domestic firms. Standard errors are not shown, but all reported coefficients are statistically significant at the one percent level. Since the controls contribute minimal explanatory power, the large R^2 values in the third column indicate that country information alone explains roughly one-third of the variation in securities' holdings around the world. These large R^2 and precise estimates of home-country bias remind the reader of why this effect has attracted so much academic literature and became a crucial force to match in theoretical models.

However, as we have emphasized, data limitations have meant that traditional analyses have not included information on currency. We report in Panel B of Table 4 the estimates of equation (3), in which we replace the home-country indicator from equation (2) with a home-currency indicator. The results are much stronger, with the point estimates on the indicators and the R^2 s both approximately twice as large as what they are in Panel A. This univariate regression at the country level re-affirms our result in Table 2 which exploited only within-firm variation: the currency of denomination of an asset on its own has a surprisingly high predictive power for who holds the asset.²⁷

Finally, to demonstrate that the results in Panel A are mostly driven by the correlation of issuers' countries with their securities' currencies of denomination, Panel C reports the estimates of equation (4), in which we include both the home-currency and home-country indicators. The coefficient on currency of denomination ($\beta_{j,1}$) is little changed from the corresponding variable in the univariate regression ($\beta_{j,0}$) in Panel B. Likewise, the R^2 shows only modest increases over that in Panel B. By contrast, the coefficient on country of issuance ($\gamma_{j,1}$) is dramatically reduced from the corresponding univariate regression ($\gamma_{j,0}$) in Panel A. Once we account for a security's currency of

²⁷We have performed a robustness check excluding Ireland and Luxembourg from the EMU. Our benchmark results are conservative inasmuch as excluding the two countries results in a higher degree of both home-country and home-currency bias for the EMU.

denomination, there is little additional scope for the security issuer's country to inform where the security is held. Table 4 shows directly that home bias regressions for bonds are confounded by the fact that most domestic bonds are denominated in domestic currency. At least for bonds, what is conventionally thought of as home-country bias is instead home-currency bias. Open economy macroeconomic models must face these new facts.

4 Currency Bias: The Borrowers' Perspective

Having documented the importance of currency in determining investors' portfolios, we now turn to characterizing the implications from the perspective of borrowing firms. If all firms had equal access to all bond markets in every currency and currency hedging was frictionless, then the investors' currency preferences would have limited effects on global capital allocation. However, we show that in each country a small number of foreign-currency borrowers are typically the only firms that borrow substantially from foreigners. In each country, most firms borrow only in local currency and their debt is mostly held by domestic investors. We also show that, consistent with the country level results shown in Figure 4, the United States is an exception to this rule: US firms that only borrow in dollars are able to place their debt into foreign and domestic portfolios with comparable ease. We rationalize these findings in a simple and tractable framework featuring downward sloping demand curves for each firm's bonds in each currency together with a fixed cost of foreign currency issuance.

4.1 Only Foreign Currency Issuers Borrow from Foreigners

In most countries, only firms that issue in foreign currency are able to place substantial parts of their debt in foreign portfolios. For example, Figure 6(a) plots for each Canadian firm with debt in our data in 2015 the share of the total firm debt that is denominated in foreign currency, i.e. currencies other than the Canadian dollar, against the share of the total firm debt that is held by foreigners. The scale of each firm's bubble captures the market value of its total borrowing. We have aggregated the data across all debt securities issued by each firm, including those issued by subsidiaries or other associated issuers.²⁸ This plot exemplifies two common features of the data. First, a large mass of smaller firms are at the origin or slightly above it. These are smaller Canadian firms that borrow only in Canadian dollars and almost entirely borrow from Canadian investors.

²⁸While we aggregate debt securities, our data do not cover loans or direct investment. Similarly, our data do not rule out the possibility that local-currency firms access the international market indirectly by receiving loans by domestic banks that themselves borrow from abroad in foreign currency. Even in this case, however, we would expect local-currency-only firms to be adversely affected since the loans are likely to come at a premium over direct bond financing from the foreigners.

Second, as firms borrow more and more in foreign currency, they borrow more and more from foreigners. The relationship is nearly one for one, with the data points clustered along the 45 degree line. Figures 6(b) and 6(c) show similar patterns in case of the European Monetary Union and Great Britain.

The relationship between foreign currency issuance and foreign borrowing is markedly different for firms in the United States, as shown in Figure 6(d). While it is still true that foreign currency borrowers tend to borrow more from foreigners, there is a significant mass of medium sized firms that issue only in US dollars but receives substantial financing from foreigners. The global taste for holding dollar debt securities effectively opens up the capital account for local currency borrowers in the US, whereas local currency borrowers in other countries are relegated to borrowing almost exclusively from domestic investors.

Figure 6 suggests that to borrow from foreigners, firms outside of the US must issue in foreign currency. So why does not every firm issue in multiple currencies? Figure 7 shows a strong size-dependence in which firms issues in multiple currencies. For example, Figure 7(a) ranks Canadian firms along the x-axis from the largest borrowers (including domestic and foreign borrowing) to the smallest borrowers. The y-axis plots the number of currencies in which the debt of each firm is denominated. Toward the right end of the plot, nearly all firms only issue bonds denominated in a single currency (which, in this case, is Canadian dollars). Moving to the left, as firms' size increases, firms issue in an increasing number of currencies. The largest Canadian borrower in our data issues bonds denominated in seven different currencies. Figures 7(b), 7(c), and 7(d) show a similar pattern in Europe, Britain, and the US. Together with Figure 6, this implies that large firms issue in foreign currency and borrow from abroad, whereas small and medium firms borrow from domestic investors in local currency.

We can more formally analyze selection into foreign currency borrowing by estimating the following probit model:

$$Pr\left(\mathbf{1}_{\{MC_p\}}\right) = \Phi\left(\alpha + \beta_{i_p}Size_p + Industry_p\right), \quad (5)$$

where $\mathbf{1}_{\{MC_p\}}$ is an indicator for a firm p having debt in foreign currency, $Size_p$ is a measure of firm size, and $Industry_p$ are a set of fixed effects capturing the firm's two-digit SIC. Unlike our prior analyses, we estimate equation (5) using operating and balance sheet data from Compustat (North America and Global) and Worldscope and using issuance data from the SDC New Issues database.²⁹ We proxy for firm size using four alternative measures: total bond principal outstanding, profits (EBIT), total assets, and revenues. We constrain the constant and fixed effects to be identical across countries but separately estimate the coefficient on size (β_{i_p}) for each country.

²⁹We use SDC instead of our data from Morningstar as it captures all issued bonds, not just those held by mutual funds. The results are robust, however, to instead using Morningstar. We merge the SDC database with firm-level balance sheet data using the CUSIP6 of the Ultimate Parent as reported in SDC.

Table 5 presents the average marginal effects for the country atop each column from estimates of equation (5) using each of our four size proxies. All estimates are positive and statistically significant: Bigger firms, all else equal, are more likely to issue in foreign currency. This size-dependence is a hallmark of selection in the presence of fixed costs. Indeed, issuing in foreign currency often involves substantial set-up costs. Firms need to build an infrastructure capable of complying with enhanced accounting standards and arranging for and paying costs of currency hedges. This often involves establishing a more sophisticated corporate treasurer's department. Foreign currency issuance also generally involves a relationship with an international investment bank, roadshows in foreign countries, and investors meetings aimed at familiarizing foreign investors with the firm.

In addition to demonstrating that larger firms are more likely to borrow in foreign currency, Table 5 suggests that this size-dependence varies substantially across countries. In particular, the coefficients for countries like the EMU, US, and Switzerland, the currencies of which have deep bond markets, are generally smaller than those for countries like Canada or Sweden. Figure 8 highlights this broad pattern by including all countries for which we have sufficient data and plots their estimated marginal effects (using firm bond debt as the size proxy) against their currency's share of worldwide outstanding debt. The decreasing relationship suggests that firms located in countries with deeper domestic-currency bond markets grow larger before opting to borrow in foreign currency. To better understand this pattern and to relate it to the allocation of global capital across firms, we next introduce a simple framework with investor currency preferences and firm selection into foreign currency issuance.

4.2 A Simple Organizing Framework

The previous section demonstrated that to borrow from abroad, firms need to issue in foreign currency, something only the largest firms do. Motivated by these findings, we now sketch an environment in which investors have a home-currency bias and markets are segmented. Firms face a downward sloping demand for their bonds in each currency: the more debt they issue in each currency the higher the interest rate, a form of price pressure. This demand structure implies that firms would like to borrow in multiple currencies to lower their total borrowing costs. We assume that all firms can borrow in local currency, but that a fixed cost has to be paid to borrow in foreign currency. As a result, only the largest firms borrow in foreign currencies, a size-dependent selection in the spirit of Melitz (2003), but in our case the selection is into foreign currency borrowing rather than into exporting.

The framework incorporates forces consistent with the empirical findings documented above and endogenously generates cross-country differences in the size, number, and borrowing behavior

of firms that issue only in local currency. In particular, local currency borrowers and local currency borrowing will be more prominent in countries whose currencies are used to denominate a larger share of global assets. Later, we demonstrate strong empirical support for these predictions. Our framework is illustrative and as streamlined as possible. Our goal is to organize our findings rather than providing a fully fledged model. For example, we present a static model with no risk to sharpen the focus on the main forces, market depth and price pressure.³⁰

Our environment consists of investors and firms located in N countries, each with a distinct local currency. In each country j there are a measure W_j of investors each endowed with one unit of capital to invest. Therefore W_j is also the initial wealth of the country. Bonds are the only traded securities. The model is static and all decision happen in the current period in the absence of uncertainty. All magnitudes are reported, without loss of generality, in US dollars.

Investors. Each investor in each country only perceives utility from investing in bonds denominated in a particular currency. We assume that $\theta_{k,j}$ is the fraction of investors in country j that perceive utility from investing in currency k . Furthermore, in the spirit of the limits of arbitrage literature (De Long et al. (1990); Gromb and Vayanos (2002); Jeanne and Rose (2002); Gabaix and Maggiori (2015)), investors are specialists in particular issuers, with a fraction $E_p/\sum_z E_z$ in each country and currency group buying debt issued by firm p , where E_p is the firm's starting net worth. We normalize the global net worth of all firms to one ($\sum_z E_z = 1$), so the number of investors willing to buy bonds issued by firm p in currency k is $\sum_j \theta_{k,j} W_j E_p$. Investors can always buy a perfectly-elastically-supplied risk-free asset with return $R_f > 1$. To sharpen the focus on the key forces in our model, we mute most non-crucial differences across countries and, for example, we set the risk-free interest rate to be identical in all countries.

An investor type is fully characterized by its specialization in a firm and currency pair (k, p) . This type of segmentation by asset type and currency is in the spirit of the limits of arbitrage literature (De Long et al. (1990); Gromb and Vayanos (2002); Jeanne and Rose (2002); Gabaix and Maggiori (2015)). We think of the investors as specialists in the debt of some firms in a specific currency. While this set-up immediately matches our facts on home-currency and international-currency bias from Section 3, it leaves open for future work to provide the deeper foundations for the reduced-form preferences that we simply assume.

Investors have bonds in the utility function, such that an investor of type (k, p) solves the following problem:³¹

³⁰The model could be extended to allow for exchange rate and interest rate risk, firms' credit risk and a fuller capital structure decision. While each of the extensions is surely meritorious, the simple model captures a lot of the economics in a transparent and analytical way. One can think of our firms as borrowing in foreign currency but then hedging the exchange rate exposure (a practice very common for firms in developed countries), the resulting interest rate differences that we model are deviations due to pure market segmentation.

³¹Bonds in the utility function are a convenient if reduced form foundation for a flexible demand curve, for recent

$$\begin{aligned} \max_{q_{k,p}} \quad & q^f R_f + q_{k,p} R_{k,p} - \frac{1}{2} \gamma (q_{k,p})^2 - q_{k,p} x_p \\ \text{s.t.} \quad & 1 = q^f + q_{k,p}, \end{aligned}$$

where q^f and $q_{k,p}$ are the investor's holdings of the risk-free asset and the bonds of firm p denominated in currency k , respectively. The term $\frac{1}{2} \gamma (q_{k,p})^2$ is a disutility due to satiation typical of bonds in the utility function set-up. The last term $x_p \geq 0$ allows for a linear disutility attached to the bonds of firm p ; this disutility is common across all bonds of firm p irrespective of currency and we include it for generality. The optimality condition implies: $R_{k,p} = R_f + x_p + \gamma q_{k,p}$. The term x_p acts as a firm specific credit spread. We define $\bar{R}_p = R_f + x_p$ as the firm's benchmark rate, the rate at which the firm could borrow if markets were perfectly integrated and the demand for debt infinitely elastic. Deviations from this rate are the main object of interest of this model.

We aggregate the individual investor demand curves to find the aggregate (global) demand curve for k, p bonds:

$$R_{k,p} = \bar{R}_p + \frac{\gamma}{\Theta_k} \frac{Q_{k,p}}{E_p} = \bar{R}_p + \Gamma_k \frac{Q_{k,p}}{E_p},$$

where we made use of the definitions: $\Theta_k = \sum_j \theta_{k,j} W_j$, $Q_{k,p} = \sum_j \theta_{i,j} W_j E_p q_{k,p}$, and $\Gamma_k = \frac{\gamma}{\Theta_k}$. The resulting aggregate demand curve for firm p debt in currency k is linear and given by:

$$R_{k,p} = \bar{R}_p + \Gamma_k \frac{Q_{i_p, \Omega, k, p}}{E_p},$$

where $Q_{i_p, \Omega, k, p}$ is the value of currency- k denominated debt issued by firm p , and where we have now added the subscripts i_p and Ω for consistency with the rest of the paper. The more debt a firm issues in each currency, the higher the corresponding interest rate, with the slope of the demand curve inversely proportional to the pool of wealth investing in that currency:

$$\Gamma_k = \frac{\gamma}{\sum_j \theta_{k,j} W_j}.$$

Currencies with large values of Γ have shallow markets. Firms borrowing in those currencies will experience faster increases in their funding costs as they grow compared to borrowers in currencies with deep markets.

Firms. Firms differ in terms of their starting capital E_p and their productivity A_p and borrow to operate a constant returns to scale technology. The firm's output is sold in a perfectly competitive examples see: Stein (2012); Engel (2011); Farhi and Maggiori (2017); Nagel (2016).

goods market at a price normalized to one.³² All firms can borrow in their local currencies, but must pay a fixed cost c if they wish to borrow in foreign currency. This fixed cost is motivated by the size-dependent likelihood of foreign currency issuance shown in Figure 7 and discussed above. The cost represents, for example, the need for firms to have treasury and legal departments of sufficient sophistication to issue and then to hedge these debts. Firm p solves the issuance problem given by:

$$\begin{aligned} \max_{\{Q_{i_p, \Omega, k, p}\}_{k=1}^N} & Y_p - \sum_k R_{k,p} Q_{i_p, \Omega, k, p} - c \mathbf{1}_{\{Q_{i_p, \Omega, -k_p, p} > 0\}}, \\ \text{s.t.} & Y_p = A_p K_p; \quad K_p = E_p + \sum_{k=1}^N Q_{i_p, \Omega, k, p}, \end{aligned} \quad (6)$$

where k_p denotes firm p 's domestic currency and $\mathbf{1}_{\{Q_{i_p, \Omega, -k_p, p} > 0\}}$ is an indicator for issuance in foreign currency. Since there is no exchange-rate risk, firms care only about the interest differential coming from our assumption of segmented markets and are otherwise indifferent between bonds in any of the two currencies. In our environment, and in practice, firms have a meaningful portfolio choice among debt in different currencies even in the absence of exchange-rate risk, such as when comparing debt that would be hedged back to a common currency (see Liao (2016) for empirical evidence).

