International Currencies and Capital Allocation

Matteo Maggiori* Brent Neiman† Jesse Schreger‡

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Abstract

We introduce a dataset of $27 trillion of security-level investment positions to establish that global portfolios are driven by an often neglected aspect: the currency of denomination of assets. We demonstrate that this investor currency preference significantly affects which firms receive capital from foreign investors. Investor holdings exhibit home currency bias to such an extent that each country holds the bulk of securities denominated in their own currency, even those issued by foreign borrowers in developed countries. In fact, 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 that issue only in local currency 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 means that even small US firms that borrow exclusively in dollars have little difficulty borrowing from abroad. The euro used to offer its borrowers some benefit as an international currency, but global portfolios shifted sharply away from the euro and toward the dollar starting with the 2008 financial crisis. We rationalize these findings using a framework with downward sloping demand for bonds in each currency and where firms must pay a fixed cost to borrow in foreign currency.

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*Harvard University, Department of Economics, NBER, and CEPR. Email: maggiori@fas.harvard.edu.
†University of Chicago, Booth School of Business, and NBER. Email: brent.neiman@chicagobooth.edu.
‡Columbia University, Graduate School of Business, and NBER. Email: jesse.schreger@columbia.edu.

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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, investor portfolios exhibit extremely strong home currency bias as they disproportionately hold securities demoninated in their own country's currency. This bias is so strong that each country holds the vast majority of securities issued in their currency, even when the borrower is foreign and resides in a developed country.[1] In fact, home currency bias is so strong that it almost entirely explains home country bias in these data. If one considers only the global supply of bonds denominated in a country's currency, that country's portfolio will exhibit little if any bias toward securities issued by domestic borrowers. Similarly, if one focuses only on the global supply of foreign currency bonds, countries do not lend disproportionately to domestic borrowers.

Second, we show that this currency bias has very different implications for different types of firms. 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 their local currencies and do not borrow from abroad. This means that investor currency preference has major consequences for which firms access foreign capital.

Third, we demonstrate that the global willingness to hold the US dollar renders the United States the unique exception to the above patterns. When foreigners buy US securities, they are about as likely to buy local currency securities as when Americans do. 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 international currencies such as the dollar – they effectively open the capital account for local currency borrowers.

By this standard, the US dollar appears today to be the world's only international currency. As recently as 10 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 of about 30 percent. These shares

[1] Our finding is reminiscent of the large literature on "Original Sin", such as Eichengreen and Hausmann (1999, 2005), that emphasizes foreign unwillingness to hold local currency assets in developing and emerging markets. Conventional explanations for that phenomenon include inflation risk and are unlikely to explain our finding in developed economies such as Australia, Canada, Europe, and the United Kingdom.

were essentially stable until the global financial crisis of 2008, after which the euro's share strikingly declined to below 20 percent, while the dollar's share rose to nearly 70 percent. European borrowers appear to receive less benefit from issuing euros than they did in the early 2000s. International currency status can change more rapidly than perhaps is assumed.

We organize and rationalize our findings in the context of a simple framework where firms issue bonds to finance production. There is no risk and firms are heterogeneous in their productivities and start-up capital or equity. Bonds are sold to specialist investors that are fully segmented into markets for each firm's securities in any given currency. This gives rise to linear demand for each debt security, where the slope of the demand curve depends on the depth of the market. As firms issue more debt in a given currency, they must pay a higher interest rate. Further, the rate at which the interest rate on those bonds increases depends on the global taste for that currency. All firms would in principle like to issue in all currencies, equalizing their borrowing costs on the margin. Doing so would involve issuing more in the currencies with deeper markets and flatter demand curves and issuing less in those currencies with shallower markets and steeper demand curves.

All firms can borrow in local currency, but we assume firms must pay a fixed cost to issue in foreign currency. We think of this fixed cost as representing the need of foreign issuers 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, where a fixed cost leads firms to select into exporting based on their productivity, the fixed cost in our model implies that those firms that select into borrowing in foreign currency are more productive, have higher leverage, and are larger. This size-dependence in the likelihood that a firm issues in foreign currency is robustly present in our data.

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, Dvorak and Warnock (2008). Our finding that foreigners avoid local currency bond exposure relative to the levels predicted in benchmark models complements the work by Lane and Shambaugh (2010) and Bénétrix, Lane and Shambaugh (2015). The result that home bias in our data is largely a reflection of home currency bias expands upon the message in Burger, Warnock and Warnock (2017), who first found using TIC data that the US foreign investment across destination countries does not appear home biased in the subset of debt that is dollar denominated and suggested it might apply more generally across countries and debt markets. One contribution of our analysis is to affirmatively establish this to be the case across a large number of bilateral country

pairs using micro data capable of disentangling preference for geography and currency from other factors such as residence, industry, maturity, or credit worthiness. In fact, we establish a strong home currency bias even among bonds issued in different currencies by the same firm.

Other recent work characterizing the behavior of global portfolios includes Alfaro, Kalemli-Ozcan and Volosovych (2008), Bertaut, Tabova and Wong (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. While these sources have far greater coverage across asset classes and investor types than our data, none simultaneously offer broad coverage of bilateral country pairs, domestic investment, and information on the underlying positions or characteristics such as currency, industry, credit riskiness, and maturity.[2]

The currency patterns in global portfolios that we document do not emerge in many benchmark models such as Alvarez, Atkeson and Kehoe (2009), Bacchetta and Van Wincoop (2010), Pavlova and Rigobon (2012), and Lustig and Verdelhan (2016). In those environments, foreign investors tend to take on direct exposure to the borrower's currency. Engel and Matsumoto (2009) and Coeurdacier and Gourinchas (2016) demonstrate that in models that allow for both bond and equity trading, real exchange rate risk is predominantly hedged via the bond and not the equity international positions. Engel and Matsumoto (2009) laments the lack of stylized facts on the currency composition of international portfolios to guide theory.[3]

Finally, our 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). The model of Varela and Salomao (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.

We proceed as follows. Section 1 introduces the data and benchmarks it to existing public datasets. In Section 2, we demonstrate the strength of investors' home currency bias and show that it accounts for home country bias in our data. Section 3 considers the repercussions of this bias for the allocation of capital across borrowers, some of which do not issue in foreign

[2] An earlier literature studied international mutual fund data, but typically concentrated on equity flows or included only a small subset of countries. Important contributions in this literature include Chan, Covrig and Ng (2005), Hau and Rey (2004, 2008*a*,*b*), Forbes et al. (2011), Jotikasthira, Lundblad and Ramadorai (2012), Raddatz and Schmukler (2012), and Didier, Rigobon and Schmukler (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.

[3] Other recent models of international portfolio choice include Corsetti, Dedola and Leduc (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, Mertens and Zhang (2015), and Gabaix and Maggiori (2015).

currency and therefore do not borrow from foreigners. We organize and rationalize our findings in a theoretical framework and offer empirical evidence corroborating our key assumptions. International currencies represent exceptions to these patterns. Section 4 documents that both the dollar and euro were to some extent international currencies in 2005, but a striking shift out of the euro has left the dollar today's unique international currency. Section 5 concludes.

1 Mutual Fund Investment Data

We assemble a novel monthly security-level dataset of worldwide mutual fund holdings. In this section we offer an overview of our data, discuss some filtering and assumptions used in organizing our data, and compare summary statistics with those from publicly available sources. The Online Appendix elaborates on our sources and methodology and offers additional comparisons to other public datasets.

1.1 Security-Level Mutual Fund Dataset

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. The funds report all positions including stocks, bonds, cash, and alternative investments.[4] The reporting is commonly done at the monthly frequency and, when not, is nearly always done at the quarterly frequency. Most 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.[5] 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 of the world.

Mutual 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. These reviews are

[4] In 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.

[5] Even for positions that lack a CUSIP, Morningstar itself generally provides related information including the country of the issuer and currency of denomination. Furthermore, we performed a fuzzy merge to recover the CUSIP for individual records that could be matched to other records within our data that included a CUSIP. See Online Appendix for full details.

widely used by investment advisors and individual investors in choosing which mutual funds to invest in. Morningstar requires significant disclosure from the mutual funds it covers so that it can generate comprehensive performance analyses and provide its clients with assessments of each fund's strategies and risk exposures. 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".[6] However, Morningstar has in place a series of checks to ensure the quality of the reporting (and, therefore, of their analysis). When mutual funds are legally required to disclose their positions publicly, Morningstar compares those holdings with positions reported to them to verify their similarity. Furthermore, Morningstar routinely checks for consistency between the publicly available realized returns (daily frequency) of each fund and its portfolio positions data. Finally, Morningstar's clients, who as investors or investment managers are often aware of the exact positions held by funds that they own, on rare occasions expose reporting errors, and Morningstar has an internal processes to improve data based on such feedback. A fund manager making systematic reporting errors to Morningstar would likely be discovered and run the risk of having Morningstar discontinue its research coverage of that fund or assign it a low rating. We have performed a number of independent checks of the Morningstar data against regulatory filings, voluntarily disclosed data by specific funds, and data provided by other third party data vendors. As reported in the Online Appendix, in all cases we have confirmed the reliability of the data.

Our data include information on the domicile of each mutual fund, but we do not have information on the residency of the investors in each fund. In general, tax optimization and regulatory restrictions make it unlikely that investors buy foreign mutual funds. 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. For example, we assume that all US domiciled funds invest on behalf of US residents.

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 largest mutual fund centers and our assumption attributing their AUM to local residents breaks down in their cases. Given our focus on currency, we pool all data for countries within the European Monetary Union (EMU), including Luxembourg and Ireland, and treat the EMU itself as a single consolidated country in

[6] In some cases, fund managers might request that Morningstar redact sensitive information on some of its specific holdings, generally for 90 days. In such cases, once the requested time lag has elapsed, Morningstar backfills its databases with that information. All but the most recent months of our data, therefore, are unaffected by this issue.

all our analyses. Section **??** discusses in detail the assumptions that we make on the residency of investors in mutual funds and provides evidence to support these assumptions.

One benefit of working with security-level data is that we can trace issuers to their parents, which allows us to associate security issuance with the industry and country that faces the economic liability and deploys the borrowed capital, even if the funds are raised on the parent company's behalf by a related offshore entity. To do this, we assign each individual security to the ultimate parent company using four external datasets: the 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 dataset. The first three datasets are used to assign each security to a unique firm. The fourth dataset is used to unwind multiple layers (up to 10) of ownerships within and across countries of these legal entities to find the ultimate parent company.