We analyze the firm problem by breaking it down in two different optimization problems, one for firms that only issue in local currency and one for firms that issue in multiple currencies.³³ A firm in country i that borrows only in the domestic currency will borrow:

$$\frac{Q_{i_p, \Omega, k_p, p_{LC}}}{E_p} = \frac{A_{p_{LC}} - \bar{R}_{p_{LC}}}{2 \Gamma_{k_p}}, \quad (7)$$

where we used the subscript p_{LC} to denote that firm p is a local currency firm.³⁴ For a given level of starting capital, firms borrow more if they are more productive (higher A), as they have higher marginal products of capital, as well as if the demand curve for their debt is flatter (lower Γ), as this limits the increase in their capital costs as they grow.

Firms that borrow in multiple currencies choose the same debt composition regardless of their nationality. The optimal issuance problem of multi-currency firms can be broken down into two

³²In the appendix we generalize the model to the case of CES demand, which allows for markups and a concave relationship between capital and revenues as prices fall with the quantities produced.

³³The optimization problem in equation (6) is not standard (convex) due to the presence of the fixed cost. The resulting value function is discontinuous. There are two local maxima corresponding to the optimal issuance in just one currency or in all currencies. The global maximum is simply the local maximum that generates the highest profits net of the fixed cost.

³⁴We allow firms to decide not to borrow and produce only using their starting capital. Therefore, $Q_{i_p, \Omega, k, p_{LC}} = 0$ whenever $A_{p_{LC}} - \bar{R}_{p_{LC}} < 0$.

separate problems: (i) choosing the optimal currency composition for each unit of debt issued, (ii) choosing the total (in all currencies) debt to be issued. The first problem solves:

$$\min_{\{\omega_{k,p}\}_{k=1}^N} \sum_{k=1}^N R_{k,p} \omega_{k,p},$$

$$s.t. \quad \sum_{k=1}^N \omega_{k,p} = 1$$

where $\omega_{k,p}$ is the fraction of the firm- p 's debt that is denominated in currency k . The optimal fraction of total debt that is dollar denominated is given by:

$$\omega_{k,p} = \frac{\prod_{m=1, m \neq k}^N \Gamma_m}{\sum_{z=1}^N S_z},$$

where $S_z = \prod_{s=1}^{N-1} \Gamma_s^z$ and Γ_s^z is one of the $N - 1$ elements of combination z in the set Z of all combinations of the set of N elements $\{\Gamma_1, \Gamma_2, \dots, \Gamma_N\}$ in groupings of $N - 1$ elements. Currencies with deeper markets – those with lower values of Γ – account for a larger share of all multi-currency issuers' debt.³⁵

The optimal issuance decision by multi-currency firms equalizes their marginal cost of borrowing across currencies. In the data, therefore, one would not find for these firms large deviations in their borrowing costs across currencies; the benefits accrue to the firms not on their marginal units of debt, but on the infra-marginal units. Multi-currency firms borrow more at the same interest rate by spreading their debt optimally across all debt markets in different currencies. Liao (2016) provides evidence for this opportunistic issuance in multiple currencies. He shows that firms at each point in time do not completely arbitrage away all debt markets (i.e. yields are not fully equalized), but they systematically attempt to do so by issuing more in currencies that, on a currency-hedged basis, offer a lower yield on their debt.³⁶

Given the optimal debt composition, it is convenient to think of multi-currency firms as facing a demand curve for their total debt given by: $R_{w,p} = \bar{R}_p + \Gamma_w \frac{Q_{i_p, \Omega, \Omega, p}}{E_p}$, where $\Gamma_w = \frac{\prod_{z=1}^N \Gamma_z}{\sum_{m=1}^N S_m}$ summarizes the depth of the world debt market.³⁷ The choice of total debt issuance by a multi-currency

³⁵To make this intuitive, let us consider the special case for two countries ($N = 2$), the US (country 1) and EMU (country 2). Then, the set of all possible combinations of the 2 elements $\{\Gamma_1, \Gamma_2\}$ in groups of 1 is given by $\{\Gamma_1; \Gamma_2\}$. Therefore we have: $\omega_{1,p} = \frac{\Gamma_2}{\Gamma_1 + \Gamma_2}$, and $\omega_{2,p} = \frac{\Gamma_1}{\Gamma_1 + \Gamma_2}$.

³⁶The yield comparison across any two markets has three subcomponents in the data: the firm credit spreads in each local currency, and the cross-currency basis. The cross-currency basis, the direct cost of hedging, used to be small (zero) until the 2008 financial crisis and has been much larger ever since (Du et al. (2017)). We stress that a zero cross-currency basis does not imply that before 2008 firms' borrowing costs, once currency hedged, were always equalized since there could be differences in the local currency credit spreads.

³⁷Returning to our example with two countries, we would have $\Gamma_w = \frac{\Gamma_1 \Gamma_2}{\Gamma_1 + \Gamma_2}$.

firm, therefore, is given by:

$$\frac{Q_{i_p, \Omega, \Omega, PMC}}{E_{PMC}} = \frac{A_{PMC} - \bar{R}_{PMC}}{2 \Gamma_w}, \quad (8)$$

where we used the subscript p_{MC} to denote that firm p is a multi-currency firm.

Finally, we turn to the decision by each firm of whether to issue only in local currency or to pay the fixed cost and issue in all currencies. Firms issue in foreign currency if their operating profits under foreign currency issuance less the fixed cost they must pay exceeds their profits when issuing only in local currency. Since the benefit of foreign currency issuance is to allow firms to grow with a gentler increase in their borrowing costs, this tradeoff will look most attractive to more productive firms that borrow and produce large amounts.

This tradeoff is not the same across countries, even when holding fixed firm size differences. Firms in countries whose currencies have steep demand curves relative to the effective global demand curve Γ_w will find foreign currency issuance particularly helpful. Firms in countries with deep local currency markets have less to gain. We define net productivity as $\hat{A}_p = A_p - \bar{R}_p$, denote by \hat{A}_i^* the combinations of starting capital E_p and net productivity \hat{A}_p that makes a firm indifferent between issuance in local and multiple currencies, and write:

$$\hat{A}_{i_p}^*(E_p) = \left(\frac{c}{E_p} \frac{4\Gamma_w \Gamma_{k_p}}{\Gamma_{k_p} - \Gamma_w} \right)^{\frac{1}{2}}.$$

Firms in each country issue in local currency if and only if their size E_p and net productivity \hat{A}_p are in the set LC defined as: $LC_i = \left\{ \hat{A}_p, E_p : \hat{A}_p < \hat{A}_{i_p}^*(E_p) \right\}$.

To aggregate to country-level outcomes in a simple way, we specify that net productivities \hat{A}_p follow a Pareto distribution with scale parameter $\hat{A} > 0$ and shape parameter $\alpha > 2$, so the corresponding pdf is $f(a_p) = \alpha a_p^{-(1+\alpha)} \hat{A}^\alpha$. We assume firms' ex-ante net-worth E_p is constant within countries but can vary across countries. Finally, country size differences are captured by different numbers of firms M_i . Under these assumptions, we can write total borrowing by firms in country i as:

$$\begin{aligned} Q_{i, \Omega, \Omega} &= \int_{\hat{A}}^{\infty} M_i Q_{i_p, \Omega, \Omega, p}(a_p) f(a_p) da_p \\ &= \underbrace{\int_{\hat{A}}^{\hat{A}_i^*} M_i E_i \frac{a_p}{2\Gamma_i} f(a_p) da_p}_{\text{Borrowing by LC firms}} + \underbrace{\int_{\hat{A}_i^*}^{\infty} M_i E_i \frac{a_p}{2\Gamma_w} f(a_p) da_p}_{\text{Borrowing by MC firms}} \\ &= Q_{i, \Omega, k_i, LC} + Q_{i, \Omega, \Omega, MC}, \end{aligned}$$

where the second equality substitutes in the optimal debt issuance for LC and MC firms. Solving for the total borrowing by LC firms and MC firms in country i we obtain:

$$Q_{i,\Omega,k_i,LC} = M_i E_i \frac{\alpha}{\alpha-1} \frac{\hat{A}^\alpha}{2\Gamma_i} \left[(\hat{A})^{1-\alpha} - \left(\frac{E_i \Gamma_i - \Gamma_W}{4c \Gamma_i \Gamma_W} \right)^{\frac{\alpha-1}{2}} \right],$$

$$Q_{i,\Omega,\Omega,MC} = M_i E_i \frac{\alpha}{\alpha-1} \frac{\hat{A}^\alpha}{2\Gamma_W} \left(\frac{E_i \Gamma_i - \Gamma_W}{4c \Gamma_i \Gamma_W} \right)^{\frac{\alpha-1}{2}},$$

and write the ratio of LC firm borrowing to MC firm borrowing as:

$$\frac{Q_{i,\Omega,k_i,LC}}{Q_{i,\Omega,\Omega,MC}} = \frac{\Gamma_W}{\Gamma_i} \left[(\hat{A})^{1-\alpha} \left(\frac{E_i \Gamma_i - \Gamma_W}{4c \Gamma_i \Gamma_W} \right)^{-\frac{\alpha-1}{2}} - 1 \right].$$

Note that this ratio is a decreasing function of Γ_i . Our framework therefore predicts that local currency borrowers represent a larger share of total borrowing by countries with deeper domestic-currency debt markets. Finally, we can express total output in each country as:

$$\begin{aligned} Y_i &= \int_{\hat{A}}^{\infty} M_i (E_i + Q_{i,p,\Omega,\Omega,p}(a_p)) a_p f(a_p) da_p \\ &= \underbrace{\int_{\hat{A}}^{\infty} M_i E_i a_p f(a_p) da_p}_{\text{Output from equity}} + \underbrace{\int_{\hat{A}}^{\hat{A}_i^*} M_i E_i \frac{a_p^2}{2\Gamma_i} f(a_p) da_p}_{\text{Output from LC firms's debt}} + \underbrace{\int_{\hat{A}_i^*}^{\infty} M_i E_i \frac{a_p^2}{2\Gamma_W} f(a_p) da_p}_{\text{Output from MC firms'debt}} \\ &= \frac{\alpha}{\alpha-1} M_i E_i \hat{A} + \frac{\alpha}{\alpha-2} \frac{M_i E_i \hat{A}^\alpha}{2} \left(\frac{1}{\Gamma_i \hat{A}^{-(\alpha-2)}} + \left(\frac{E_i}{4c} \right)^{\frac{\alpha-1}{2}} \left(\frac{\Gamma_i - \Gamma_W}{\Gamma_i \Gamma_W} \right)^{\frac{\alpha}{2}} \right). \end{aligned}$$

The first term in the last equation above is the output of country i if no firms were to raise debt. The second term is the extra output that is created via debt financing, from both LC and MC firms. The depth of the domestic-currency debt market, Γ_i , has two opposite effects on output. On the one hand, a lower Γ_i boosts output because LC firms with otherwise equivalent fundamentals will borrow and produce more (capital deepening). On the other hand, a lower Γ_i means less firms will access international capital markets, a countervailing force that reduces leverage and production.

We think of the international currency in this environment as the currency that is most commonly used to denominate bonds. This currency will have the deepest market (the highest Θ_k) or, equivalently, the flattest demand curve (the lowest Γ_k). The benefits of being an international currency in our framework are linked to greater foreign capital allocation to local-currency firms. We have intentionally muted other important effects on risk-free rates (in fact, we assumed R_f to

be the same among all currencies) and the role of risk and the safe haven properties of exchange rates. This sharpens the extent to which the benefits of being an international currency analyzed in this paper are distinct from, and probably complementary to, the mechanisms more commonly emphasized in the literature (Caballero et al. (2008); Gourinchas et al. (2011); Maggiori (2017); Farhi and Maggiori (2017)).

In sum, this framework implies that only the largest firms in each country issue foreign currency bonds and borrow the most from abroad. The smaller local currency issuers are largely unable to place their debt into foreign portfolios. Further, the framework implies that this dichotomy is least stark for the international currency issuer. That country's local currency issuers attract relatively more foreign capital and constitute a larger share of total borrowing. In the next subsection, we show empirically that the US dollar is the most international currency and US firms that borrow exclusively in US dollars differ from local currency borrowers in other countries in accordance with these theoretical predictions.

4.3 International Currencies and Foreign Borrowing by LC Firms

We start this subsection by confirming the prediction of the model that local currency firms in the United States, the international currency issuer as of 2015, are better able to place debt into foreign portfolios compared with LC firms in other countries. To see this, start with the left panel of Figure 9, which separately plots the share of total domestic investment in the bonds of Canadian firms ($q_{CAN,CAN,BC,p/\Omega}$, in solid red circles) and the share of foreign investment in Canadian firms ($q_{CAN,-CAN,BC,p/\Omega}$, in blue hollow diamonds) allocated to each parent Canadian firm in 2015. The sum of the solid red dots and the sum of the blue hollow diamonds, therefore, each equals one. The parent firms are ordered along the x-axis based on their shares of domestic investment in Canadian firms, as opposed to the foreign or overall holdings, so the solid red dots monotonically decline by construction. Looking across the plot, there are some firms for which the solid red dots are above the hollow blue diamonds – indicating domestic investors are overweight relative to foreign investors – and others for which the opposite is true.

A striking pattern emerges as we separately investigate firms in this plot that are local-currency or multi-currency. The right panel of Figure 9 plots the same objects as the left panel but restricts the sample to include only the subset of firms that issue only in local currency (i.e. in Canadian dollars). As noted earlier, LC-only issuers are typically smaller, and indeed the leftmost firms ranked 1-5 are missing from the figure in the right panel. The difference between the solid red dots and hollow blue diamonds in the right panel is striking – the red dots are almost uniformly above the blue diamonds. Local currency issuers represent significantly larger shares of domestic portfolios than of foreign portfolios.

Figure 10 shows again this analysis of domestic and foreign investment in Canadian LC-only firms but adds equivalent plots for the European Monetary Union, Great Britain, and the United States. The solid red dots in the plots for Canada, the European Monetary Union, and Great Britain are all almost uniformly above the hollow blue diamonds. In those countries, LC-only issuers do not typically place their debt into foreign portfolios and therefore borrow almost exclusively from local lenders. The one exception is the US, shown in Figure 10(d), where the solid red dots roughly split through the hollow blue diamonds, indicating that LC-only firms in the US are equally likely to represent a given share of domestic or foreign portfolios. US LC-only firms, unlike the others, borrow from foreigners.

Aggregating across firms, we can separately sum all the solid red dots and hollow blue diamonds in the plots in Figure 10 and report in Figure 13(f) for each country the aggregate shares of LC-only issuers in domestic and foreign portfolios. The red bars report the sum of the red dots and are almost always dramatically taller than the blue bars that report the sum of the blue diamonds. But as predicted by the above framework, the United States, the world's only international currency issuer in 2015, stands out as the only exception. There, the red and blue bars are of similar height, indicating local currency firms account for similar shares of domestic and foreign portfolios. Relatedly, Figure 13(e) confirms another of the framework's predictions, that LC-only firms in international currency issuers will represent a far larger share of total borrowing than in other countries. LC-only firms in the US account for nearly 60 percent of the country's total borrowing, as shown in the first bar. The equivalent value for Canada, the European Monetary Union, and Great Britain range from 20 to 30 percent.

One might worry that these patterns, at least for countries other than the US, reflect differences in the LC-only issuers that are distinct from, though correlated with, currency. Perhaps LC-only issuers are in industries for which foreign investors would naturally lack expertise or interest. To demonstrate this is not the case, we repeat our exercise but with equities. Figure 11 considers these same LC-only firms in the four countries but plots the share of their equities in domestic and foreign equity portfolios for that market. It is clear that the difference in LC-only firms' shares of foreign and domestic equity portfolios, if any, is far more muted than is the case for their debt securities.

Figure 12 further explores the joint holdings of equity and debt of the same firm by foreign and domestic investors. We start by defining a measure of how overweight foreigners are in the debt or equity of a firm p by taking the log of the ratio of the foreign portfolio share of firm p to the domestic portfolio share of firm p in that asset class: $\log(q_{i_p, -i_p, k, p} / \Omega / q_{i_p, i_p, k, p} / \Omega)$. In other words, we form the ratio of the hollow blue diamonds to the solid red dots for each firm from Figures 10 (for debt) and 11 (for equities) and then take logs. The higher this ratio, the more overweight the foreign investors are in that asset class for that firm. Figure 12 plots the debt

ratio on the vertical axis and the equity ratio on the horizontal axis for each firm in our sample that has a publicly listed equity. LC firms are depicted with red circles and MC firms with blue ones, with the size of each circle proportional to the total market value of the total debt of the firm. If there were some unobserved factor other than currency causing LC firms to be undesirable investments to foreigners, we would expect there to be a close relationship between the extent to which foreigners are overweight the firms' debt and equity and the red lines would have a clear upward slope. Instead, they are always flat. Foreigners are underweight LC firm debt even when they are overweight their equity. Further, this relationship fails among MC firms, where there is a positive relationship between debt and equity holdings. We conclude that foreigners would have wanted greater exposure to the LC firms' debt but for home-currency bias. Finally, consistent with the dollar's status as international currency, we note that the US is the only country that lacks this asymmetry.

The above patterns are hard to reconcile with benchmark frictionless international macro models. In a world of frictionless FX-hedging such differences in the ability to access foreign capital could not exist. An investor would buy whichever securities generate her desired exposure to the underlying risk factors and if it so turned out that those securities, given their currency of denomination, generated an undesired currency exposure, the investor would then adjust the currency exposure using a long-short portfolio of risk-free bonds denominated in various currencies. The fundamental logic of frictionless models is that currency risk can be traded separately and therefore cannot be a source of distortion for capital allocations.³⁸ Our results, therefore, offer a challenge and new guidance to international macroeconomic models. First, they point to models in which, even conditional on investing abroad, investors predominantly buy domestic currency bonds. Few existing general-equilibrium models generate this type of result. Second, models need to generate a skewed capital allocation in which foreigners predominantly do not finance LC-only firms. This requires studying frictions both on the firm side (the supply of debt), perhaps expanding on the simple fixed-cost we introduced in the previous section, and the investor side (the demand side).³⁹

In sum, consistent with the framework developed in Section 4.2, investor home currency bias and fixed costs of foreign currency issuance together imply that most firms issue only local currency debt and do not borrow from abroad. The United States, however, issues an international

³⁸Indeed this is the logic used in the equity home-bias literature to argue that exchange rate risk, arising by the fact that foreign equities are mostly foreign-currency denominated, cannot be responsible for a distorted (i.e. home biased) portfolio allocation (Van Wincoop and Warnock (2006, 2010); Engel and Matsumoto (2009); Coeurdacier and Gourinchas (2016)).

³⁹To date there are no systematic empirical studies of firms and investors FX-hedging activities. It appears likely that firms, rather than investors, do most of the hedging. Arguments in this direction point to the firm's relative advantage in hedging since it can be done, using FX-swaps, once and for-all at issuance. Investors, on the contrary, would each have to hedge separately and enter and exit the hedges as they vary over time their position in the bond. Similarly, the firm might have superior knowledge of the correlation between exchange rates and its default risk.

currency and represents an exception to these patterns. Even small firms are able to place their dollar-denominated bonds into foreign portfolios. In the US, these LC-only firms account for comparable shares of domestic and foreign portfolios and for a large share of overall US borrowing. We find, in theory and in practice, that having an international currency effectively opens the capital account for the country's local currency borrowers.

5 International Currencies: The Fall of the Euro and Rise of the Dollar

The above results demonstrate that issuers of international currencies receive a benefit and that, as of 2015, the US appears to be the only international currency issuer. One might understandably conclude that the dollar has been the only international currency for many decades, perhaps since the advent of the Bretton Woods system following the Second World War. In this section, we demonstrate that in fact the euro was also used to denominate a significant share of bonds in the global portfolio as recently as 2007. Following the global financial and eurozone crises, however, its share fell pervasively and dramatically and this fall was mirrored by a rise in the use of the dollar. We conclude that international currency status may be more volatile, and dependent on countries' and central bank policies, than is typically assumed.

Figure 14 shows the share of all cross-border corporate bond positions in our data accounted for by bonds denominated in dollars and in euros. The solid red line shows that, on the eve of the 2008 global financial crisis, dollar denominated bonds represented approximately 50 percent of these positions in our data. The dashed blue line shows that euro-denominated bonds accounted for 30 percent at that point in time. Further, these shares had been stable during the preceding four years. No other currencies come close to representing such large shares in cross-border portfolios. These patterns are not uncommon in international data and have lead commentators to label the euro and the dollar as international currencies.⁴⁰

Strikingly, starting immediately after the crisis, these international bond portfolios exhibit a dramatic shift away from the euro and into the dollar. The euro share of total cross border bonds collapsed by late 2015 to below 20 percent while the dollar share approached 70 percent. The currency switch is similarly apparent when one includes sovereigns, local governments, and all other bonds in our data, as shown in Figure 15(a).⁴¹

⁴⁰The dollar and the euro are used to denominate a large share of bonds between borrowers and lenders which do not use either as their home currency. In this sense, our notion of international currency echoes that discussed in the literature on the invoicing of international trade in goods. See, for instance, Goldberg and Tille (2008) and Gopinath (2015).

⁴¹The BIS International Debt Securities database collects information on the currency of securities that are issued in foreign markets (i.e. for which the nationality of the issuer and the market of issuance of the security are different).

This pattern is not driven by something specific to investors or borrowers in the US or the EMU. To see this, Figure 15(b) plots the currency shares in global cross-border corporate bond portfolios after excluding the US and EMU as either the source (lender) or destination (borrower) of the positions. The fact that the pattern remains strong in this subset of data shows that the shift is not simply attributable to changes in the relative size of the US and EMU markets nor is it directly driven by the unconventional monetary policy (quantitative easing) of the Fed or the ECB. Figures A.9 to A.12 in the appendix demonstrate that these patterns are pervasive across bilateral country pairs. Another possibility is that the dollar-euro exchange rate underlies these patterns and indeed, the dollar has strengthened relative to the euro since 2008. This relative price movement, however, can only directly explain a small portion of the relative trends in the previous charts.⁴² We have verified this by regenerating the plots in 14 using an alternative dataset generated with exchange rates fixed at their 2005 levels.

One might be concerned that these patterns merely reflect compositional changes in our data. For example, if Canada and Mexico hypothetically entered late in the dataset and predominantly hold dollar bonds, it would plausibly explain the above trends. To address this concern, we regress the share of euro-denominated bonds and dollar-denominated bonds in the portfolio of country j invested in securities issued by i on time fixed effects and country-pair (borrower i and lender j) fixed effects:

$$q_{i,j,k_x/k}^t = \gamma_x^t + \alpha_{i,j} + \varepsilon_{i,j,x}^t. \quad (9)$$

We run this regression separately for $x \in \{EUR, USD\}$, for various assets k , and for various country pair rules (such as $i \neq j$ or $i, j \neq \{USA, EMU\}$). The country-pair fixed effect $\alpha_{i,j}$ ensures that changes in the composition of countries in our sample do not drive our inference on the time series variation in the roles of the dollar and euro in cross-border bond portfolios. We run this regression on the baseline as well as constant exchange rate data sets and find that composition is not driving this trend. Figure 15(c) plots time fixed effects, γ_{EUR}^t and γ_{USD}^t , both normalized to zero in 2005, from specifications that focus on cross-border corporate bond positions valued at constant (2005 base) exchange rates.

Finally, one might wonder if the shift is directly driven by the banking sector alone. Figure 15(d) restricts the sample to only contain non-financial corporate borrowers. There is a level difference from the earlier plots as non-financial corporates more commonly borrow in US dollars.

These securities represent a small share of the world debt market. Nonetheless, Appendix Figure A.8 demonstrates that even in these data there is a rise in the share of dollar-denominated bonds and a collapse in euro-denominated bonds that evolves together with our measures.

⁴²Some simple accounting: the euro weakened approximately 15 percent over this period relative to the dollar. Applying this depreciation rate to the share of euro denominated bonds in cross-border corporate debt positions, which was 25 percent in 2008, the exchange rate accounts at most for 5 of the more than 20 percentage point increase in the gap between the dollar and euro shares of cross-border corporate positions in 2015.

The shift away from euro-denominated bonds and into dollar-denominated bonds, however, is robust even after excluding financial institutions.

Table 6 summarizes this evidence on the shift in global portfolios away from euro and into dollar bonds. Column 5 of the table shows the difference in the euro and dollar portfolio share for each specification between the fourth quarter of 2005 and the fourth quarter of 2015. Across most of these specifications, the share of dollar denominated bonds rises by 10 to 20 percentage points whereas the share of euro denominated debt declines by about the same magnitude.

The rise of the dollar and fall of the euro since 2008 as international currencies appears as a robust global pattern. Through the lens of our framework, the euro offers EMU local currency borrowers less and less of the benefit of being an international currency. The US, and its many dollar-only issuers, benefits.

6 Conclusion

In this paper, we demonstrated that investor currency preferences are crucial for understanding global capital allocation. Other than international currencies like the dollar, investors are more reluctant than was previously thought to take on currency risk when buying the debt of foreign countries, even when those countries are developed countries like Canada, the EMU, or Great Britain. Firms can borrow from abroad by issuing in foreign currency, but evidence suggests it is costly to do so. Unless a country issues an international currency, therefore, many firms will issue only in local currency and will have to do without foreign capital. This highlights a new benefit of issuing the world's international currency – it effectively opens the capital account for the local currency firms. The fall of the euro and the rise of the dollar as international currencies has brought more and more of this benefit to US firms.

References

- Adler, Michael and Bernard Dumas**, “International portfolio choice and corporation finance: A synthesis,” *The Journal of Finance*, 1983, 38 (3), 925–984.
- Alfaro, Laura, Sebnem Kalemli-Ozcan, and Vadym Volosovych**, “Why doesn’t capital flow from rich to poor countries? An empirical investigation,” *The Review of Economics and Statistics*, 2008, 90 (2), 347–368.
- Alvarez, Fernando, Andrew Atkeson, and Patrick J Kehoe**, “Time-varying risk, interest rates, and exchange rates in general equilibrium,” *Review of Economic Studies*, 2009, 76 (3), 851–878.
- Bacchetta, Philippe and Eric Van Wincoop**, “Infrequent portfolio decisions: A solution to the forward discount puzzle,” *American Economic Review*, 2010, 100 (3), 870–904.
- Bekaert, Geert and Xiaozheng Sandra Wang**, “Home bias revisited,” 2009.
- Bénétrix, Agustín S, Philip R Lane, and Jay C Shambaugh**, “International currency exposures, valuation effects and the global financial crisis,” *Journal of International Economics*, 2015, 96 (1), S98–S109.
- Bertaut, Carol, Alexandra Tabova, and Vivian Wong**, “The replacement of safe assets in the US financial bond portfolio and implications for the US financial bond home bias,” Technical Report, Working Paper, Federal Reserve Board 2013.
- Boermans, Martijn A and Robert Vermeulen**, “Newton meets Van Leeuwenhoek: Identifying international investors? common currency preferences,” *Finance Research Letters*, 2016, 17, 62–65.
- Burger, John D, Francis E Warnock, and Veronica Cacadac Warnock**, “Currency Matters: Analyzing International Bond Portfolios,” 2017.
- Caballero, Ricardo J, Emmanuel Farhi, and Pierre-Olivier Gourinchas**, “An Equilibrium Model of Global Imbalances and Low Interest Rates,” *The American Economic Review*, 2008, 98 (1), 358–393.
- Chan, Kalok, Vicentiu Covrig, and Lilian Ng**, “What determines the domestic bias and foreign bias? Evidence from mutual fund equity allocations worldwide,” *The Journal of Finance*, 2005, 60 (3), 1495–1534.
- Choi, Jaewon and Mathias Kronlund**, “Reaching for yield by corporate bond mutual funds,” 2016.

- Coeurdacier, Nicolas and Hélène Rey**, “Home Bias in Open Economy Financial Macroeconomics,” *Journal of Economic Literature*, 2013, 51 (1), 63–115.
- **and Pierre-Olivier Gourinchas**, “When bonds matter: Home bias in goods and assets,” *Journal of Monetary Economics*, 2016, 82, 119–137.
- Colacito, Riccardo and Mariano M. Croce**, “Risks for the Long Run and the Real Exchange Rate,” *Journal of Political Economy*, 2011, 119 (1), 153–181.
- **, Mariano Massimiliano Croce, Federico Gavazzoni, and Robert C Ready**, “Currency risk factors in a recursive multi-country economy,” 2015.
- Corsetti, Giancarlo, Luca Dedola, and Sylvain Leduc**, “International risk sharing and the transmission of productivity shocks,” *The Review of Economic Studies*, 2008, 75 (2), 443–473.
- Curcuru, Stephanie E, Tomas Dvorak, and Francis E Warnock**, “Cross-border returns differentials,” *The Quarterly Journal of Economics*, 2008, 123 (4), 1495–1530.
- Devereux, Michael B and Alan Sutherland**, “Country portfolios in open economy macro-models,” *Journal of the European Economic Association*, 2011, 9 (2), 337–369.
- Didier, Tatiana, Roberto Rigobon, and Sergio L Schmukler**, “Unexploited gains from international diversification: Patterns of portfolio holdings around the world,” *Review of Economics and Statistics*, 2013, 95 (5), 1562–1583.
- Dou, Winston Wei and Adrien Verdelhan**, “The Volatility of International Capital Flows and Foreign Assets,” Technical Report, Working Paper MIT Sloan 2015.
- Du, Wenxin, Alexander Tepper, and Adrien Verdelhan**, “Deviations from covered interest rate parity,” Technical Report, National Bureau of Economic Research 2017.
- **and Jesse Schreger**, “Sovereign risk, currency risk, and corporate balance sheets,” 2016.
- **, Carolin E Pflueger, and Jesse Schreger**, “Sovereign debt portfolios, bond risks, and the credibility of monetary policy,” Technical Report, National Bureau of Economic Research 2016.
- Eichengreen, Barry and Ricardo Hausmann**, “Exchange rates and financial fragility,” 1999.
- Eichengreen, Barry J and Ricardo Hausmann**, *Other People’s Money: Debt Denomination and Financial Instability in Emerging Market Economics*, University of Chicago Press, 2005.
- Engel, Charles**, “The Real Exchange Rate, Real Interest Rates, and the Risk Premium,” Working Paper 17116, NBER June 2011.

- **and Akito Matsumoto**, “The International Diversification Puzzle When Goods Prices Are Sticky: It’s Really about Exchange-Rate Hedging, Not Equity Portfolios,” *American Economic Journal: Macroeconomics*, 2009, 1 (2), 155–88.
- **and JungJae Park**, “Debauchery and original sin: The currency composition of sovereign debt,” *Working Paper, University of Wisconsin*, 2016.
- Farhi, Emmanuel and Matteo Maggiori**, “A Model of the International Monetary System,” *Forthcoming in Quarterly Journal of Economics*, 2017.
- Fidora, Michael, Marcel Fratzscher, and Christian Thimann**, “Home bias in global bond and equity markets: the role of real exchange rate volatility,” *Journal of international Money and Finance*, 2007, 26 (4), 631–655.
- Forbes, Kristin, Marcel Fratzscher, Thomas Kostka, and Roland Straub**, “Bubble thy neighbor: direct and spillover effects of capital controls,” in “12th Jacques Polak Annual Research Conference” 2011.
- French, Kenneth R and James Michael Poterba**, “Investor Diversification and International Equity Markets,” *American Economic Review*, 1991, 81 (2), 222–226.
- Gabaix, Xavier and Matteo Maggiori**, “International Liquidity and Exchange Rate Dynamics,” *The Quarterly Journal of Economics*, 2015, 130 (3), 1369–1420.
- Goldberg, Linda S and Cédric Tille**, “Vehicle currency use in international trade,” *Journal of international Economics*, 2008, 76 (2), 177–192.
- Gopinath, Gita**, “The international price system,” Technical Report, National Bureau of Economic Research 2015.
- Gourinchas, Pierre-Olivier and Hélène Rey**, “International financial adjustment,” *Journal of Political Economy*, 2007, 115 (4), 665–703.
- , **Nicolas Govillot, and Hélène Rey**, “Exorbitant Privilege and Exorbitant Duty,” *Unpublished manuscript, UC Berkeley and LBS*, 2011.
- Gozzi, Juan Carlos, Ross Levine, and Sergio L Schmukler**, “Patterns of international capital raisings,” *Journal of international Economics*, 2010, 80 (1), 45–57.
- , – , **Maria Soledad Martinez Peria, and Sergio L Schmukler**, “How firms use corporate bond markets under financial globalization,” *Journal of Banking & Finance*, 2015, 58, 532–551.