A key benefit of studying cross-border investment positions using mutual fund data is that we observe very detailed characteristics of each security, including the unique security identifier called the 9-digit CUSIP. This allows us to match securities to the company that issues them, which is generally captured by the first 6-digits of the CUSIP. Further, we use several publicly available databases to match multiple 6-digit CUSIPs to a common ultimate parent. For example, Petrobras is a Brazilian energy firm that issues some debt securities through subsidiaries in the Cayman Islands, some of which have different 6-digit CUSIPs and are themselves classified as firms in the finance sector. Whereas naive aggregate statistics would likely classify their borrowing as done by Cayman Island banks, our matching procedure would attribute the borrowing to Brazil's energy sector, which for our purposes is a more economically meaningful mapping.

Online Appendix A.1 provides details about the data cleaning and cross-checking procedures that we employed as well as robustness checks. The ultimate result is the ability to perform our study at either the residency level (i.e. the country where the security is issued) or the ultimate parent nationality level for each security. This level of analysis is at the forefront of national statistics practice: traditionally, national statistics (and most of the publicly available data) are based on the residency principle, but recently most agencies attempt to provide statistics based on the nationality principle.

1.2 Representativeness of the Data and of Mutual Fund Investment

In this subsection, we describe our coverage relative to the overall mutual fund industry. We describe the share of mutual funds in US cross-border portfolio investment and in total gross foreign assets, a category that additionally includes bank lending and direct investment. Finally, we compare portfolio shares by country and currency in our mutual fund data with the

equivalent in US TIC data.

Our data account for a substantial fraction of all worldwide open-end mutual fund assets under management (AUM). They exclude closed-end funds and exchange traded funds (ETFs). 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.[7] 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 national ICI data. From very low levels of AUM in the 1980s, the industry grew at a rapid pace in the 1990s. Assets under management moderately 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 equity, 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.[8]

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 Eurozone and the UK closely track the equivalent aggregates provided by ICI over time.[9]

Having concluded that our data provide good coverage of the overall mutual fund industry, we now assess how large a share of foreign investment is attributable to mutual funds as opposed to investments such as bank lending and direct investment. We focus on the US foreign investment since US data are by far the most detailed and high-quality publicly-available

[7]These 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.

[8]Fund 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.

[9]The 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, Servaes and Tufano (2005).

sources to benchmark the external validity of our data. Figure 3 shows the external assets of the US for the years 2005, 2010, and 2015. Portfolio security investment, represented by the red rectangles (shaded plus unshaded) atop each bar, accounts on average for about 40 percent of total external investment. This share has been growing over time across most countries (Shin (2014), Lane and Milesi-Ferretti (2017)), thus making the study of global security portfolios an increasingly pressing policy and academic concern.

We estimate the share of portfolio investment attributable to mutual funds by first computing the share of US-domiciled mutual fund assets that are invested abroad in our data and then multiplying that share by the US mutual fund industry total AUM reported by ICI. We conclude that mutual funds account for 35 percent of US outward portfolio-securities investment; a fraction that we illustrate in Figure 3 with the shaded red regions. Our calculations are consistent with recently released TIC data showing that 64 percent of US outward investment in 2015 was undertaken by institutions classified as "Other financial corporations - Of which: Other", a category the bulk of which is accounted for by mutual funds but that also includes hedge funds and other investment vehicles. The remaining 36 percent owes to holdings by insurance and pension funds (20 percent), non-financial corporations (12 percent), and banks (4 percent).

As shown above, our data account directly for a sizable share of cross-border portfolio security investment. We further show that our data are in some important dimensions also representative of non-mutual fund portfolio investment. For example, Figures 4(a) and 4(b) compare the portfolio shares of foreign countries in US outward investment in equities and fixed income in our data and in TIC data on foreign long-term securities held by financial organizations other than depository institutions. We plot data from 2005, 2010, and 2013 and combine the relevant countries into a single EMU aggregate for comparability with the rest of our analysis. In Figure 4(a), which plots the US portfolio in foreign equities, nearly all countries lie closely along the solid 45 degree line across all three years, indicating that our mutual fund data is highly representative of the entire US foreign equity portfolio. The similarity in each country-destination share in the two data sets suggests that US insurers and pension funds invest similar shares of their equity portfolios across foreign countries as do US mutual funds.[10]

Figures 4(c) and 4(d) (and Online Appendix Figure A.2) plot inward investment to the US in equities and fixed income from each foreign country as a percentage of total inward investment from the rest of the world. Countries in the EMU constitute a much larger source of inward investment to the US in our mutual fund data than in the TIC data, while China and the Cayman Islands constitute a larger source in the TIC data. A part of these large discrepancies are to be

[10]Among the few data points that lie away from the line are Bermuda (BMU) and the Cayman Islands (CYM), major tax havens for the United States.

expected. For example, Chinese holdings of US treasuries are as large as $6 trillion, but almost none of these holdings are accounted for by China-domiciled mutual funds; rather, the official sector in China holds these securities. Similarly, Cayman Island holdings in the US largely come from opaque investment vehicles (often reputed to be actually held by US residents) and not from open-end mutual funds.

For US outward investment in foreign fixed income, we can further decompose the TIC holdings into four categories capturing whether the bonds are denominated in US dollars or local currency (LCU) and whether the bonds are issued by sovereigns or corporates. Figure 5 plots the corresponding portfolio shares. Within all four categories there is a very strong positive correlation between the portfolio shares in the TIC and in our mutual fund data.

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 US TIC data suggests 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 are representative even when focusing on tighter subsets that distinguish between government and corporate debt, and dollar or local currency denominated debt.

1.3 Final Sample Selection

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-years for which Morningstar's coverage of fixed-income funds is less than one-quarter of (or, more rarely, twice as large as) the scale of those reported by ICI. Table 1 shows the domicile countries that we retain after applying this filter along with the dates for which they enter in our sample, and their total AUM in our data.

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 therefore 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 AUM, we observe about $1 trillion or more in AUM for each of the the UK, China, Brazil, and Canada.[11]

[11]The 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.

2 Investor Home Currency Bias

In this section we demonstrate the strength of investor home currency bias and show the closely related implication that only firms that issue in foreign currency borrow substantial funds from foreigners. Further, we highlight that the US dollar represents an exception to these parterns and offer a framework that can organize and rationalize these findings. 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:

$$Q^t_{i,j,k},$$

where the index k denotes the security type. The index k can take the values B (all bonds), BC (corporate bonds), BS (sovereign bonds), and E (equities). We add a subscript to k to clarify the security's currency. For example, $k = BS_{\text{EUR}}$ denotes euro-denominated sovereign bonds, $k = BC_i$ 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 $k = B_{-\text{USD}}$ 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 Japanese funds in 2010 are denoted by $Q^{2010}_{\Omega,JPN,B}$, UK funds' foreign equity positions in 2015 are denoted by $Q^{2015}_{-GBR,GBR,E}$, and US funds' positions in Mexico in 2005 are denoted by $Q^{2005}_{MEX,USA,\Omega}$.

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:

$$q^{2010}_{USA/\Omega,EMU,B} = \frac{Q^{2010}_{USA,EMU,B}}{Q^{2010}_{\Omega,EMU,B}} = \frac{Q^{2010}_{USA,EMU,B}}{\sum_i Q^{2010}_{i,EMU,B}},$$

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

$$q^{2005}_{EMU,EMU,BS_{USD}/BS} = \frac{Q^{2005}_{EMU,EMU,BS_{USD}}}{Q^{2005}_{EMU,EMU,BS}}.$$

A number of our analyses require additional subscripts to denote the borrowing firm p (for parent, identified with the CUSIP 6-digit code) within an (i,j,k) bundle or to denote a specific security c (for CUSIP 9-digit code) within an (i,j,k,p) bundle. Further, we sometimes add subscripts p to i to capture the country of the borrowing firm and add subscripts c to k to capture the currency of the security. For example, consider $p =$ General Electric (GE), which is

a US firm, so $i_{GE} = USA$ in this case. We would use $q^t_{i_{GE},EMU,BC,GE/\Omega,\Omega}$ to denote GE's share of the EMU portfolio of US corporate bonds, or we would use $q^t_{i_{GE},EMU,BC,GE/\Omega,c/\Omega}$ to capture the share of a particular GE bond c in that same portfolio.

2.1 Country Level Results

We find that domestic investment almost always occurs using the domestic currency. For example, when Canadian investors lend to Canadian borrowers, the transaction is almost always denominated in Canadian dollars. However, foreigners invest differently. When Australians lend to Canadian borrowers, the transaction very rarely is denominated in Canadian dollars and is often denominated in Australian dollars. Using the notation introduced above, these facts can be described as :

$$q_{i,-i,B_i/B} << q_{i,i,B_i/B} \quad \text{and} \quad q_{i,j,B_j/B} >> q_{i,i,B_j/B}.$$

Figure 6(a) plots these statistics for the corporate bond portfolios of all investing countries in our data as of December 2015. The shaded red bars on the left plot for each the share of all lending by that country's nationals 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 corporations.

More surprisingly, however, is our finding that foreigners invest differently. The hollow blue bars on the right of Figure 6(a) show the share of foreign investment in i's corporate bonds that is in i's currency, $q_{i,-i,BC_i/BC}$.[12] For example, the third blue hollow bar shows that less 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 6(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.

Willingness of foreigners to hold US dollar denominated securities does not explain these

[12]The 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 hollow blue bars into the portfolios from individual investor countries and verified that these patterns hold robustly across bilateral pairs.

patterns for non-US borrowers. To see this, Figure 6(b) simply replicates the calculations after dropping all US dollar denominated positions. 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.[13] This basic patterns holds but is more muted for Sovereign bonds, as shown in Figure 7(a), but remains strongly evident when we pool all debt securities, as in Figure 7(b). A large literature on "Original Sin" such as Eichengreen and Hausmann (1999) and Eichengreen and Hausmann (2005) has emphasized the similar fact that emerging market borrowers issue to 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 are largely unable to place local currency debt into foreign portfolios.