- Gromb, Denis and Dimitri Vayanos**, “Equilibrium and welfare in markets with financially constrained arbitrageurs,” *Journal of Financial Economics*, 2002, 66 (2), 361–407.
- Hachem, Kinda and Zheng Michael Song**, “Liquidity regulation and unintended financial transformation in China,” 2016.
- Hassan, Tarek A.**, “Country Size, Currency Unions, and International Asset Returns,” *Journal of Finance*, 2013, 68 (6), 2269–2308.
- Hassan, Tarek A, Thomas M Mertens, and Tony Zhang**, “Currency Manipulation,” 2015.
- Hau, Harald and Hélène Rey**, “Can portfolio rebalancing explain the dynamics of equity returns, equity flows, and exchange rates?,” Technical Report, National Bureau of Economic Research 2004.
- **and Helene Rey**, “Global portfolio rebalancing under the microscope,” Technical Report, National Bureau of Economic Research 2008.
- **and —**, “Home bias at the fund level,” Technical Report, National Bureau of Economic Research 2008.
- **and Sandy Lai**, “Asset allocation and monetary policy: Evidence from the eurozone,” *Journal of Financial Economics*, 2016, 120 (2), 309–329.
- Jeanne, Olivier and Andrew K. Rose**, “Noise trading and exchange rate regimes,” *Quarterly Journal of Economics*, 2002, 117 (2), 537–569.
- Jotikasthira, Chotibhak, Christian Lundblad, and Tarun Ramadorai**, “Asset fire sales and purchases and the international transmission of funding shocks,” *The Journal of Finance*, 2012, 67 (6), 2015–2050.
- Khorana, Ajay, Henri Servaes, and Peter Tufano**, “Explaining the size of the mutual fund industry around the world,” *Journal of Financial Economics*, 2005, 78 (1), 145–185.
- Lane, Philip R and Gian Maria Milesi-Ferretti**, “The external wealth of nations mark II: Revised and extended estimates of foreign assets and liabilities, 1970–2004,” *Journal of international Economics*, 2007, 73 (2), 223–250.
- **and Jay C Shambaugh**, “Financial exchange rates and international currency exposures,” *The American Economic Review*, 2010, pp. 518–540.
- Lane, Philip RR and Gian Maria Maria Milesi-Ferretti**, “International financial integration in the aftermath of the global financial crisis,” 2017.

- Larrain, Mauricio and Sebastian Stumpner**, “Capital account liberalization and aggregate productivity: The role of firm capital allocation,” *The Journal of Finance*, 2017, 72 (4), 1825–1858.
- Lewis, Karen K**, “Trying to explain home bias in equities and consumption,” *Journal of economic literature*, 1999, 37 (2), 571–608.
- Liao, Gordon Y**, “Credit migration and covered interest rate parity,” *Project on Behavioral Finance and Financial Stability Working Paper Series (2016-07)*, 2016.
- Long, J. Bradford De, Andrei Shleifer, Lawrence H. Summers, and Robert J. Waldmann**, “Noise Trader Risk in Financial Markets,” *Journal of Political Economy*, 1990, pp. 703–738.
- Lucas, Robert E.**, “Interest rates and currency prices in a two-country world,” *Journal of Monetary Economics*, 1982, 10 (3), 335–359.
- Lustig, Hanno and Adrien Verdelhan**, “Does Incomplete Spanning in International Financial Markets Help to Explain Exchange Rates?,” Technical Report, National Bureau of Economic Research 2016.
- Maggiore, Matteo**, “Financial Intermediation, International Risk Sharing, and Reserve Currencies,” *Forthcoming in American Economic Review*, 2017.
- Melitz, Marc J**, “The impact of trade on intra-industry reallocations and aggregate industry productivity,” *Econometrica*, 2003, 71 (6), 1695–1725.
- Moor, Lieven De and Rosanne Vanpée**, “Bond and equity home bias and foreign bias: An international study,” 2013.
- **and** —, “What drives international equity and bond holdings? An empirical study,” *Applied Financial Economics*, 2013, 23 (13), 1067–1082.
- Nagel, Stefan**, “The liquidity premium of near-money assets,” *The Quarterly Journal of Economics*, 2016, 131 (4), 1927–1971.
- Pavlova, Anna and Roberto Rigobon**, “Equilibrium Portfolios and External Adjustment Under Incomplete Markets,” *Unpublished Manuscript LBS*, 2012.
- Perez, Diego, Pablo Ottonello et al.**, “The Currency Composition of Sovereign Debt,” *Working Paper, New York University*, 2016.
- Raddatz, Claudio and Sergio L Schmukler**, “On the international transmission of shocks: Micro-evidence from mutual fund portfolios,” *Journal of International Economics*, 2012, 88 (2), 357–374.

- Salomao, Juliana and Liliana Varela**, “Exchange Rate Exposure and Firm Dynamics,” Technical Report 2016.
- Sercu, Piet and Rosanne Vanpée**, “Home bias in international equity portfolios: A review,” 2007.
- Solnik, Bruno H**, “An equilibrium model of the international capital market,” *Journal of economic theory*, 1974, 8 (4), 500–524.
- Stein, Jeremy C.**, “Monetary Policy as Financial Stability Regulation,” *The Quarterly Journal of Economics*, 2012, 127, 57–95.
- Tille, Cedric and Eric Van Wincoop**, “International capital flows,” *Journal of international Economics*, 2010, 80 (2), 157–175.
- Wasi, Nada, Aaron Flaaen et al.**, “Record linkage using stata: Pre-processing, linking and reviewing utilities,” *Stata Journal*, 2015, 15 (3), 672–697.
- Wincoop, Eric Van and Francis E Warnock**, “Is home bias in assets related to home bias in goods?,” Technical Report, National Bureau of Economic Research 2006.
- **and** —, “Can trade costs in goods explain home bias in assets?,” *Journal of International Money and Finance*, 2010, 29 (6), 1108–1123.

Table 1: Countries Included in Analysis

	Country Code	Start Year	End Year	AUM in 2015 (\$ Billions)	
(1)	United States	USA	2005	2015	15,397
(2)	European Monetary Union	EMU	2005	2015	5,072
(3)	United Kingdom	GBR	2005	2015	1,229
(4)	China	CHN	2007	2015	1,136
(5)	Brazil	BRA	2011	2015	1,007
(6)	Canada	CAN	2005	2015	973
(7)	Switzerland	CHE	2005	2015	374
(8)	Australia	AUS	2007	2015	327
(9)	Sweden	SWE	2005	2015	299
(10)	Denmark	DNK	2005	2015	116
(11)	Mexico	MEX	2008	2015	111
(12)	Norway	NOR	2005	2015	103
(13)	Chile	CHL	2009	2015	39
(14)	New Zealand	NZL	2005	2015	22

Note: This table reports summary statistics for the countries (i.e. domiciles of mutual funds) that have sufficient coverage relative to the levels AUM reported in ICI and therefore are included in our main analyses.

Table 2: Home Currency Bias: Within-Firm Variation

j	CAN	CHE	EMU	GBR	SWE	USA
Currency	0.922*** (0.011)	0.661*** (0.015)	0.581*** (0.014)	0.528*** (0.026)	0.806*** (0.022)	0.612*** (0.014)
Obs.	34,237	34,237	34,237	34,237	34,237	34,237
# of Firms	8,879	8,879	8,879	8,879	8,879	8,879
R^2	0.952	0.935	0.824	0.830	0.954	0.851
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: Table reports estimates of the regression in equation (1). The dependent variable is the share of each security (at the CUSIP 9-digit level) bought by each country in our sample: $q_{i,p,j}/\Omega_{BC,p,c}$. We include fixed effects at the ultimate-parent firm level. Controls include maturity and coupon bins. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3: Home Currency Bias: Robustness

		CAN	CHE	EMU	GBR	SWE	USA
(1) MC Only	β	0.921***	0.660***	0.579***	0.524***	0.804***	0.612***
	Obs.	5,016	6,927	12,524	9,386	2,627	12,692
(2) Foreign	β	0.940***	0.644***	0.612***	0.534***	0.730***	0.568***
	Obs.	32,387	33,233	26,082	31,926	33,363	23,066
(3) Foreign, Int'l	β	0.973***	0.487***	0.580***	0.593***	0.713***	0.577***
	Obs.	4,272	4,015	3,578	3,951	4,368	3,757
(4) Financial	β	0.912***	0.672***	0.595***	0.476***	0.841***	0.624***
	Obs.	10,717	10,717	10,717	10,717	10,717	10,717
(5) Non-Financial	β	0.936***	0.659***	0.581***	0.588***	0.706***	0.614***
	Obs.	15,025	15,025	15,025	15,025	15,025	15,025
(6) Foreign Financial	β	0.917***	0.651***	0.626***	0.452***	0.756***	0.578***
	Obs.	10,013	10,208	8,521	9,809	10,331	7,275
(7) Foreign Non-Fin.	β	0.962***	0.644***	0.605***	0.630***	0.694***	0.576***
	Obs.	13,762	14,770	12,650	14,227	14,894	7,530
(8) SF, SV, LS	β	0.922***	0.663***	0.598***	0.540***	0.800***	0.630***
	Obs.	153,488	153,488	153,488	153,488	153,488	153,488
(9) All bonds	β	0.898***	0.658***	0.590***	0.542***	0.788***	0.531***
	Obs.	206,776	206,776	206,776	206,776	206,776	206,776
(10) Residency	β	0.899***	0.660***	0.580***	0.529***	0.802***	0.602***
	Resid.	0.056***	0.027***	0.006	-0.001	0.022	0.072***
	Obs.	34,457	34,457	34,457	34,457	34,457	34,457

Notes: (1) Includes only the debt of firm that issues in multiple currencies, including the local currency for the issuer. (2) Includes only foreign firms from the perspective of the source country. (3) Includes only the international issuance of foreign firms. (4) Includes only financial firms. (5) Includes only non-financial firms. (6) Includes only foreign financial firms. (7) Includes only foreign non-financial firms. (8) In addition to corporate bonds, includes structured finance, sovereign issuance, and local government debt. (9) Includes all bonds. (10) Sample is the benchmark set of corporates, but includes the usual dummy for the bond being issued in the investing country's currency and also includes a dummy for the bond being issued in the investing country's residency.

Table 4: Home Country Bias or Home Currency Bias?

	Panel A: Only Country Indicators		Panel B: Only Currency Indicators		Panel C: Country and Currency Indicators		
	$\gamma_{j,0}$	R^2	$\beta_{j,0}$	R^2	$\gamma_{j,1}$	$\beta_{j,1}$	R^2
CAN	0.512	0.405	0.940	0.912	0.038	0.911	0.914
CHE	0.389	0.246	0.808	0.876	0.080	0.770	0.884
EMU	0.387	0.229	0.648	0.613	0.072	0.610	0.619
GBR	0.227	0.140	0.552	0.660	0.037	0.536	0.663
SWE	0.521	0.495	0.810	0.921	0.035	0.781	0.923
USA	0.444	0.343	0.646	0.712	0.133	0.572	0.734

Note: Panel A reports estimates of the regression in equation (2). Panel B reports estimates of the regression in equation (3). Panel C reports estimates of the regression in equation (4). The dependent variable is the share of each security (at the CUSIP 9-digit level) bought by each country in our sample: $q_{i,p,j/\Omega,BC,p,c}$. Standard errors not reported, all coefficients are significant at one percent level.

Table 5: Firm Size and Foreign Currency Debt Issuance

Measure of Size	CAD	CHF	EUR	GBP	SEK	USD	Obs.
Bond Issuance (\$B)	0.161*** (0.043)	0.014** (0.006)	0.029*** (0.004)	0.068*** (0.021)	0.356*** (0.075)	0.006*** (0.001)	14,815
EBIT (\$B)	0.207*** (0.055)	0.169*** (0.058)	0.177*** (0.027)	0.217*** (0.053)	0.497*** (0.121)	0.030*** (0.005)	3,723
Assets (\$B)	0.063*** (0.012)	0.005*** (0.001)	0.005*** (0.001)	0.002* (0.001)	0.040*** (0.010)	0.002*** (0.000)	3,728
Revenue (\$B)	0.406*** (0.099)	0.021*** (0.007)	0.018*** (0.004)	0.096*** (0.024)	0.091*** (0.017)	0.004*** (0.001)	3,728

Note: This table reports the results from 4 probit regression defined in equation 5. Each row is a different regression where “Size” is defined as (1) billions of USD of principal of bond issuance, (2) billions of USD of earnings before interest and tax (EBIT), (3) billions of dollars of total assets, and (4) billions of dollars of total revenue. Every specification includes two-digit SIC industry fixed effects. The coefficients reported are average marginal effects. All specifications are run using data for 2015.

Table 6: International Currencies: The Rise of the Dollar and Fall of the Euro

Specification	2005q4	2008q4	2015q4	Long Difference
(1) All Bonds				
$q_{\Omega,\Omega,B_{USD}/B}$	0.579	0.676	0.650	0.072
$q_{\Omega,\Omega,B_{EUR}/B}$	0.294	0.201	0.145	-0.148
(2) All Bonds Held by Foreigners				
$q_{-i,i,B_{USD}/B}$	0.477	0.463	0.607	0.130
$q_{-i,i,B_{EUR}/B}$	0.271	0.256	0.150	-0.122
(3) Govt Bonds Held by Foreigners				
$q_{-i,i,BS_{USD}/BS}$	0.466	0.428	0.496	0.030
$q_{-i,i,BS_{EUR}/BS}$	0.173	0.189	0.108	-0.065
(4) Corp Bonds Held by Foreigners				
$q_{-i,i,BC_{USD}/BC}$	0.484	0.480	0.661	0.178
$q_{-i,i,BC_{EUR}/BC}$	0.325	0.288	0.170	-0.155
(5) Financial Corp Bonds by Foreigners				
$q_{-i,i,BC_{USD}/BC}$	0.398	0.456	0.668	0.270
$q_{-i,i,BC_{EUR}/BC}$	0.359	0.273	0.170	-0.189
(6) Non-Financial Corp Bonds by Foreigners				
$q_{-i,i,BC_{USD}/BC}$	0.680	0.658	0.814	0.135
$q_{-i,i,BC_{EUR}/BC}$	0.192	0.198	0.094	-0.098
(7) Corp Bonds by Foreigners, Ex-USA/EMU				
$q_{-i,i,BC_{USD}/BC}$	0.252	0.219	0.363	0.111
$q_{-i,i,BC_{EUR}/BC}$	0.173	0.201	0.115	-0.058

Note: Table reports the portfolio shares of euro and dollar denominated bonds at year end in 2005, 2008, and 2015, as well as the difference between the 2015 and 2005 share (last column). We study seven different portfolio configurations. For each configuration the dollar share is reported in the first row and the euro share in the second row.