2.2 Security Level Results

The above results suggest investors exhibit "home currency bias" in that they disproportionally hold securities denominated in their home currency. To demonstrate that currency is the critical factor driving this patterns 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, and legal jurisdiction 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 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, say, are much more likely to hold BP's long-term zero-coupon Canadian dollar debt than BP's long-term zero-coupon British pound debt, this would overwhelmingly support the conclusion that currency is the salient factor driving that outcome.

Recall that $q_{i_p,j/\Omega,\mathrm{BC}_{\mathrm{CAD}},p,c}$ denotes the share of the total worldwide market capitalization of a corporate bond c, issued by parent firm p from country i_p, which is held by investors from country j. For example, Canada's share of the total outstanding value of the above-described

[13] In the Online Appendix, we split the sample into bonds issued by financial and non-financial corporations and confirm that the pattern holds in both subsamples.

Canadian-dollar BP security would be $q_{\text{USA,CAN}/\Omega,\text{BC}_{\text{CAD}},\text{BP},c}$, where the currency of c is CAD.

We pool all 9-digit CUSIPs for corporate bonds in our data and estimate the following regression for each investing country j:

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

where here and below we omit the third subscript k since all regressions in this section are run only on our data on corporate bond positions.[14] Our estimates are run using data for 2015, are weighted by the outstanding value of each security, and control for maturity and coupon payment.[15]

Table 2 reports our estimates of equation (1) for a subset of our countries. Differences across countries in the constant term $\gamma_{j,p}$ reflects differences in each investor country's share of global holdings of bonds in currencies other than their own. For example, the value of the constant in Canada's regression (the first column) equals 0.010, which is about 14 times smaller than the value in the US's regression (the last column) of 0.139. This means that the US tends to hold 14 times the value that Canada holds when considering bonds denominated in currencies other than the Canadian and US dollars, which is natural given the US's larger size.

The indicator variable $\mathbf{1}_{\{\text{Currency}_c=\text{Currency}_j\}}$ equals one when security c is denominated in the currency of country j. The critical coefficient of interest, therefore, is the estimate of β_j, which reports the extent to which country disproportionately hold securities denominated in their home currency. Conceptually, it captures the same notion of home currency bias as analyzed above at the country level, but reports the bias that persists after accounting for other differences in portfolio holdings. 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 91 percentage points larger than what they hold of securities not denominated in Canadian dollars. This implies that Canadian investors holds the vast majority of Canadian dollar securities that are issued around the world. A similar effect holds for all other countries. Even among bonds issued by the same issuer, investors disproportionately hold those bonds that are denominated in their home currency.

[14] 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.

[15] We 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.

The Online Appendix demonstrates the robustness of this conclusion. We reports results from estimates that include all bonds, including borrowing by sovereigns, local governments and municipalities, sovranationals such as the World Bank, and various structured fixed income products. We run regressions that include only firms that issue multiple currencies so the coefficients on all the controls are estimated from the same set of firms as our key currency bias variable. We separately consider regressions including only securities from financial firms, non-financial firms, foreign financial firms, and foreign non-financial firms. Finally, we include separate indicator variables for the security's residence (i.e. the legal jurisdiction under which it is issued) as well as its currency. By comparing dollar and non-dollar bonds issued under New York Law, say, or euro denominated bonds issued in London and Frankfurt, we can again insure that our results are driven by currency and not an omitted but correlated factor. The coefficient on home currency bias remains economically large, stable, and precisely estimated across all these alternative specifications.

2.3 Home Currency Bias or Home Country 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.[16] Home country bias is to date the singularly effective force for empirically characterizing global portfolios.

Our results thus far, however, offer the tantalizing 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, Warnock and Warnock (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 (1) because it included a issuer fixed effect. Since any given issuer is associated with a single country, the fixed effect would absorb any borrower country preference. We therefore drop the borrower fixed effect, add a

[16] See, also, Fidora, Fratzscher and Thimann (2007), De Moor and Vanpée (2013*b*), and De Moor and Vanpée (2013*a*)

home country indicator, and run three otherwise equivalent regressions:

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

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

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

Specification (2) is a univariate regression that identifies the extent to which a country is overweight securities issued by firms in that same country. Panel A of Table 3 reports the estimates of the country dummy $\gamma_{j,0}$ in this regression. Consistent with the large literature on home bias, all these coefficients are positive and range from about 20 percent to 50 percent depending on the country, thus confirming that countries are overweight securities that are domestic. Standard errors are not shown, but all reported coefficients are statistically significant at the one percent level. The controls contribute minimal explanatory power, so 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.

But, as we've emphasized, traditional analyses of this style have ignored currency. We therefore report in Panel B of Table 3 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^2s both approximately twice what they were in Panel A. This univariate regression at the country level re-affirms our result in Table 2 which exploited instead within-firm variation: the sole information of the currency of denomination of an asset has a surprisingly high predictive power for the nationality of the holder of that asset.

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), where we include both indicators. The coefficient on currency of denomination ($\beta_{j,1}$) is little changed from the corresponding univariate regression ($\beta_{j,0}$) and the R^2 shows only modest increases over the univariate regression with currency information (equation (3)). By contrast, the coefficient on country of issuance ($\gamma_{j,1}$) is dramatically reduced from the corresponding univariate regression ($\gamma_{j,0}$). Once we account for a security's currency of denomination, there is little additional scope for the security issuer's country to inform which countries hold larger shares of that security. 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.[17]

[17]The bottom row of each panel reports the R^2 from a corresponding regression that pools the data and includes

3 Currency Bias: The Borrower's Perspective

Having documented the importance of currency in determining investors' portfolios, we now turn to characterizing the implications from the perspective of borrowing firms. We start by demonstrating that a small number of foreign currency borrowers are typically the only firms that can borrow money from foreigners. Most firms borrow only in local currency and their securities represent tiny shares of foreign portfolios even though they represent sizable portions of domestic portfolios. We then show that, consistent with the country level results shown in Figure 6(a), the United States is an exception to this rule. Global demand for the US dollar is such that in 2015, it is the only "International Currency" and so even US local currency borrowers are able to place their debt into foreign and domestic portfolios with comparable ease. We conclude this section by rationalizing these findings in a framework featuring downward sloping demand curves for each firm's bonds in each currency together with a fixed cost of foreign currency issuance.

3.1 Only Foreign Currency Issuers Borrow from Foreigners

In most countries, only firms that issue in foreign currency are able to place their debt in foreign portfolios. Start by considering Figure 8(a), which plots for each Canadian firm with debt in our data in 2015 the share that is denominated in foreign currency, i.e. currencies other than the Canadian dollar, against the share of their debt that is held in foreign portfolios along the y-axis. The size of each firm's bubble captures the scale of its total borrowing, and each datapoint aggregates across all debt securities issued by each firm, including those issued by subsidiaries or other associated issuers. We emphasize two features of this plot. First, a large mass of small firms are at the origin or slightly above it. These are small Canadian firms that borrow only in Canadian dollars and only from Canadian investors. Second, moving to the right, 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 bubbles clustered along the 45 degree line.[18] These patterns hold comparably well in the European Monetary Union as well as in Great Britain, as shown in Figures 8(b) and 8(c).

country fixed-effects and country fixed-effects interacted with the country and/or currency dummies in the three specifications. These panel regressions allow us to infer the total global variation explained by currency. The R^2 of the pooled regression rises from 0.632 in Panel A to 0.827 in Panel B, and then barely increases to 0.839 in Panel C, corroborating our earlier conclusion from the country-by-country cases. Given knowledge of the currency in which a bond is issued, additional knowledge of the country that issues the security provides almost no additional explanatory power.

[18] We also note the set of small firms that borrow entirely in foreign currency and entirely from foreigners, but will generally ignore that relatively small set of firms below.

The relationship between the importance of foreign currency and foreign lenders is different for firms in the United States, as shown in Figure 8(d). Whereas foreign currency lenders do tend to borrow more from foreigners, there's a significant mass of medium sized firms that issue only in US dollars and yet which borrow substantially from abroad. It is this feature of the US dollar which causes us to characterize it as an international currency, a notion we will formalize in the next section. The global taste for holding dollar debt securities effectively opens up the capital account to local currency borrowers in the US, whereas local currency borrowers in other countries are relegated to borrowing exclusively from domestic investors.

Figure 8 suggests that to borrow from foreigners, firms outside of the US must issue in foreign currency. So why doesn't everyone issue in multiple currencies? Figure 9 demonstrates a strong size-dependence in who issues in multiple currencies, a finding indicative that issuing in multiple currencies requires payment of a fixed cost. Figure 9(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 used by that firm in its borrowing. 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 firm size increases, we increasingly see firms issue in multiple currencies. The largest Canadian borrower in our data, Toronto Dominion bank, in fact issues bonds denominated in 7 different currencies. Figures 9(b), 9(c), and 9(d) confirm that this pattern is not specific to Canada. In Europe, Britain, and the US, the more firms borrow the more likely they are to borrow in foreign currency. Together with Figure 8, 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.

3.2 A Simple Framework to Interpret These Findings

The previous section demonstrated that to borrow from abroad, firms need to issue in foreign currency, something only the largest firms appear to do. Motivated by these findings, we now sketch an environment where firms face downward sloping demand for their bonds in each currency. This demand structure implies firms would like to borrow in multiple currencies to lower their total average borrowing costs, but we assume a fixed cost is required to do so. As a result, only the largest firms borrow in foreign currencies, a size-dependent selection in the spirit of Melitz (2003), but for selection into foreign currency borrowing rather than for exporting. Finally, heterogeneity across currencies in the sensitivity of demand implies that each country's local currency issuers are differentially able to access foreign capital.

We consider an environment with countries $i \in \{EMU, USA\}$ each with (invested) wealth W_i, and where all magnitudes are reported, without loss of generality, in US dollars. Bonds

are the only traded securities and bond holdings depend only on the currency of denomination. There is no uncertainty. Each country's wealth is populated by "specialist" investors that are fully segmented by currency. As in De Long et al. (1990), Gromb and Vayanos (2002), Jeanne and Rose (2002) and Gabaix and Maggiori (2015), we specify a linear demand schedule for debt of a firm in each currency:

$$R_{p,k} = R_f + \Gamma_k \frac{Q_{p,k}}{E_p}, \tag{5}$$

where $Q_{p,k}$ is the value of currency-k debt issued by firm p and E_p is their starting capital or equity. We assume the slope of the demand curves is inversely proportional to the wealth investing in that currency:

$$\Gamma_k = \frac{\gamma}{\sum_j \theta_{k,j} W_j}, \tag{6}$$

where $\theta_{i,j}$ is country j's holdings of bonds in country i's currency. This assumption is meant to capture the idea that the global market for some currencies is deeper than others, leading to less sensitivity of borrowing costs to leverage. Here, we consider the case with currencies $k \in \{EUR, USD\}$.

Firms differ in terms of their starting capital E_p and their productivity A_p and borrow to finance production. 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 9. 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 then solves the problem:

$$\max_{Q_{i_p,\Omega,USD,p},\, Q_{i_p,\Omega,EUR,p}} A_p K_p - R_p^{USD}\, Q_{i_p,\Omega,USD,p} - R_p^{EUR}\, Q_{i_p,\Omega,EUR,p} - c\, \mathbf{1}_{\{Q_{i_p,\Omega,FC_p,p}>0\}}, \tag{7}$$

where

$$K_p = E_p + Q_{i_p,\Omega,USD,p} + Q_{i_p,\Omega,EUR,p}, \tag{8}$$

and where $\mathbf{1}_{\{Q_{i_p,\Omega,FC_p,p}>0\}}$ is an indicator for issuance in foreign currency. It is important to note here how different this is from a standard capital structure problem. Because we have assumed that firms are hedging their currency exposure and there is no risk, without the assumption of demand curves segmented by currency, firms would be indifferent between the two bonds. However, because in this environment the currency-specific interest rate is an increasing function of the amount borrowed in that currency, firms continue to face a meaningful portfolio choice problem in the absence of risk.

It is convenient to analyze the problem by braking it down in 2 different optimization prob-

lems. First, it is easy to demonstrate that firms in the US and EMU that only borrow in their respective local currencies choose optimal borrowing according to:

$$\frac{Q_{USA,\Omega,\$,p_{LC}}}{E_p} = \frac{A_p - R_f}{2\Gamma_{USD}} \tag{9}$$

$$\frac{Q_{EMU,\Omega,\in,p_{LC}}}{E_p} = \frac{A_p - R_f}{2\Gamma_{EUR}} \tag{10}$$

Second, we can show that irrespective of their nationality, firms that borrow in both currencies choose an optimal size of total debt issuance of:

$$\frac{Q_{i_p,\Omega,\Omega,p_{MC}}}{E_{p_{MC}}} = \frac{A_{p_{MC}} - R_f}{2\Gamma_w}, \tag{11}$$

where $\Gamma_w = \dfrac{\Gamma_{USD}\Gamma_{EUR}}{(\Gamma_{USD}+\Gamma_{EUR})}$. The fraction of this total debt that is dollar denominated is given by:

$$x = \frac{\Gamma_{EUR}}{(\Gamma_{USD}+\Gamma_{EUR})}. \tag{12}$$

This ratio is intuitive, as the dollar share is the ratio of the elasticity of EUR demand schedule to the sum of the EUR and USD elasticities. The more wealth that invests solely in USD the lower is Γ_{USD}, and so the higher share issuance in USD. The solution to this portfolio problem guarantees that multi-currency issuing firms will equalize their marginal cost of borrowing across currencies. We will use the notation p_{MC} to denote those firms that issue in both currencies.

Finally, we turn to the decision by each firm of whether to issue only in LC or to pay the fixed cost and issue in both currencies. Each firm compares the highest profits that it can achieve with or without foreign currency issuance. Profits per unit of starting capital under local currency issuance are:

$$\pi_{USA,p_{LC}} = A_{p_{LC}} + \frac{(A_{p_{LC}} - R_f)^2}{4\Gamma_{USD}}, \tag{13}$$

$$\pi_{EMU,p_{LC}} = A_{p_{LC}} + \frac{(A_{p_{LC}} - R_f)^2}{4\Gamma_{EUR}}. \tag{14}$$

Profits for multi-currency issuers, irrespective of nationality are:

$$\pi_{i,p_{MC}} = A_{p_{MC}} + \frac{(A_{p_{MC}} - R_f)^2}{4\Gamma_w} - \frac{C}{E_p}. \tag{15}$$

The first term on the RHS of each of the above expression are the profits of an all internally

financed firm (i.e. invest just E_p, no debt). The second term are the extra profits that the firm generates by issuing debt. We define $\hat{A}_p = A_p - R_f$. A firm in each country issues in multiple currencies if and only if:

$$\pi_{i,p_{MC}} \geq \pi_{USA,p_{LC}} \tag{16}$$

$$\pi_{i,p_{MC}} \geq \pi_{EMU,p_{LC}}. \tag{17}$$

A firm is more likely to issue in MC, then bigger the firm is, the more productive the firm is, and the bigger the difference between the interest rate elasticity in their country and the world market. We can describe the combination of firm size E_p and productivity A_p that makes a firm indifferent between LC and MC issuance. We denote these threshold values by $A_{i,T}$ and solve for them as functions of E_p:

$$\hat{A}_{EMU,T}(E_p) = \left(\frac{C}{E_p}\frac{4\Gamma_w\Gamma_{EUR}}{\Gamma_{EUR}-\Gamma_w}\right)^{\frac{1}{2}}, \tag{18}$$

$$\hat{A}_{USA,T}(E_p) = \left(\frac{C}{E_p}\frac{4\Gamma_w\Gamma_{USD}}{\Gamma_{USD}-\Gamma_w}\right)^{\frac{1}{2}}. \tag{19}$$

Firms in each country issue in local currency if and only if their characteristics, size E_p and productivity $\hat{A}_p$, are in the set LC defined as:

$$LC_{EMU} = \left\{\hat{A}_p, E_p : \quad \hat{A}_p < \hat{A}_{EMU,T}(E_p)\right\}, \tag{20}$$

$$LC_{USA} = \left\{\hat{A}_p, E_p : \quad \hat{A}_p < \hat{A}_{USA,T}(E_p)\right\}. \tag{21}$$

Finally, define the international currency as that used most in denominating bonds (i.e. the currency with the flattest demand and the deepest market). This currency will have the lowest Γ_k. Clearly, there is a benefit of being the international currency issuer because local currency firms in that country will have their funding costs reduced (relative to having a higher Γ_k) because they borrow more from foreigners.

In sum, this framework implies that only the largest firms in each country will issue foreign currency bonds and borrow from abroad. Further, local currency issuers in the countries whose currencies have the deepest market and flattest demand curves, what we call international currencies, will differ from local currency issuers in other countries in three ways. First, local currency only issuers in international currency issuers attract more foreign financing than in other countries. Second, they constitute a larger share of total borrowing. And third, they are bigger and more levered – relative to multiple currency issuers – than in other countries. Below, we demonstrate that these patterns all characterize US local currency issuers relative to

other countries' local currency issuers, as the dollar is the world's sole international currency as of 2015. Crucially, these effects of being an international currency on capital allocation are generated in this framework without appealing differences in currency-specific risk-free rates or the stochastic properties of exchange rates. Instead, the capital allocation effects are all generated by the market structure and fixed costs, clarifying the extent to which the benefits of being an international currency generated by this framework are distinct from the mechanisms highlighted elsewhere in the literature.

3.3 International Currencies and Foreign Borrowing by LC Firms

We start by demonstrating that in countries other than the US, local currency issuers rarely place their bonds into foreign portfolios. To see this, start with the left panel of Figure 10. Parent firms are ordered along the x-axis based on their share of the domestic, as opposed to overall, portfolio. The solid red dots list each firm's share in the domestic portfolio of investments in Canadian debt, $q_{CAN,CAN,BC,c/\Omega}$, and therefore, by construction, the red dots decline when moving from left to right in the plot. The hollow blue diamonds plot each firm's share in the foreign portfolio of investments in Canadian debt, $q_{CAN,\text{-}CAN,BC,c/\Omega}$. The sum of the sold red dots and the sum of the blue hollow diamonds, therefore, each equals one. Looking across the the plots, 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.

The right panel of Figure 10 plots these values for a subset of these issuers, namely those 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 right plot. 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 foreign portfolios.

Figure 11 replicates this comparison of the shares in domestic and foreign portfolios of the debt issued by LC-only firms. 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 data into foreign portfolios and therefore borrow almost exclusively from local lenders. The one exception is the US, shown in Figure 11(d), where the solid red lines roughly split through the hollow blue diamonds, indicating that LC-only firms in the US are about equally as likely to represent given share of domestic or foreign portfolios. US LC-only firms, unlike the others, borrow from foreigners.

One might worry that these patterns, at least for the non-US countries, reflect differences

in the LC-only issuers that are distinct from, though correlated to, currency. Perhaps LC-only issuers are in industries for which foreign investors would naturally lack interest. To demonstrate this isn't the case, we repeat our exercise but with equities. Figure 12 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.

Returning to the debt contracts, we can separately sum all the solid red dots and hollow blue diamonds in the plots in Figure 11 and report for each country the aggregate shares of LC-only issuers in domestic and foreign portfolios. We do this in Figure 13(b), where the red bars report the sum of the red dots and the blue bars report the sum of the blue diamonds. For nearly all countries, the red bars are dramatically taller than the blue ones. As predicted in the above framework, the United States, the world's only international currency issuer in 2015, stands out as the only country where the bars are of similar height. Relatedly, Figure 13(a) confirms the framework's second prediction, 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, for example, 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.

In sum, consistent with the framework developed in Section 3.2, 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 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.

4 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 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.[19]

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).[20]

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 and A.12 in the Online Appendix demonstrate that these patterns are pervasive across bilateral country pairs.

The dollar exchange rate has broadly strengthened relative to the euro since 2008, but this relative price movement can only directly explain a small portion of the relative trends in the

[19]The 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), Gopinath (2015).

[20]The 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). While this is a somewhat selected sample and certainly much smaller than the total 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.

previous charts.[21] We formally show the muted effect of nominal exchange rate changes by re-building our dataset with exchange rates fixed at their 2005 levels.

One might be concerned that these patterns merely reflect compositional changes in our data. For example, imagine Canada and Mexico enter late in the dataset and predominantly hold dollar bonds. This might 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:

$$q^t_{i,j,k_x/k} = \gamma^t_x + \alpha_{i,j} + \varepsilon^t_{i,j,x}. \tag{22}$$

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^t_{EUR} and γ^t_{USD}, both normalized to zero in 2005, from specifications that focus on cross-border corporate bond positions valued at constant (2005 base) exchange rates . The rise of the dollar and fall of the euro in international portfolios appears as a robust global pattern.