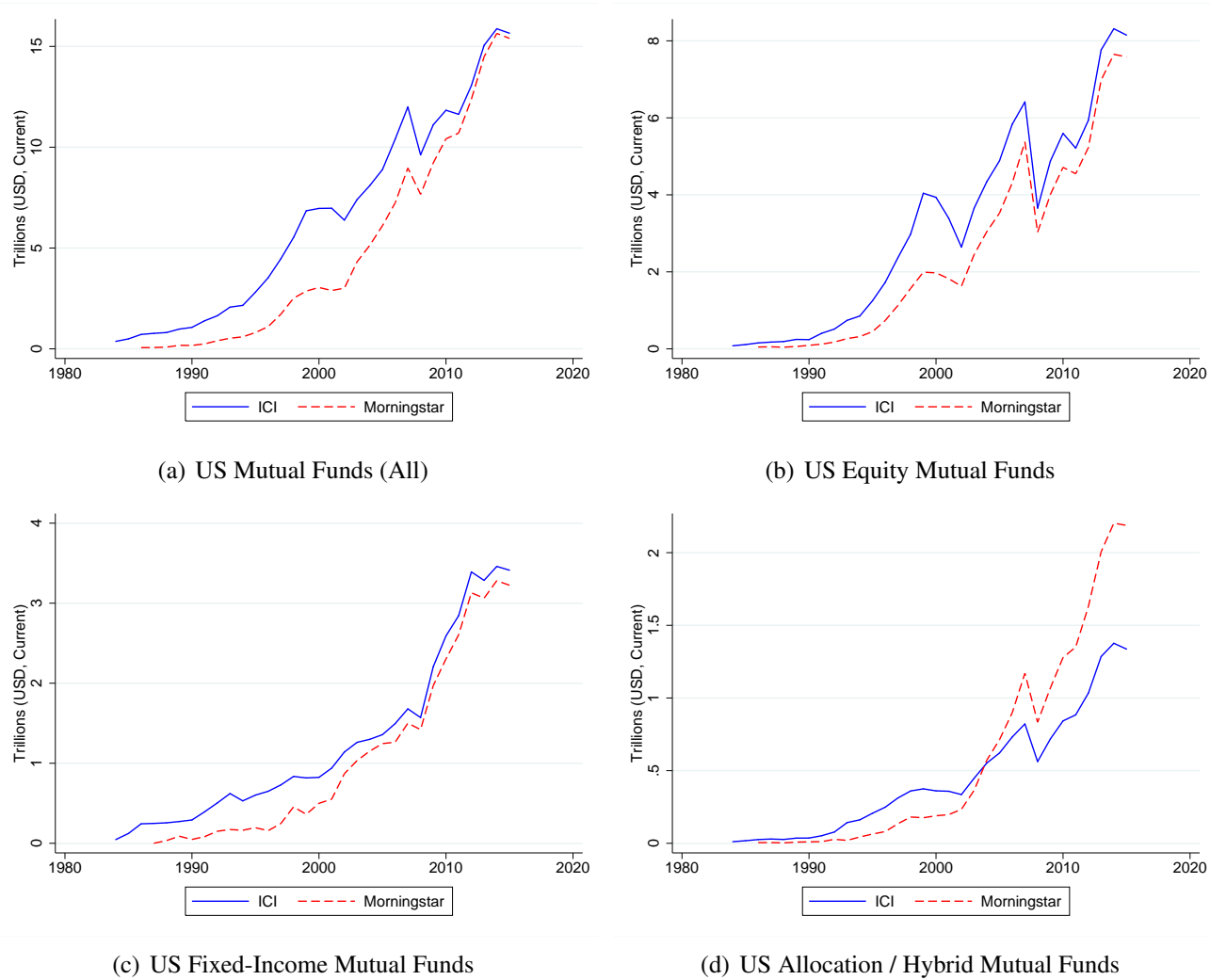


Figure 1: Morningstar's Coverage of US Mutual Fund Assets Under Management

Note: The graphs plot total Asset Under Management (AUM) for open-end mutual funds domiciled in the US. The blue solid line plots data on total AUM provided by the Investment Company Institute (ICI). The red dashed line reports the total AUM in our data. Panel (a) includes all type of mutual funds (equity, fixed income, allocation, money market funds). Panels (b),(c),(d) focus separately on each type of fund.

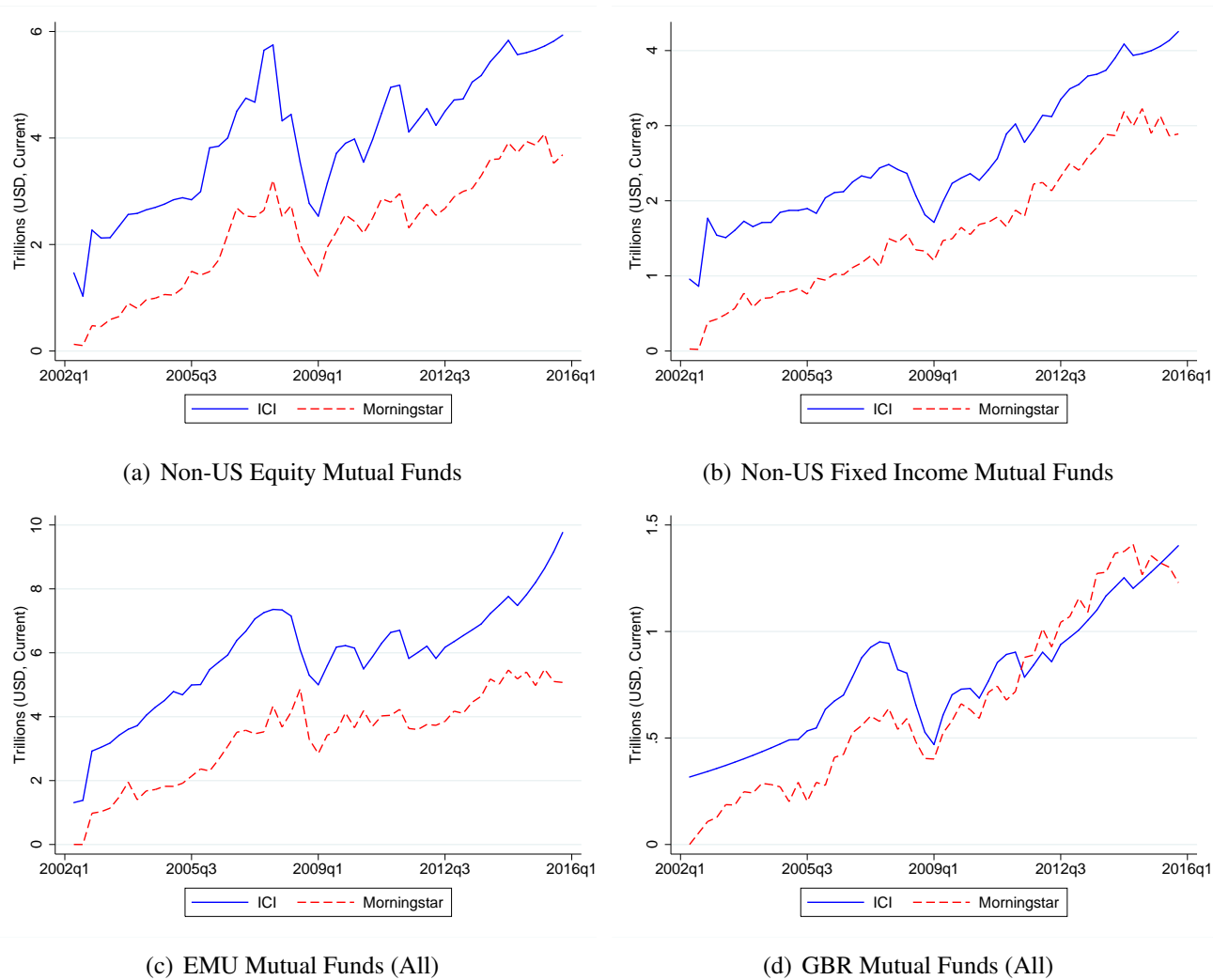
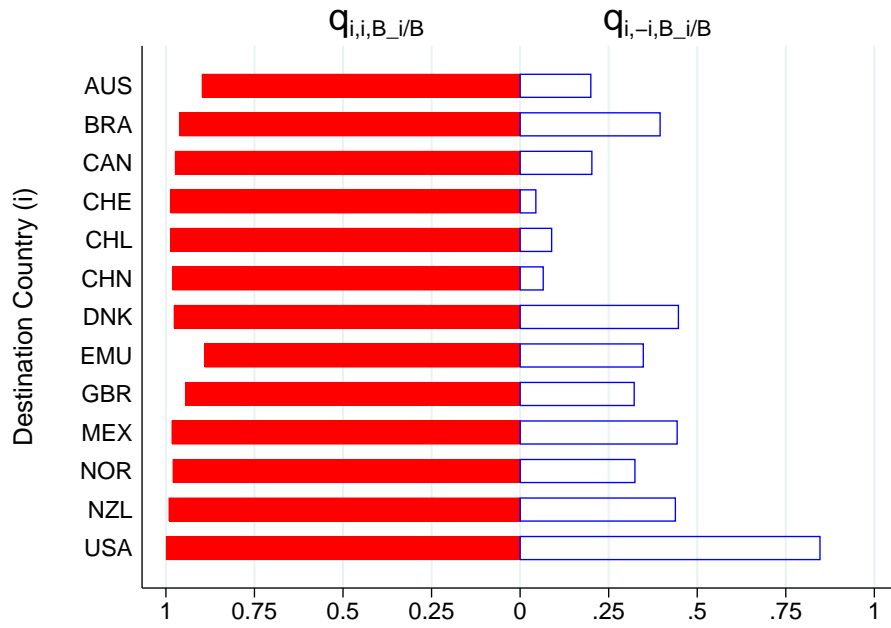
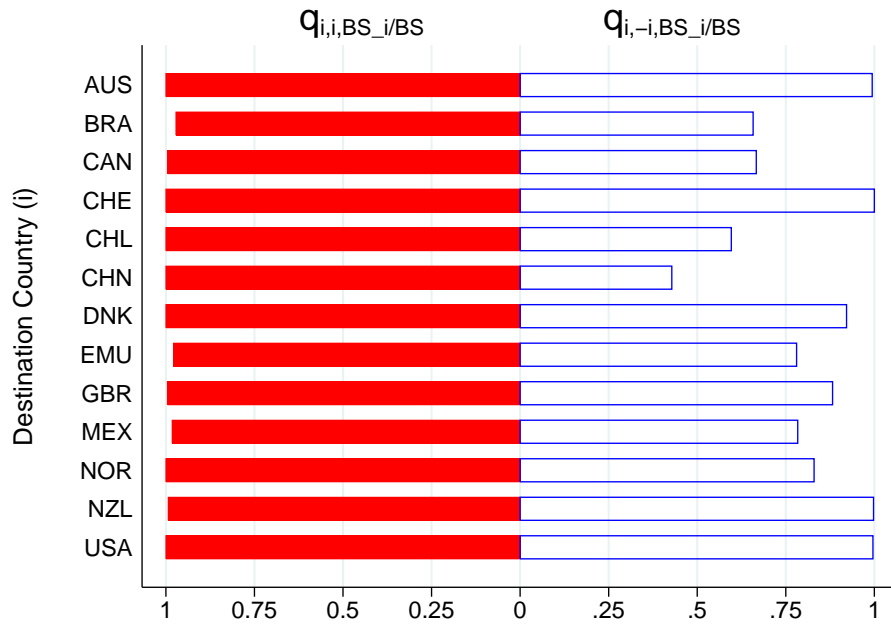


Figure 2: Morningstar's Coverage of Non-US Mutual Fund Assets Under Management

Note: The graphs plot total Asset Under Management (AUM) for open-end mutual funds domiciled outside the US (Panels (a) and (b)), in the EMU (Panel (c)), and in Great Britain (Panel (d)). The blue solid line plots data on total AUM provided by the Investment Company Institute (ICI). The red dashed line reports the total AUM in our data. Panel (a) includes only equity focused mutual funds. Panel (b) includes only fixed-income mutual funds. Panels (c) and (d) include all types of funds (equity, fixed income, allocation, money market funds).



(a) All Bonds



(b) Sovereign Debt

Figure 3: Share of Investment in Country i 's Securities Denominated in i 's Currency, 2015

Note: In Panel (a) the solid red shaded bars show for each country i the share of bonds denominated in i 's local currency out of all domestic investment in sovereign bonds. In Panel (a) the hollow blue bars show for each (destination) country i the share of bonds denominated in i 's local currency out of all foreign investment in i 's sovereign bonds. Panel (b) reports the same statistics as Panel (a) except all fixed income securities are used in the calculations.

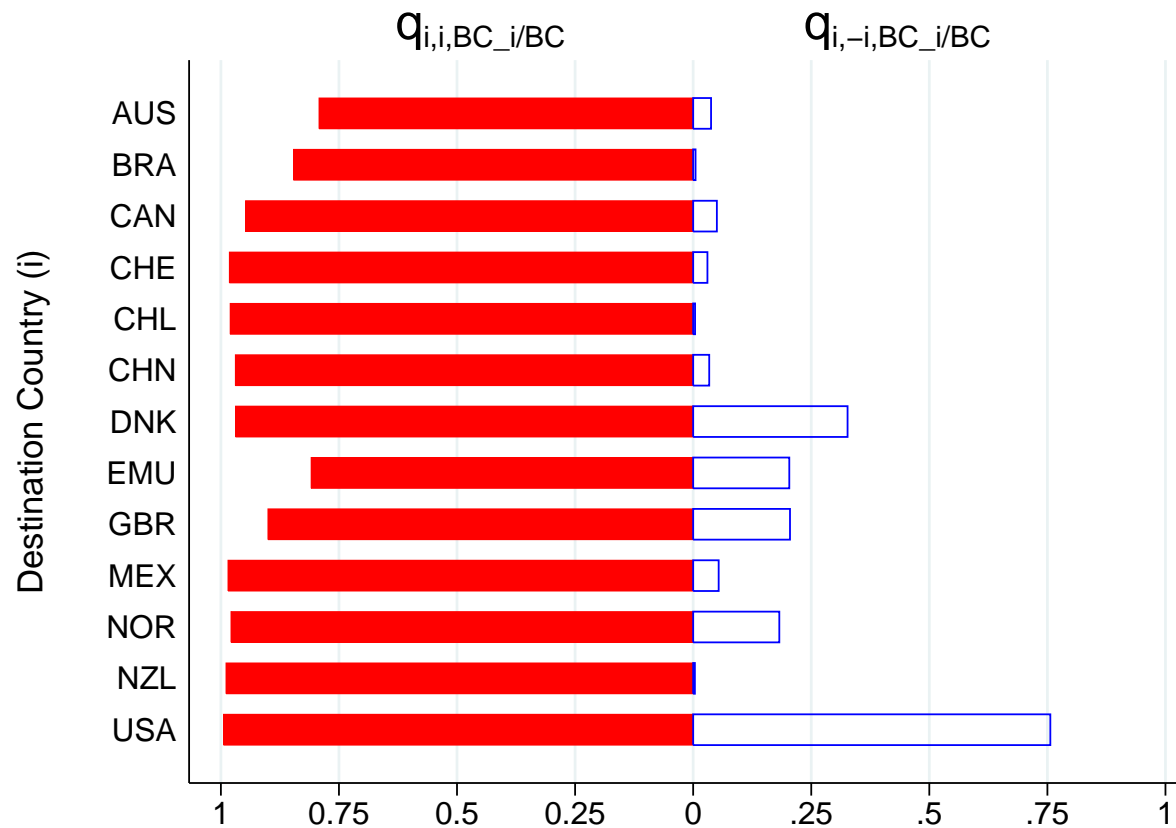
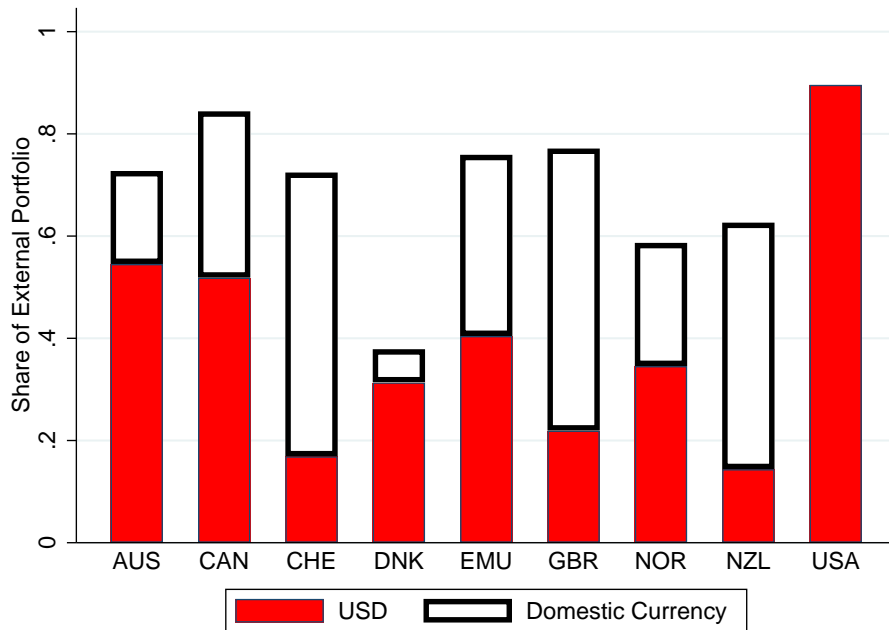
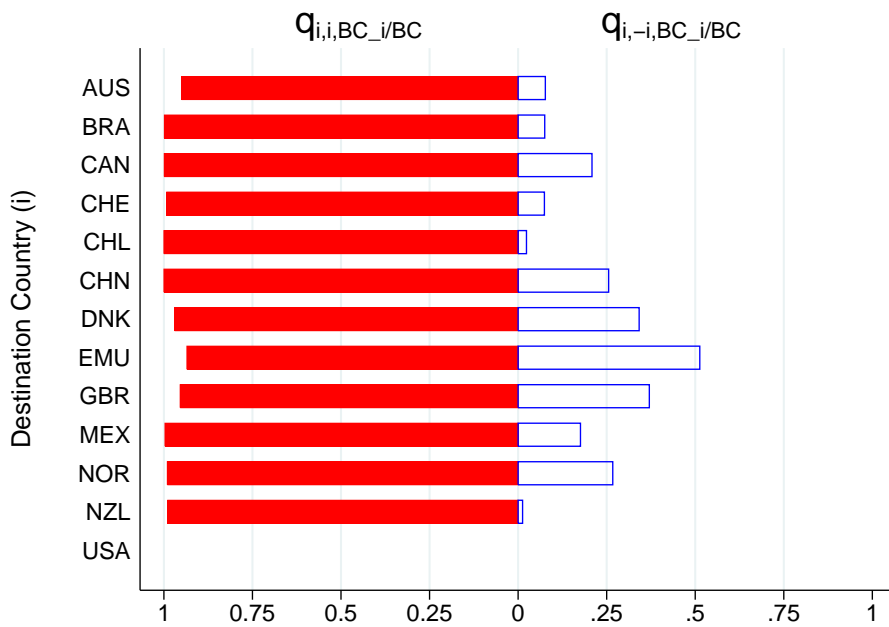