Finally, one might wonder if the shift is directly driven by the banking sector alone. Figures 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. The shift away from euro-denominated bonds and into dollar-denominated bonds, however, is robust even after excluding financial institutions.

Table 4 summarizes all the above evidence and the robustness of the portfolio switch 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.

Given the pervasiveness of this shift, we view it as a broadbased change in global investors' taste for euro compared with dollar bonds. Through the lens of our framework, the euro offers euro borrowers less and less of the benefit of being an international currency. The US, and its

[21] Some 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.

many dollar-only issuers, benefits.

5 Conclusion

In this paper, we demonstrated that investor currency preferences are crucial for understanding global capital allocation. In particular, we showed that unless a country issues an international currency, its firms will receive very little capital from foreign investors unless it borrows in a foreign currency. If there are fixed costs of foreign currency issuance, then this means many firms will effectively be shut off from global capital markets. This highlights a new benefit of issuing the world's international currency because all firms, rather than only firms large enough to manage foreign currency issuance, can access international financing. We rationalize these patterns and explore the implications of investor currency preference in a simple model where firms face currency-specific demand curves.

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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

	CAN	**CHE**	**EMU**	**GBR**	**SWE**	**USA**
Currency	0.919***	0.661***	0.585***	0.538***	0.798***	0.626***
	(0.010)	(0.010)	(0.007)	(0.014)	(0.013)	(0.007)
Constant	0.010***	0.009***	0.225***	-0.009***	-0.001	0.139***
	(0.001)	(0.001)	(0.006)	(0.002)	(0.001)	(0.008)
Obs.	153,660	153,660	153,660	153,660	153,660	153,660
R^2	0.935	0.934	0.841	0.835	0.955	0.885
CUSIP6 FE	Yes	Yes	Yes	Yes	Yes	Yes
WLS	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 Country Bias or Home Currency Bias?

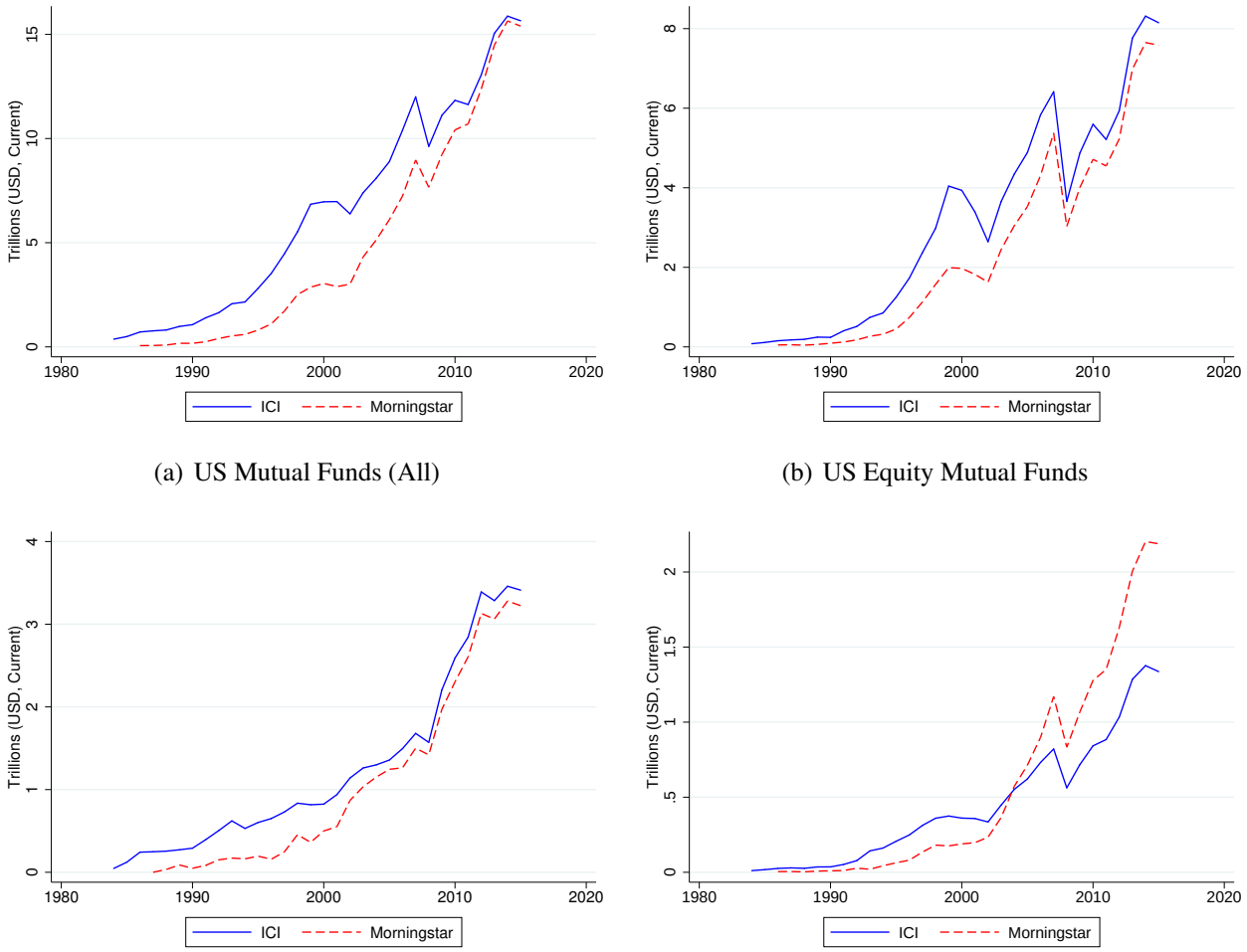
	Panel A: Only Country Indicators		**Panel B: Only Currency Indicators**		**Panel C: Country and Currency Indicators**		
	$\gamma_{j,0}$	R^2	$\beta_{j,0}$	R^2	$\gamma_{j,1}$	$\beta_{j,1}$	R^2
CAN	0.517	0.400	0.943	0.894	0.042	0.911	0.895
CHE	0.369	0.232	0.766	0.825	0.095	0.722	0.838
EMU	0.465	0.274	0.715	0.607	0.108	0.651	0.617
GBR	0.247	0.161	0.567	0.671	0.042	0.547	0.675
SWE	0.535	0.516	0.812	0.923	0.039	0.780	0.924
USA	0.554	0.457	0.757	0.719	0.204	0.620	0.757
Pooled		0.632		0.827			0.839

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: $q_{i_p,j/\Omega,BC,p,c}$. The last row in each panel reports the R^2 of a pooled regression with country fixed effects and country fixed effects interacted with the home country dummy (Panel A), home currency dummy (Panel B), and both home country and home currency dummies (Panel C). Standard errors not reported, all coefficients are significant at one percent level.

Table 4: 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.



(a) US Mutual Funds (All)

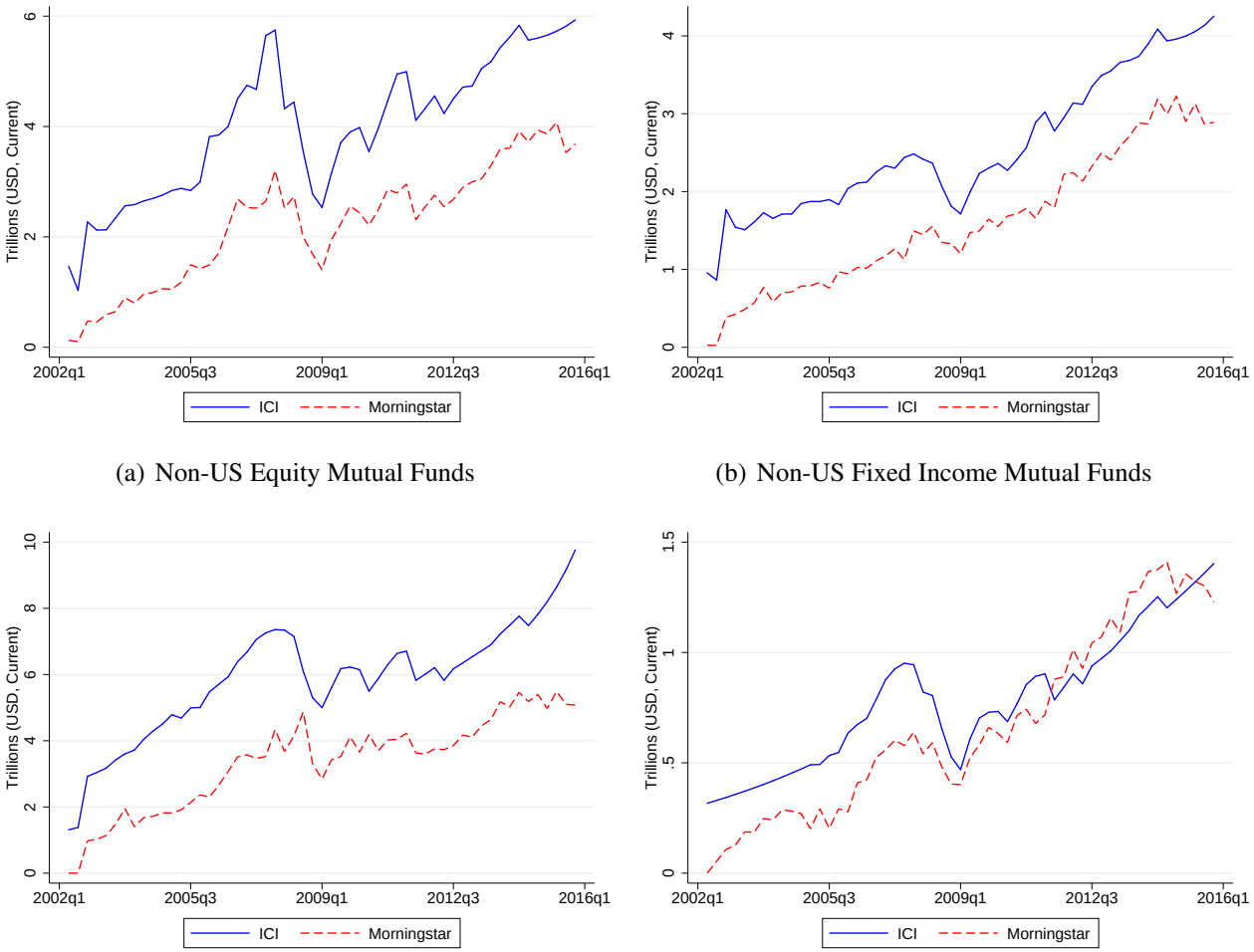
(b) US Equity Mutual Funds

(c) US Fixed-Income Mutual Funds

(d) US Allocation / Hybrid Mutual Funds

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.