Figure 4: Share of Investment in Country i 's Corporate Debt Denominated in i 's Currency, 2015

Note: In Panel (a) the solid red shaded bars show for each country i the share of bonds denominated in i 's local currency out of all domestic investment in corporate bonds. In Panel (a) the hollow blue bars show for each (destination) country i the share of bonds denominated in i 's local currency out of all foreign investment in i 's corporate bonds. Panel (b) reports the same statistics as Panel (a) except that all dollar-denominated bonds are excluded from the calculations.



(a) Share of Source Country External Investment In USD and Domestic Currency



(b) Share of Investment in Country's Corporate Debt Denominated in i's Currency excluding USD, 2015

Figure 5: Role of Dollar in External Portfolios, 2015

Note: In Panel (a) the solid red shaded bars show for each country i the share of bonds denominated in i 's local currency out of all domestic investment in sovereign bonds. In Panel (a) the hollow blue bars show for each (destination) country i the share of bonds denominated in i 's local currency out of all foreign investment in i 's sovereign bonds. Panel (b) reports the same statistics as Panel (a) except all fixed income securities are used in the calculations.

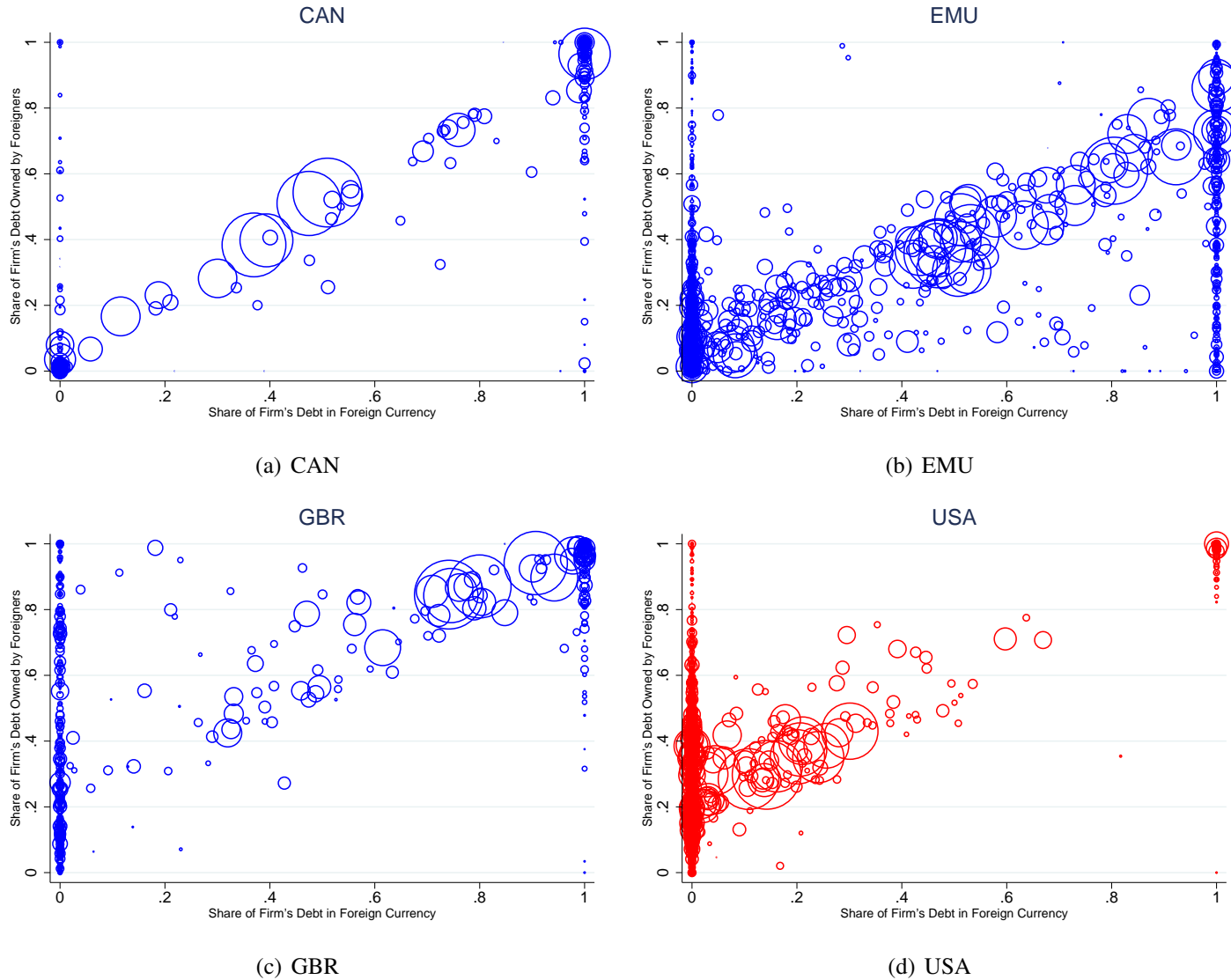
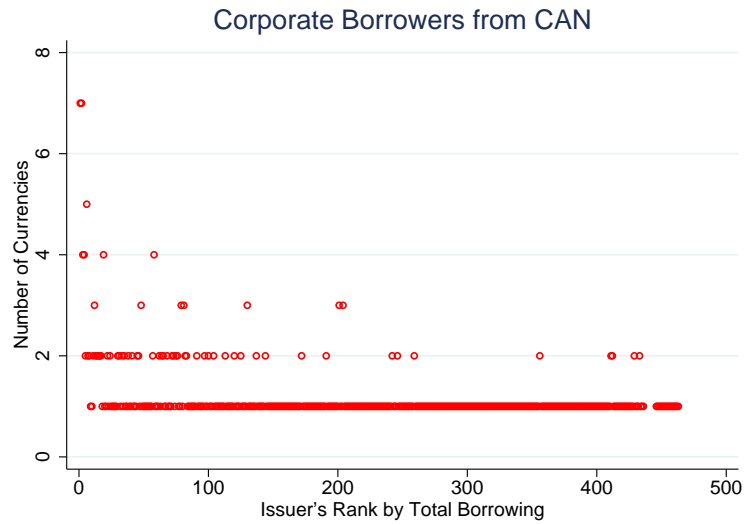
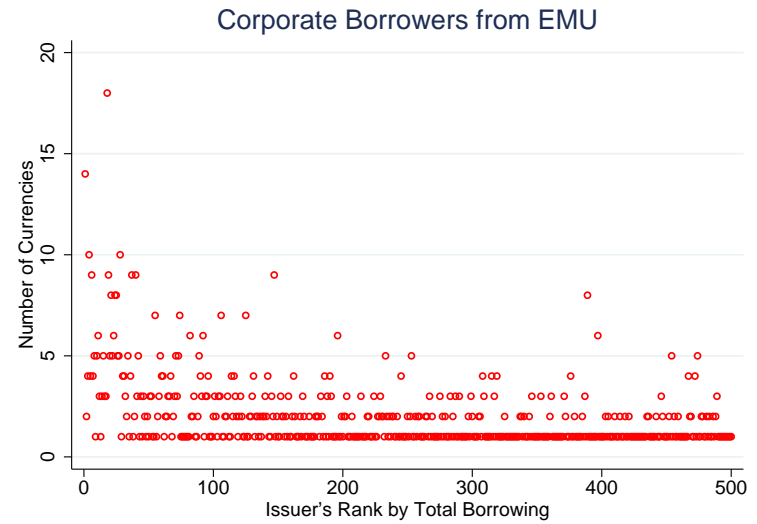


Figure 6: Shares of Foreign Currency Debt and Foreign Lending

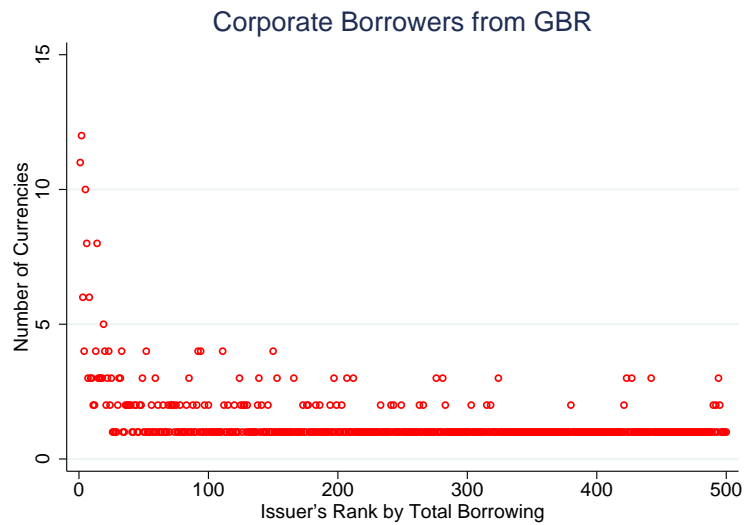
Note: In each figure, each bubble corresponds to a single firm based Canada, the EMU, the United Kingdom and the United States, respectively. The size of each bubble is proportional to the total amount borrowed by that particular firm. The x-axis plots the share of a firm's debt that is in foreign currency and the y-axis is the share of that firm's debt that is owned by investors' outside the country where that particular firm is based. Both variables are measured using the positions in the Morningstar data in 2015.



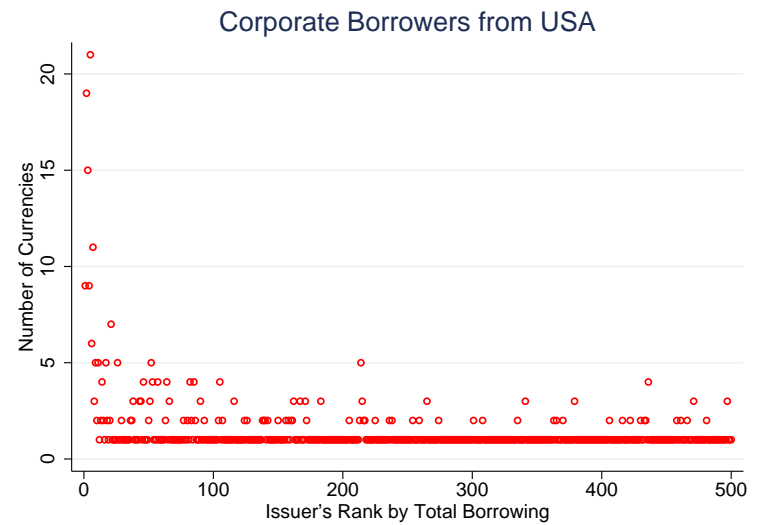
(a) CAN



(b) EMU



(c) GBR

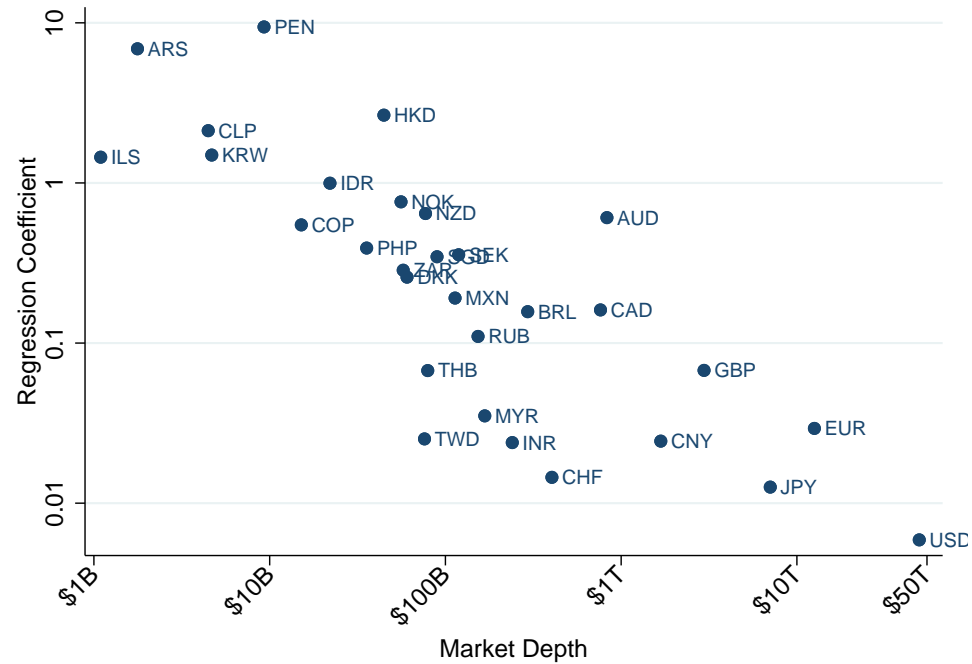


(d) USA

Figure 7: Number of Currencies and Firm Size

Note: In each figure, firms are ranked in order of the total amount of debt they have issued with the largest firm ranked first. The y-axis denotes the total number of currencies in which that particular firm has a bond that is owned by a mutual fund investor in the Morningstar data in 2015.

Figure 8: Multicurrency Issuance and Market Depth



Note: This table reports the results from the coefficient from the probit regression defined in equation 5 where size is defined as billions of USD of principal of bond issuance (the top row of Table 5) plotted against a measure of “Market Depth.” On the x-axis, Market Depth is measured as the total principal outstanding of bonds issued globally in that particular currency and outstanding as of year-end 2015. The y-axis refers to the average marginal effect of the measure of size in equation 5. Both the x and y-axis are reported in log scales but labeled using the level of the variables.

CAN Firm Shares in Domestic and Foreign Portfolios

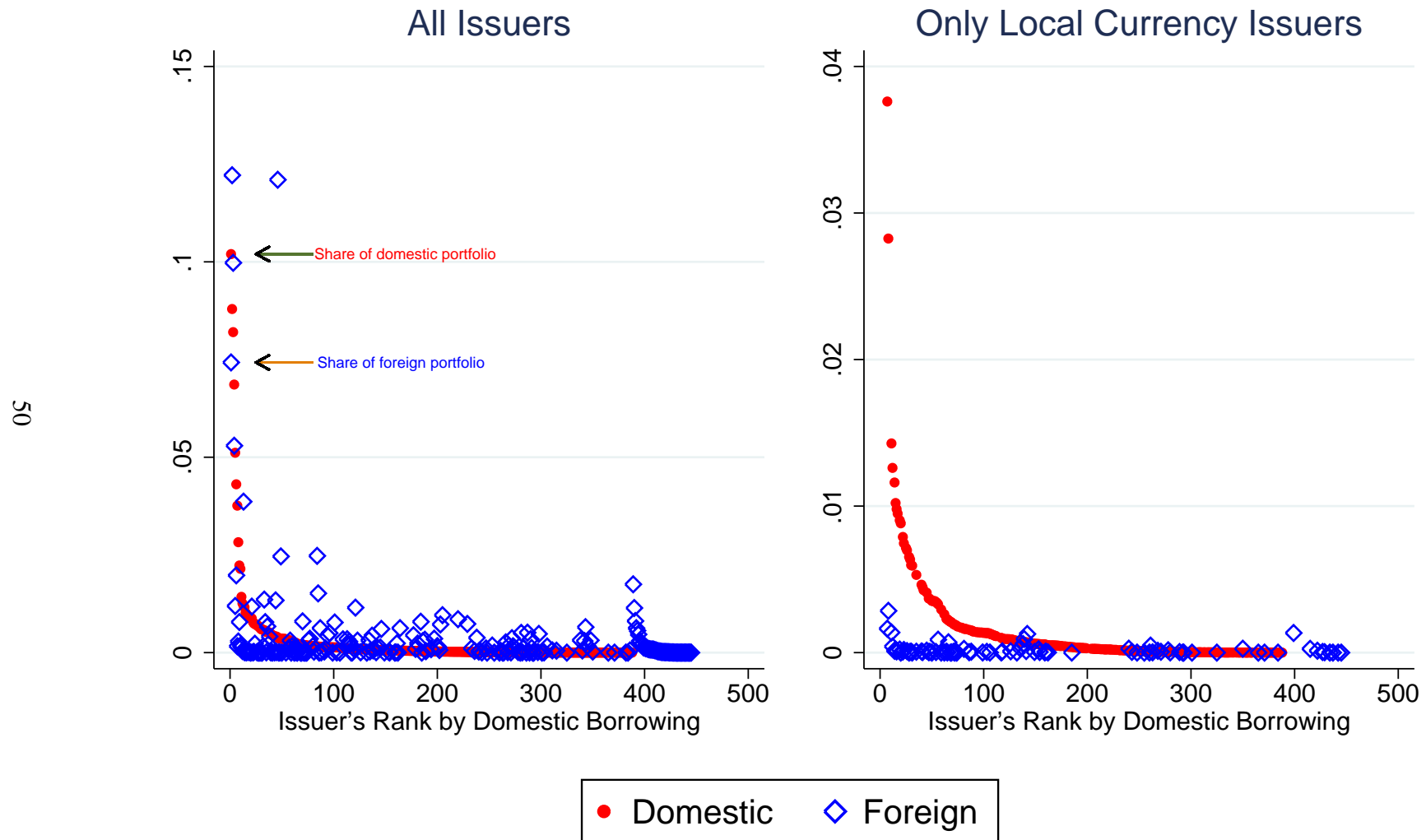
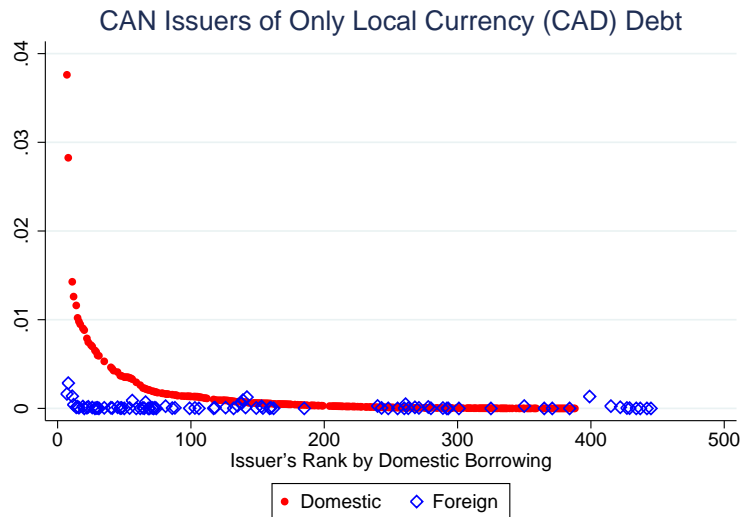
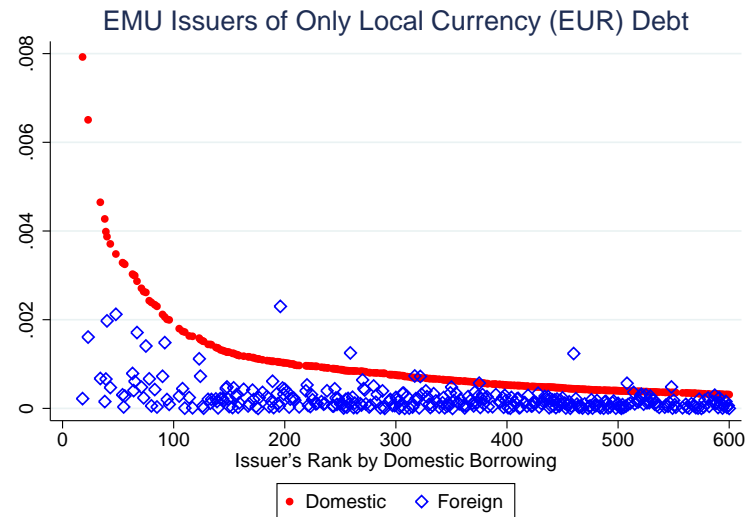


Figure 9: Canadian Corporate Debt Held in Domestic and Foreign Portfolios, 2015

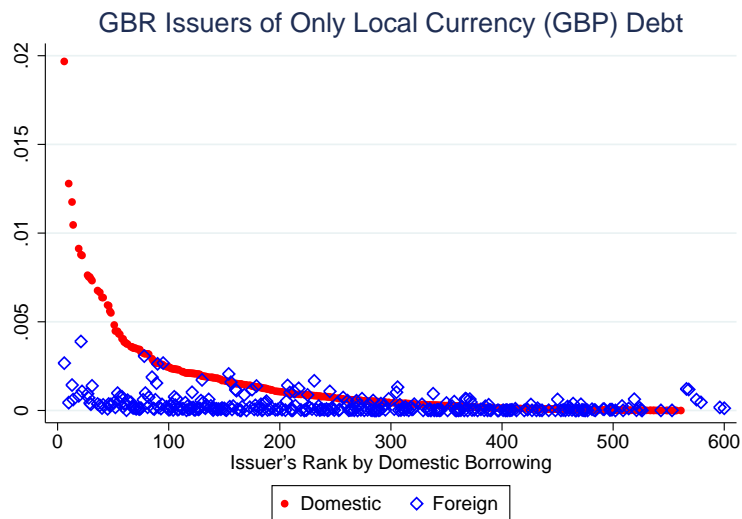
Note: This figure plots the corporate bond portfolio of domestic and foreign investors in Canada with the portfolio positions in each issuer are ranked according to their size in the domestic portfolio. The left panel considers all issuers and the right panel considers only firms that issue entirely in Canadian dollars, the local currency.



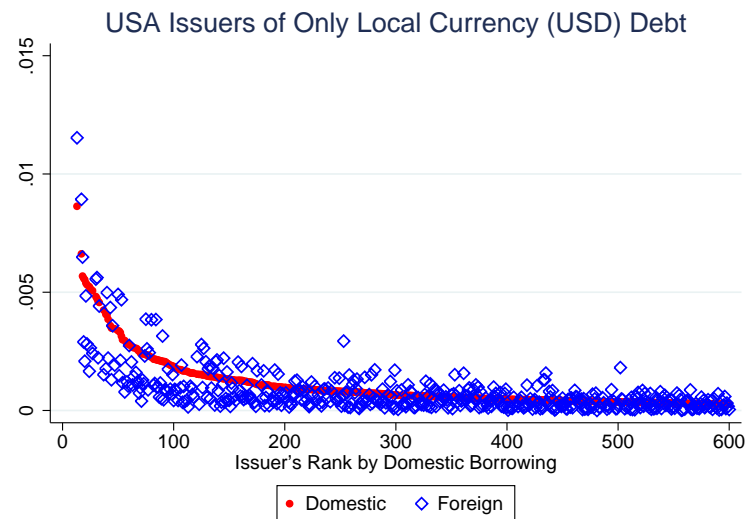
(a) CAN



(b) EMU



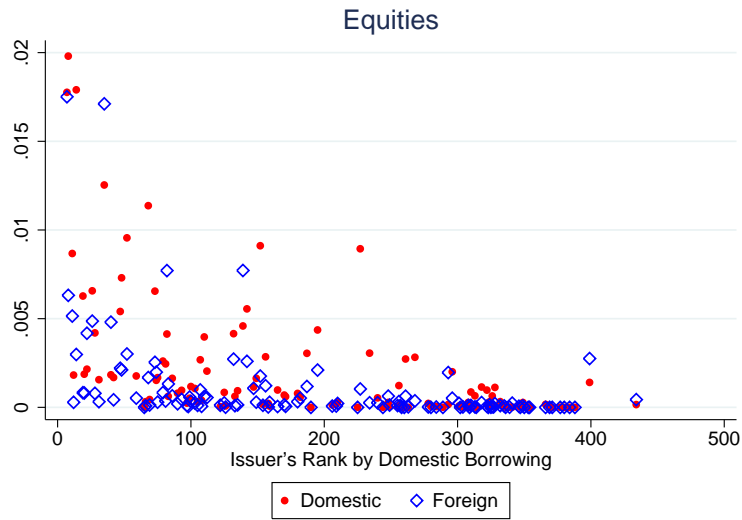
(c) GBR



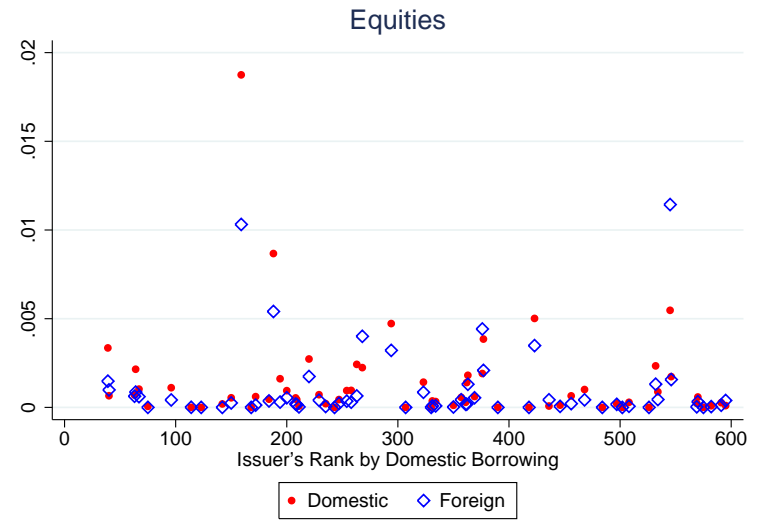
(d) USA

Figure 10: Corporate Debt from LC-only Issuers in Domestic and Foreign Portfolios, 2015

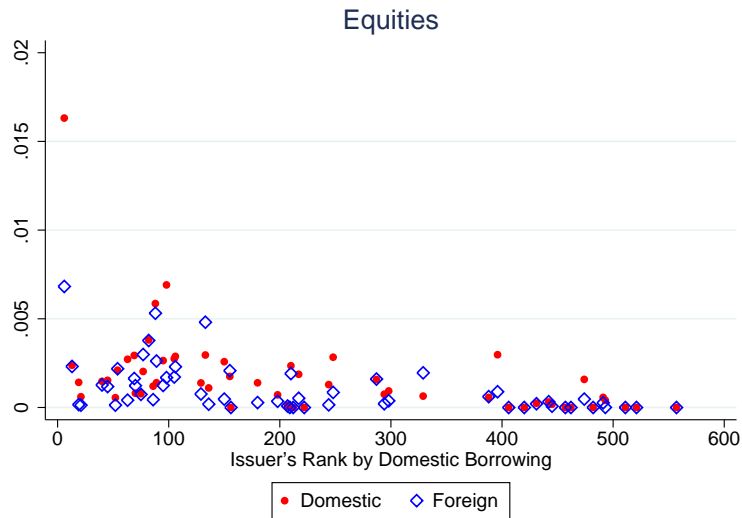
Note: This figure plots the corporate bond portfolio of domestic and foreign investors in Canada (a), the EMU (b), the United Kingdom (c), and the United States (d). The portfolio positions in each issuer are ranked according to their size in the domestic portfolio. Each figure plots only those firms that issue entirely in the local currency.



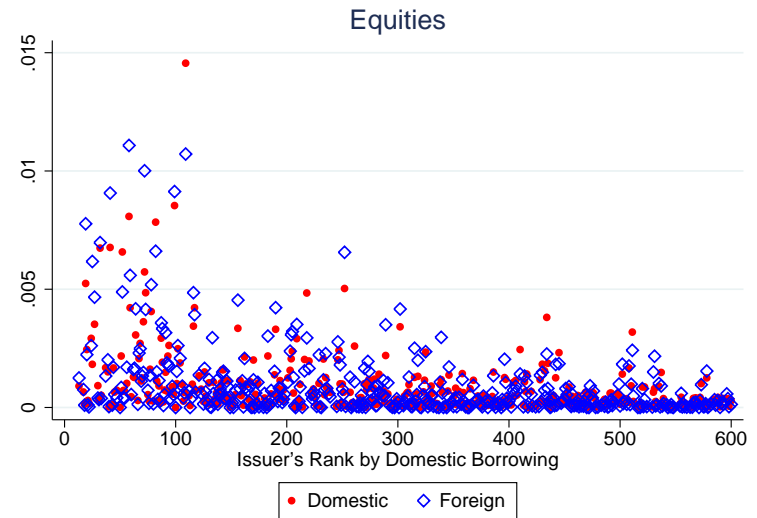
(a) CAN



(b) EMU



(c) GBR

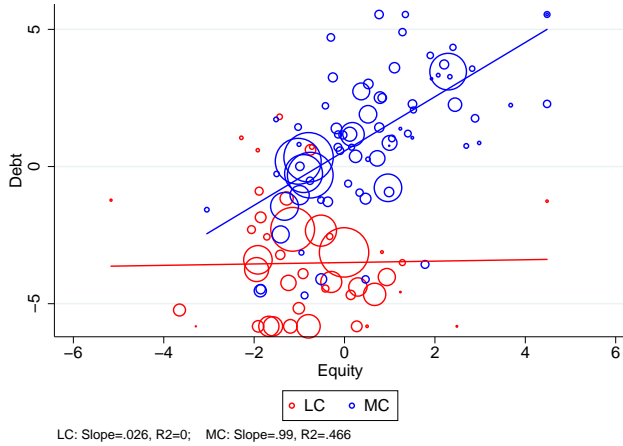


(d) USA

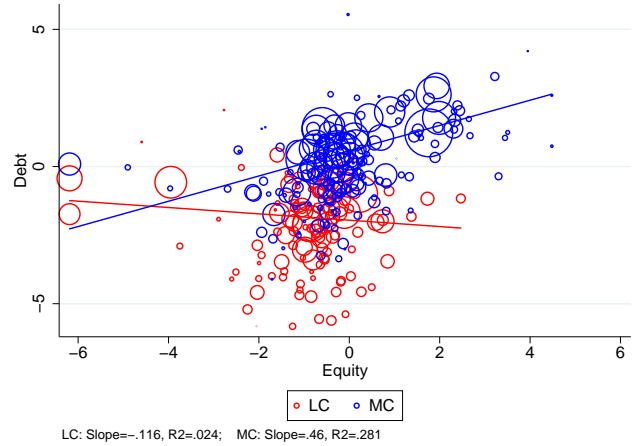
Figure 11: Equities from LC-only Issuers in Domestic and Foreign Portfolios, 2015

Note: This figure plots the equity portfolio of domestic and foreign investors in Canada (Panel a), the EMU (Panel b), the United Kingdom (Panel c), and the United States (Panel d). The portfolio positions in each issuer are ranked according to their size in the domestic portfolio. Each figure plots only those firms that issue entirely in the local currency.