(a) Non-US Equity Mutual Funds

(b) Non-US Fixed Income Mutual Funds

(c) EMU Mutual Funds (All)

(d) GBR Mutual Funds (All)

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).

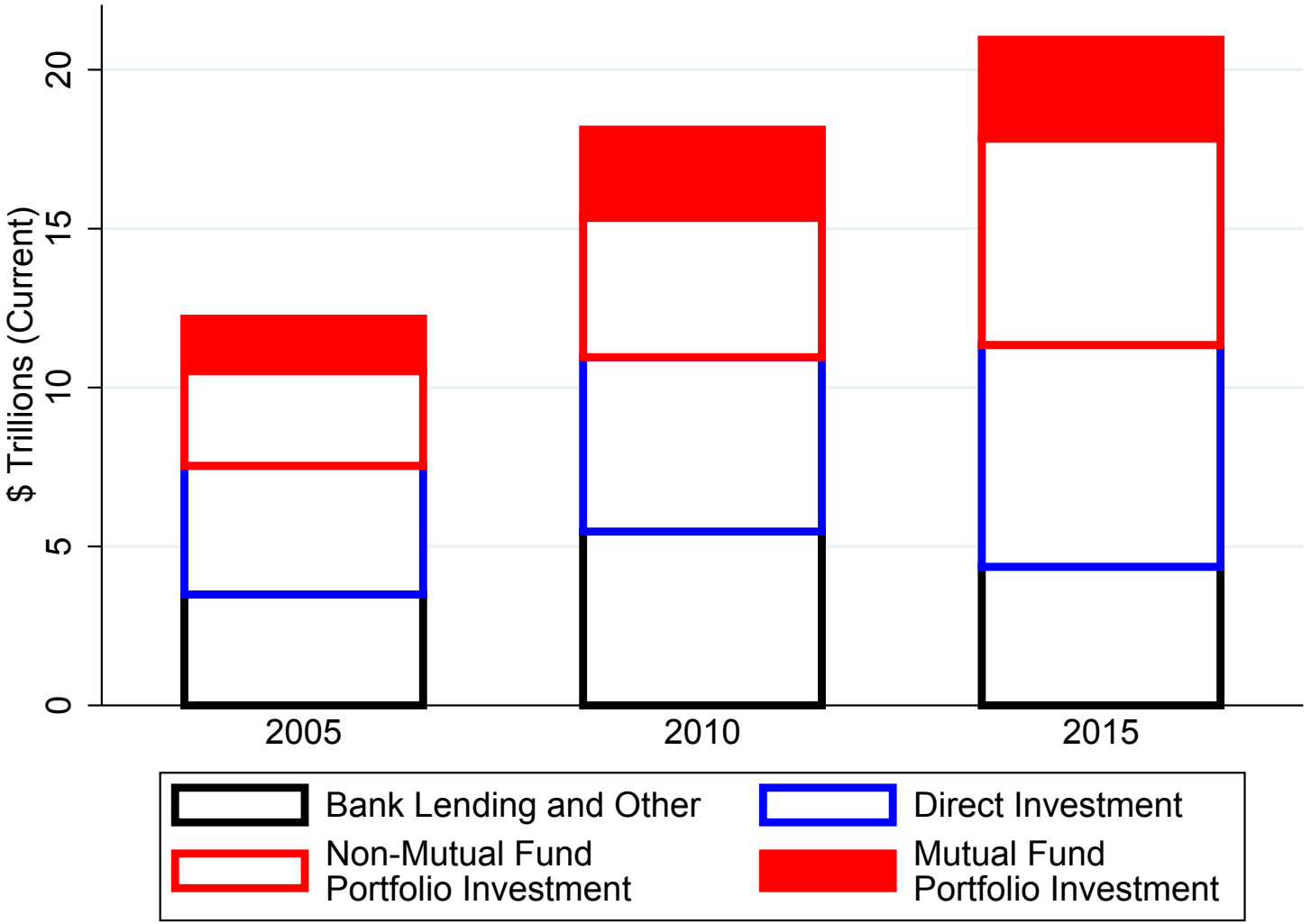
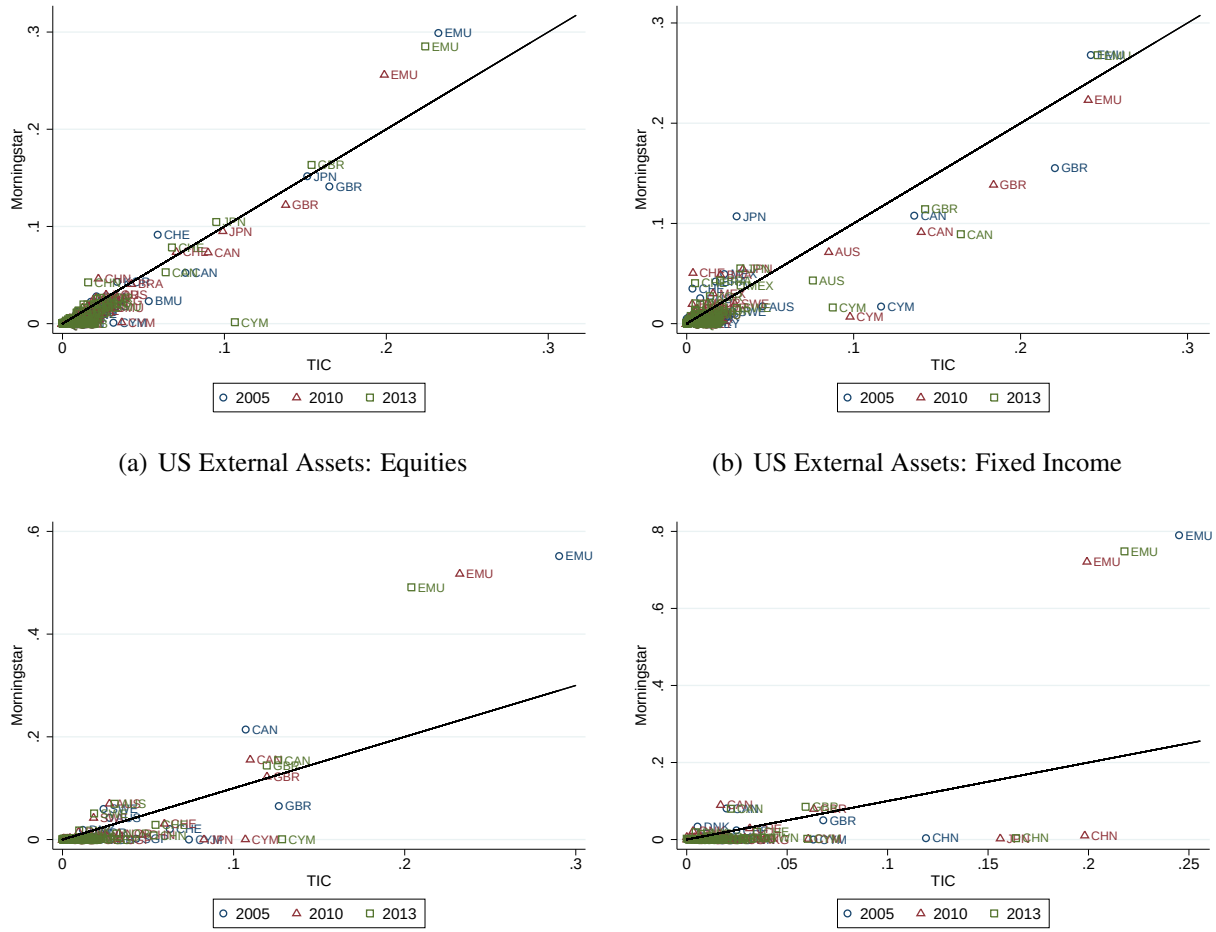


Figure 3: US External Assets by Type of International Investment Position

Note: The graphs plots the US foreign assets from the International Investment Position data (source: Bureau of Economic Analysis). The bottom (black) rectangle represents bank landing from the US to the rest of the world. The middle (blue) rectangle represents direct investment from the US to the rest of the world. The top (red) rectangle represents portfolio security investment from the US to the rest of the world. The solid (red) shaded area in the top rectangle represents the value of positions observable in our data. This value is obtained by summing up individual positions in our data for which the holding fund is domiciled in the US and the investment is in a security issued abroad; this value is then scaled by our coverage of mutual funds in the ICI database.