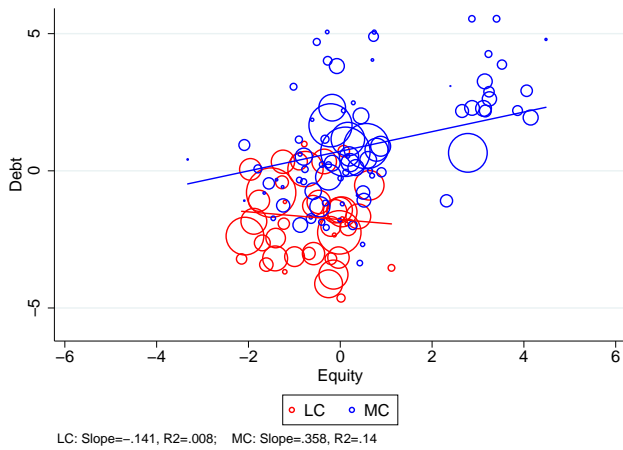
Figure 12: Debt and Equity



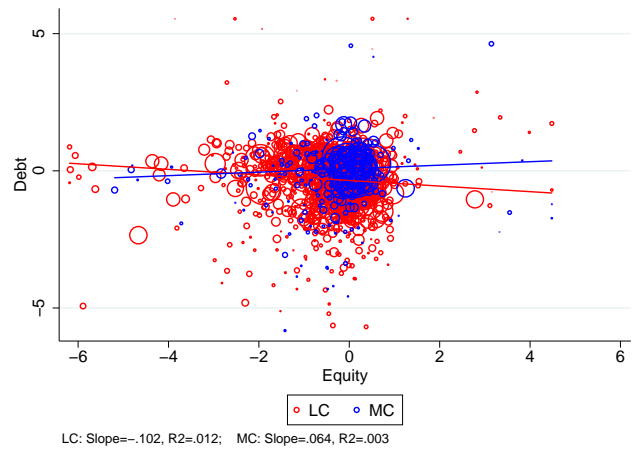
(a) CAN



(b) EMU

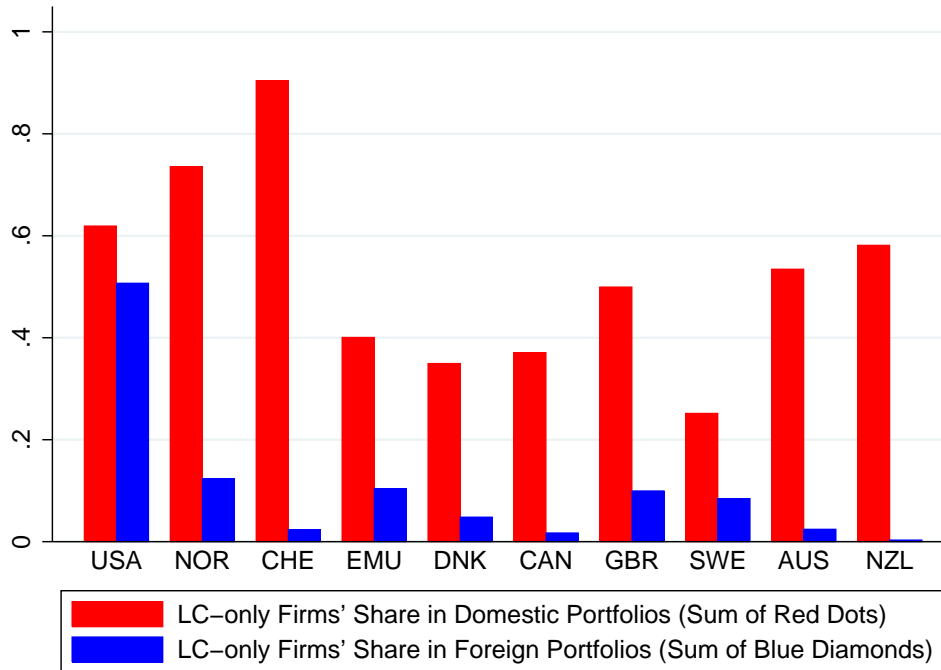


(c) GBR



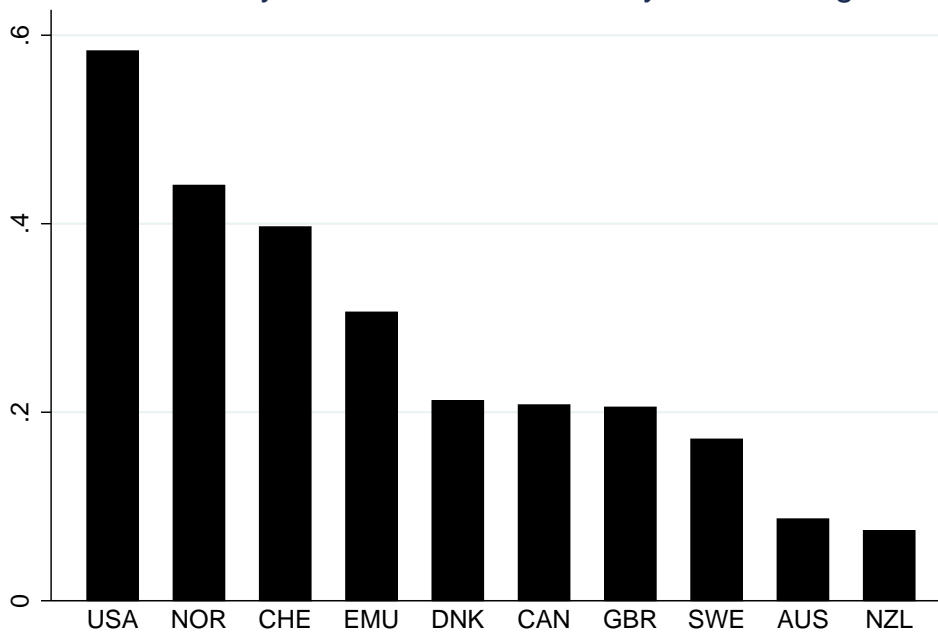
(d) USA

Note: This figure plots the relationship between how overweight foreign investors are in a firm's debt and equity. We measure how overweight foreigners are as the logarithm of the ratio of the share of all corporate bond or equity investment that goes to firm p as a share of investment in country i . Foreign investors are more overweight the debt of firm p compared to domestic investors the higher the ratio $\log \frac{q_{i,-i,BCp/BC}}{q_{i,i,BCp/BC}}$ is. The equivalent ratio for equity is given by: $\log \frac{q_{i,-i,E_p/E}}{q_{i,i,E_p/E}}$. This figure plots the debt ratio on the vertical axis and the equity ratio on the horizontal axis for each firm in our sample that has a publicly listed equity. Firms that borrow only in the local currency (LC) are depicted with red circles and those that borrow in multiple currencies (MC) firms with blue ones. The size of each circle is proportional to the total market value of total debt of the firm.



(e) LC-only Firms Aggregate Shares of Total Borrowing

LC-only Firms' Share of Country's Borrowing



(f) LC-only Firms Aggregate Shares of Domestic and Foreign Portfolios

Figure 13: Aggregate Contributions to Borrowing from LC-only Firms, 2015

Note: The top panel reports the share of all debt that is issued by firms that borrow only in local currency in domestic investor's domestic debt portfolio (red) and in foreign investor's debt portfolio in that particular country (blue). These bars are equal to the sum of the value of the red dots and blue diamonds, respectively, in Figure 10. The bottom panel plots the share of all debt issued by firms in each country that are issued by firms that borrow only in the local currency.

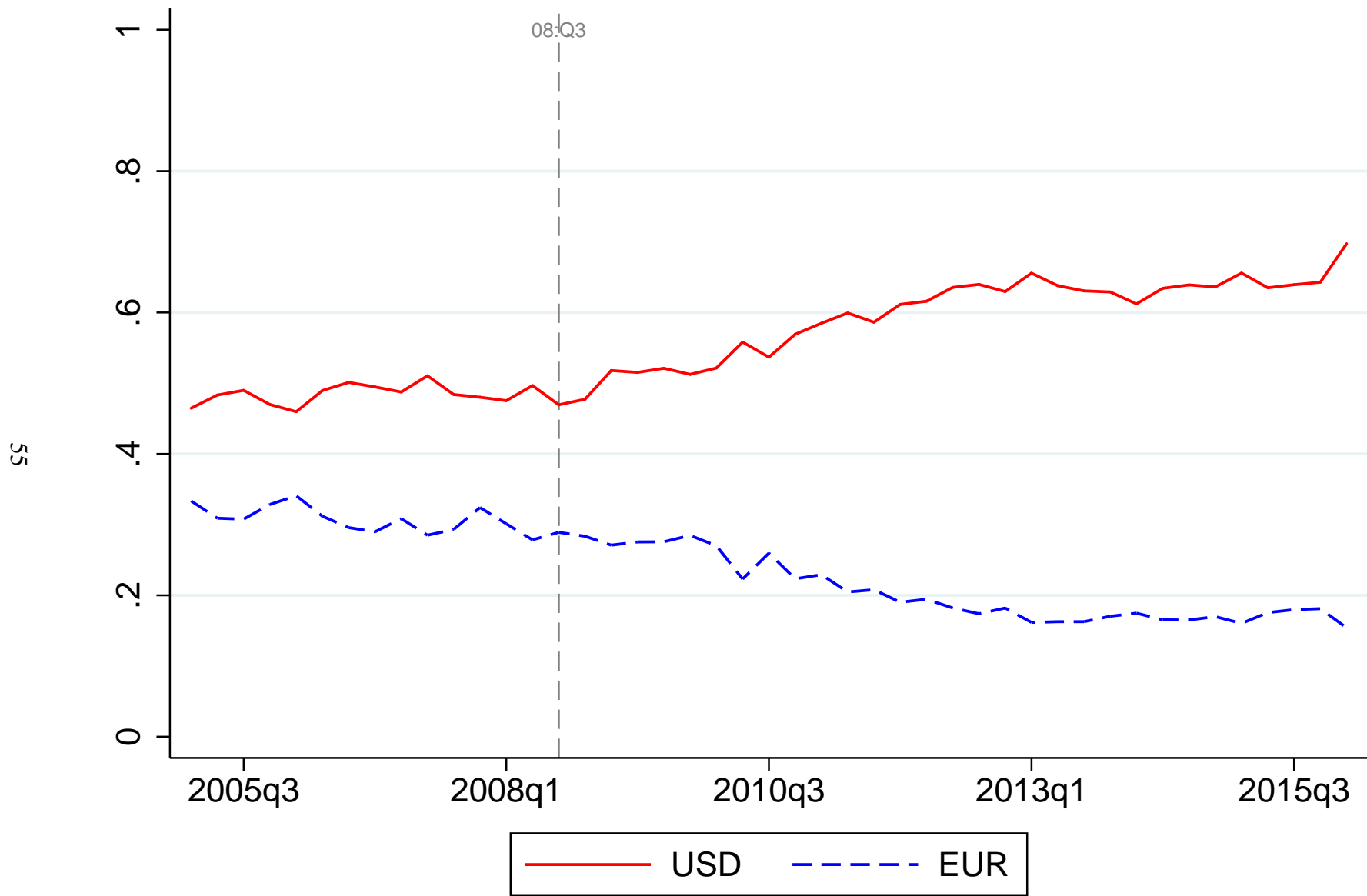
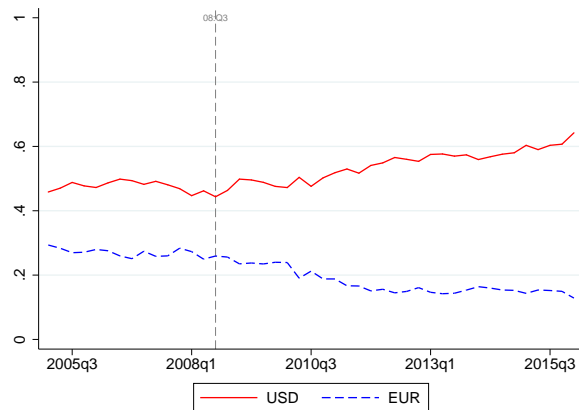
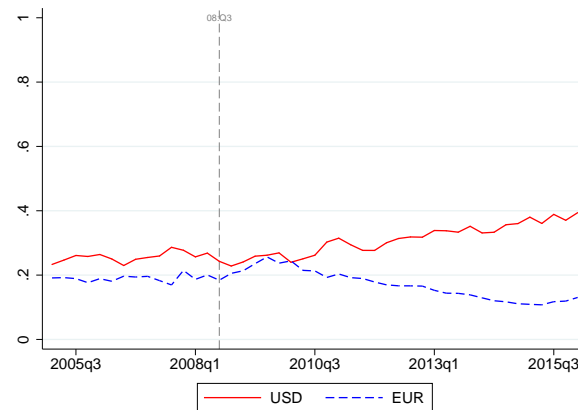


Figure 14: Dollar and Euro Shares of Cross-Border Corporate Bond Positions

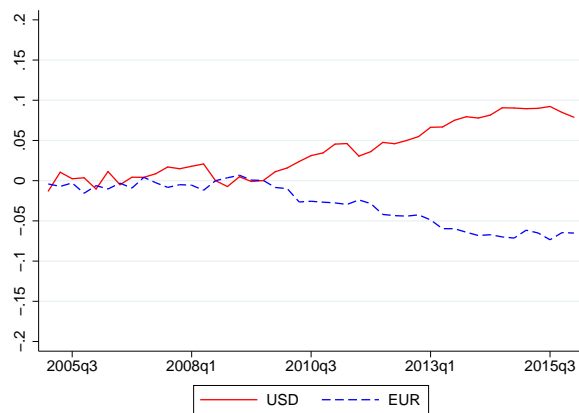
Note: Figure plots the share of dollar and euro denominated corporate bonds in total cross-border holdings (i.e. $i \neq j$).



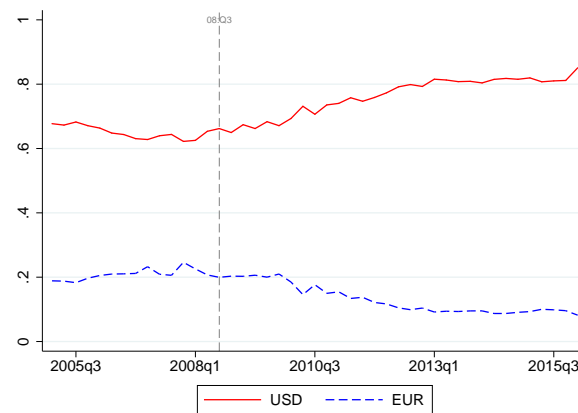
(a) All Bonds, International Positions



(b) Corporates, Intl. Pos., Ex-USA/EMU



(c) Corporates, Intl. Pos., FE Regs with Const FX



(d) Non-Financial Corporate Bonds, Intl. Pos.

Figure 15: International Currencies: The Rise of the Dollar and Fall of the Euro in Cross-Border Asset Trade

Note: Panels (a) plots the share of dollar and euro denominated bonds in total cross-border holdings (i.e. $i \neq j$). Panel (b) plots the analogous shares but only for corporate bonds and further excludes positions for which either the US or the EMU are either the borrower or the lender (i.e. $i, j \neq \{USA, EMU\}$). Panel (c) plots the fixed effects estimated using equation (9) on the dataset constructed with fixed exchange rates at 2015 levels. Finally, Panel (d) shows that these trends hold also for non-financial borrowers.