(a) US External Assets: Equities

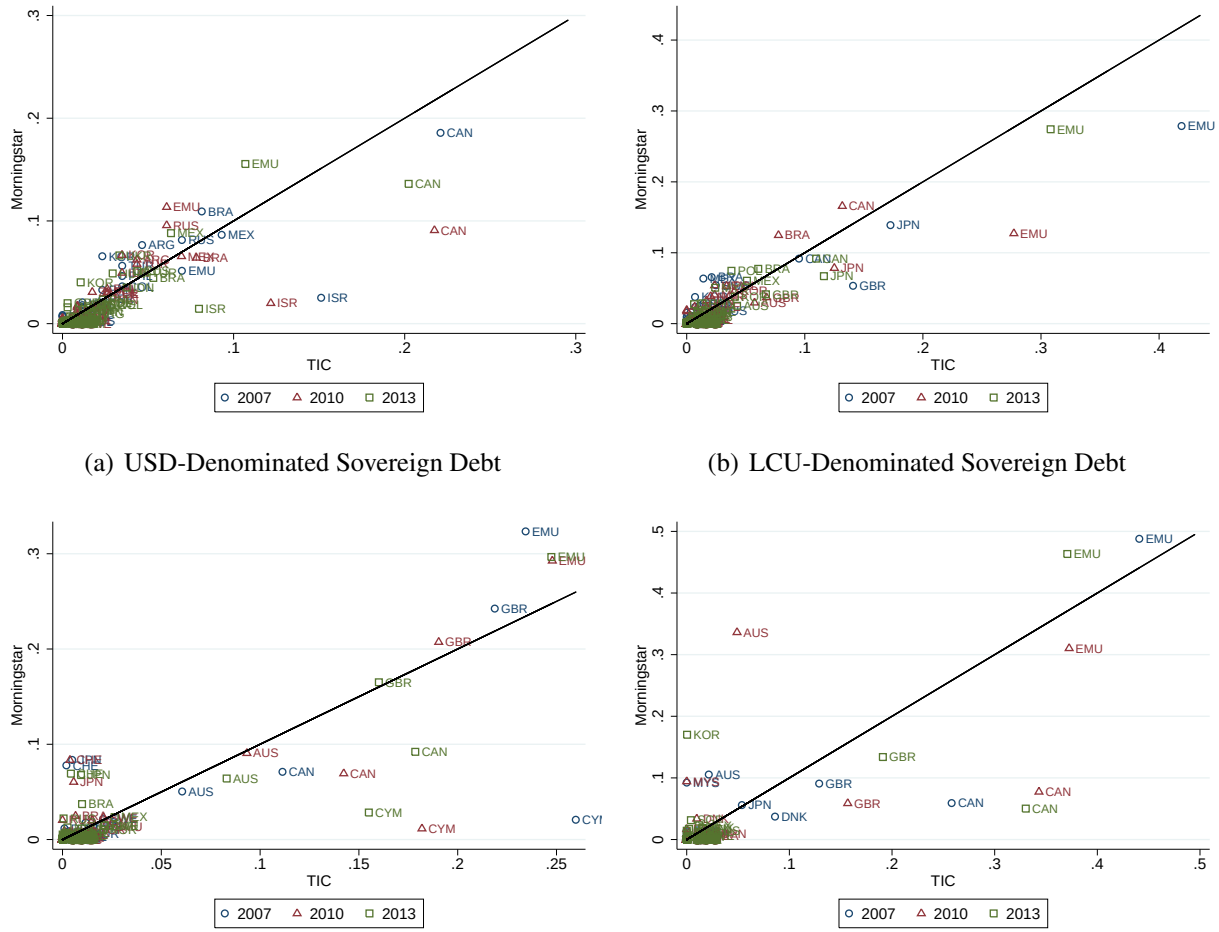
(b) US External Assets: Fixed Income

(c) US External Liabilities: Equities

(d) US External Liabilities: Fixed Income

Figure 4: US TIC and Mutual Fund Data Comparison: Bilateral Portfolio Shares

Note: The graphs compare the US foreign assets and liabilities from the Treasury International Capital data (source: US Treasury Department) with estimates from our data. Panel (a) plots each foreign country (destination) share of the total US investment in foreign equity securities. Panel (b) plots each foreign country (destination) share of the total US investment in foreign fixed-income securities. Panel (c) plots each foreign country (source) share of the total US foreign liabilities in equity securities. Panel (c) plots each foreign country (source) share of the total US foreign liabilities in fixed-income securities. In all panels the horizontal axis represents the shares obtained using TIC data. In all panels the vertical axis represents the corresponding shares estimated with our data. The black line is the 45 degree line.



(a) USD-Denominated Sovereign Debt

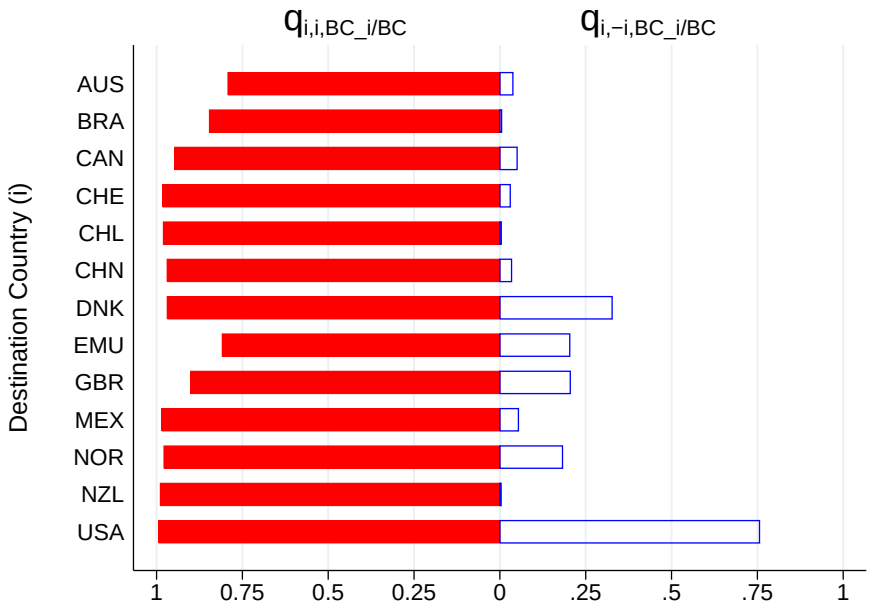
(b) LCU-Denominated Sovereign Debt

(c) USD-Denominated Corporate Debt

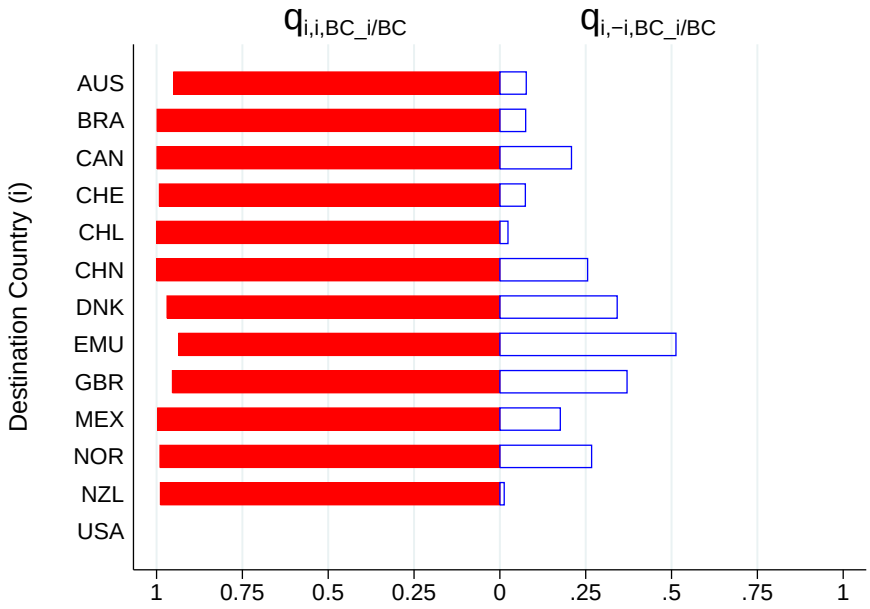
(d) LCU-Denominated Corporate Debt

Figure 5: Bilateral Shares of Outward Portfolios from the United States, by Type and Currency

Note: The graphs compare the US foreign assets from the Treasury International Capital data (source: US Treasury Department) with estimates from our data. Panel (a) plots each foreign country (destination) share of the total US investment in foreign dollar-denominated sovereign debt. Panel (b) plots each foreign country (destination) share of the total US investment in foreign lcu-denominated sovereign debt. Panel Panel (c) plots each foreign country (destination) share of the total US investment in foreign dollar-denominated corporate debt. Panel (d) plots each foreign country (destination) share of the total US investment in foreign lcu-denominated corporate debt. In all panels the horizontal axis represents the shares obtained using TIC data. In all panels the vertical axis represents the corresponding shares estimated with our data. The black line is the 45 degree line.



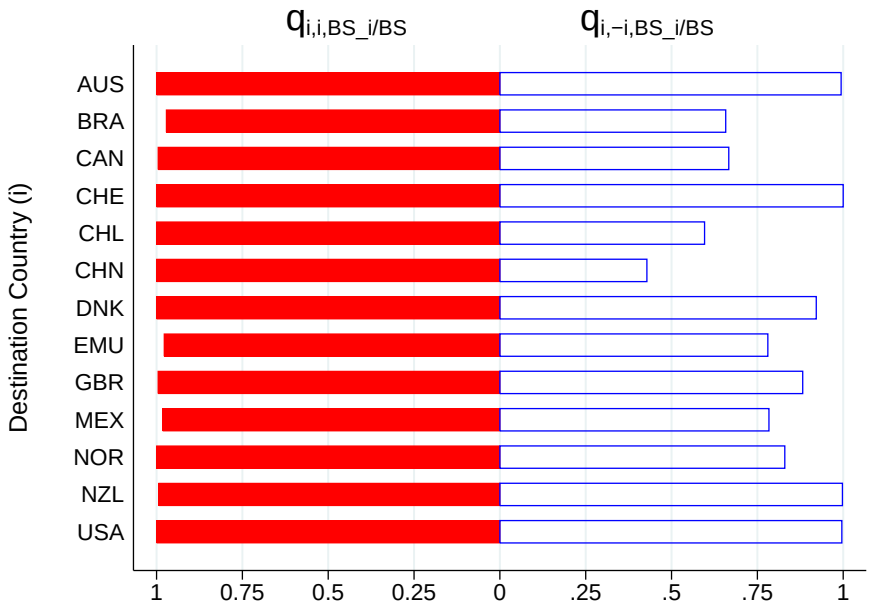
(a) All Currencies



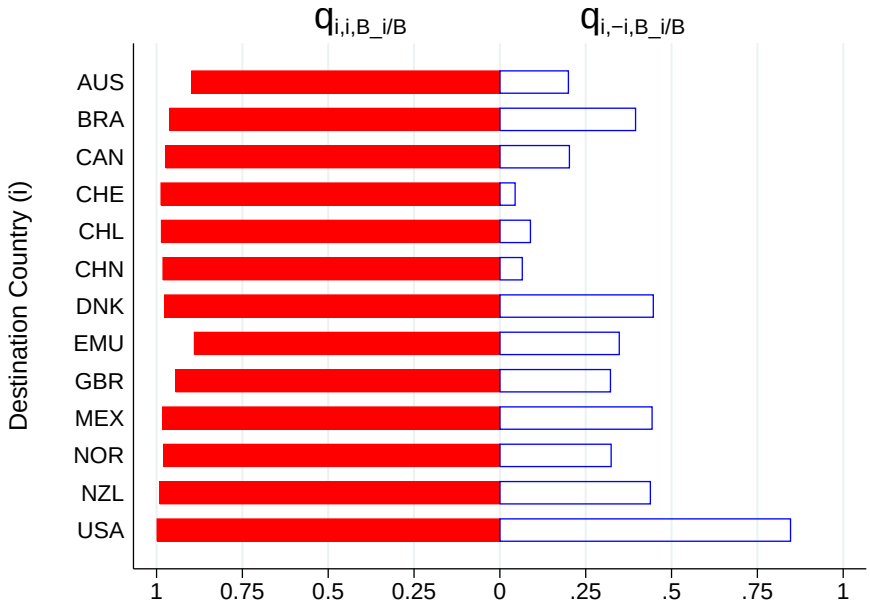
(b) Excluding US Dollars

Figure 6: 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.



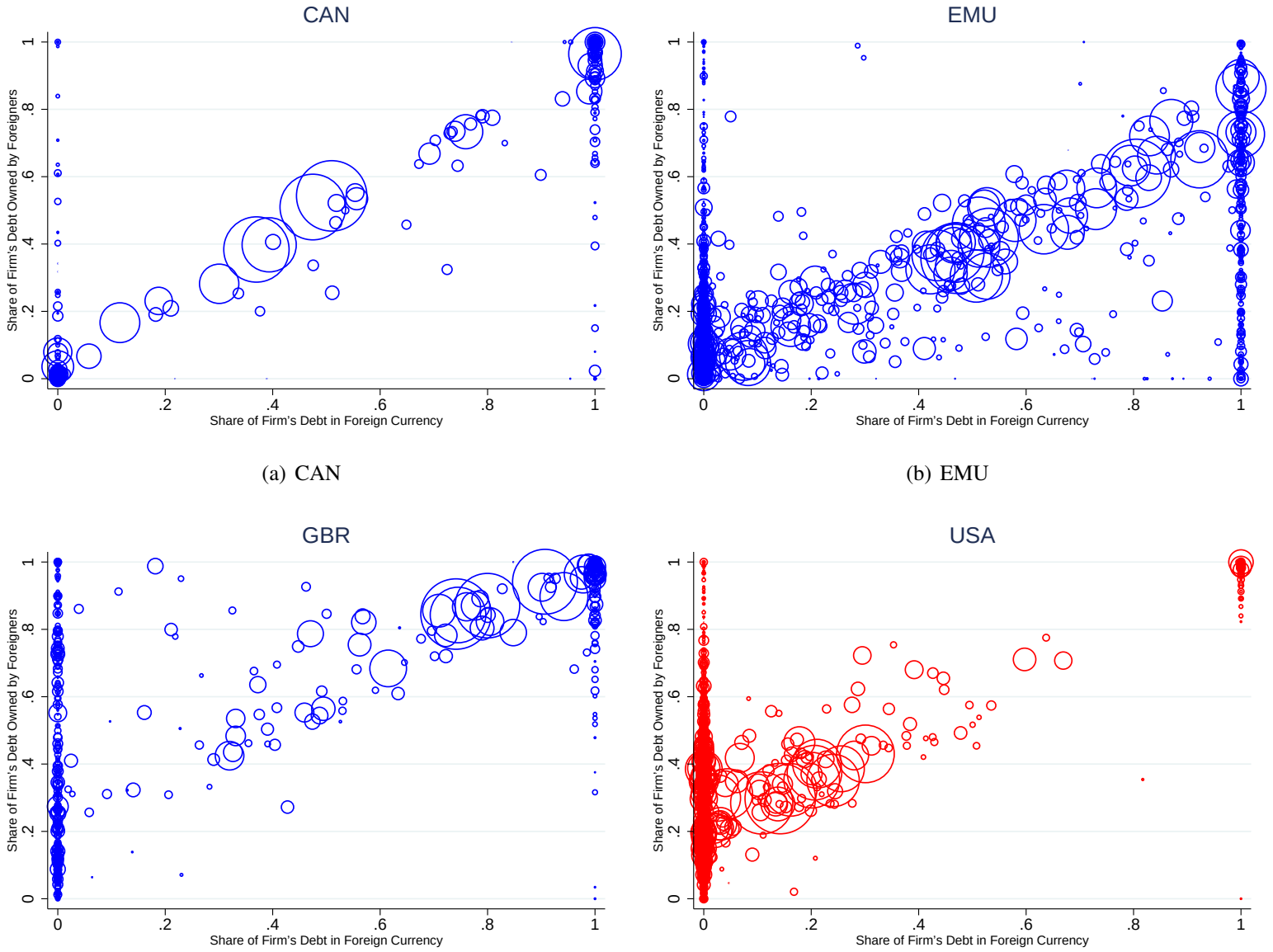
(a) Sovereign Debt



(b) All Bonds

Figure 7: 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.



(a) CAN

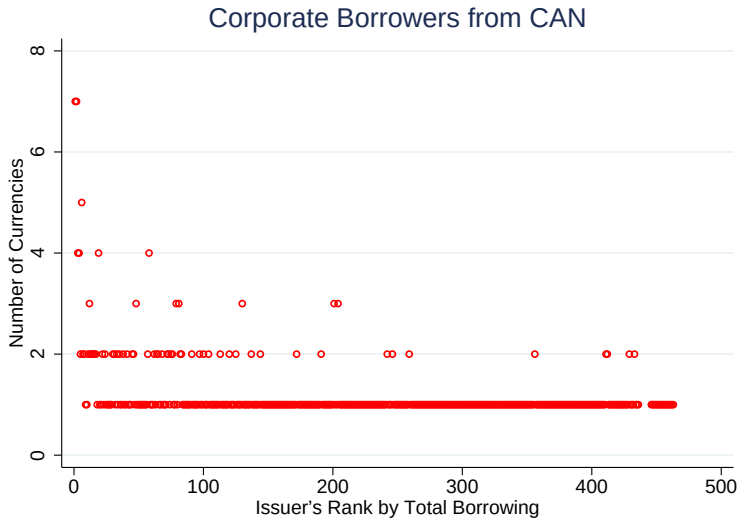
(b) EMU

(c) GBR

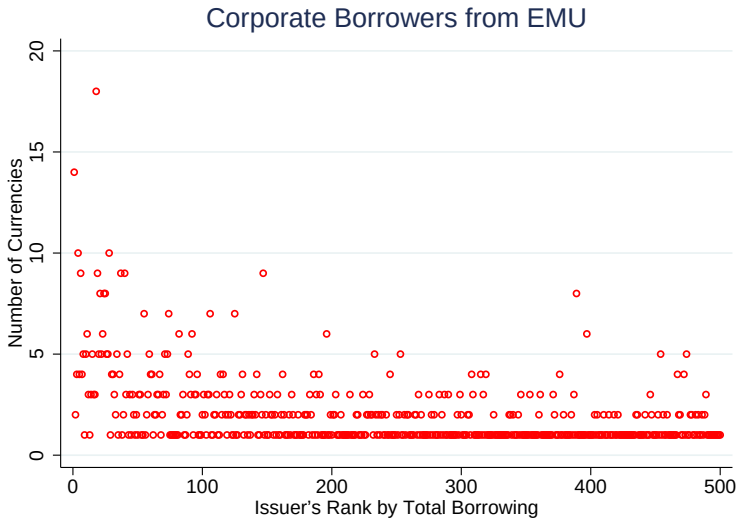
(d) USA

Figure 8: Shares of Foreign Currency Debt and Foreign Lending

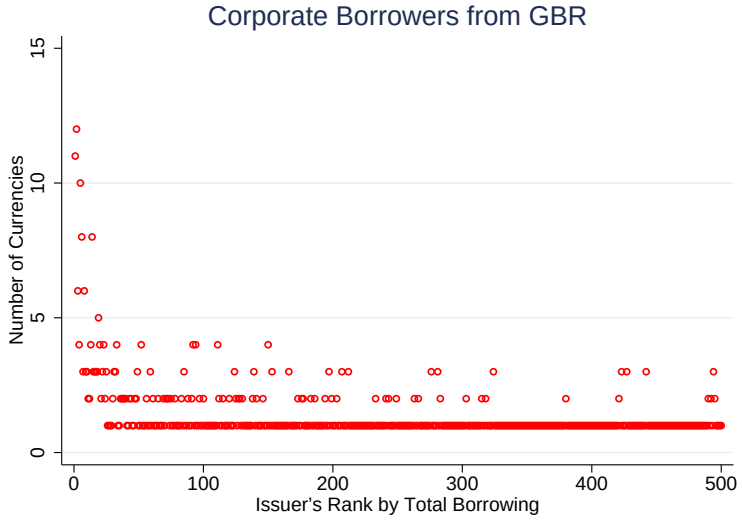
Note: TBD



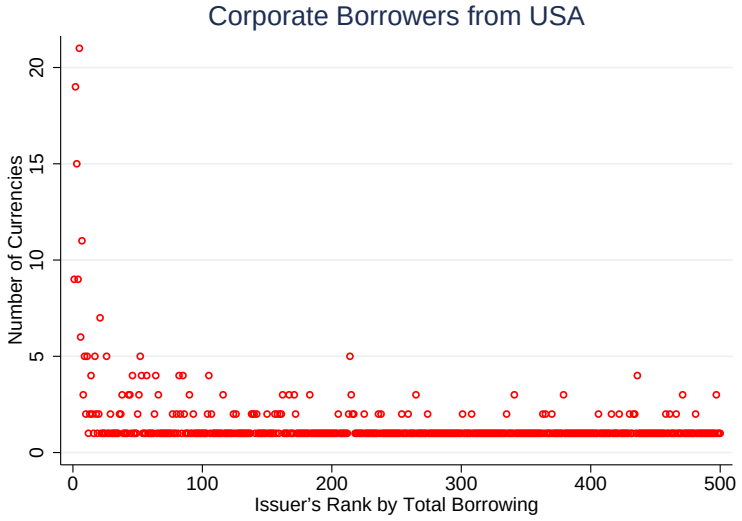
(a) CAN



(b) EMU



(c) GBR



(d) USA

Figure 9: Number of Currencies and Firm Size

Note: TBD

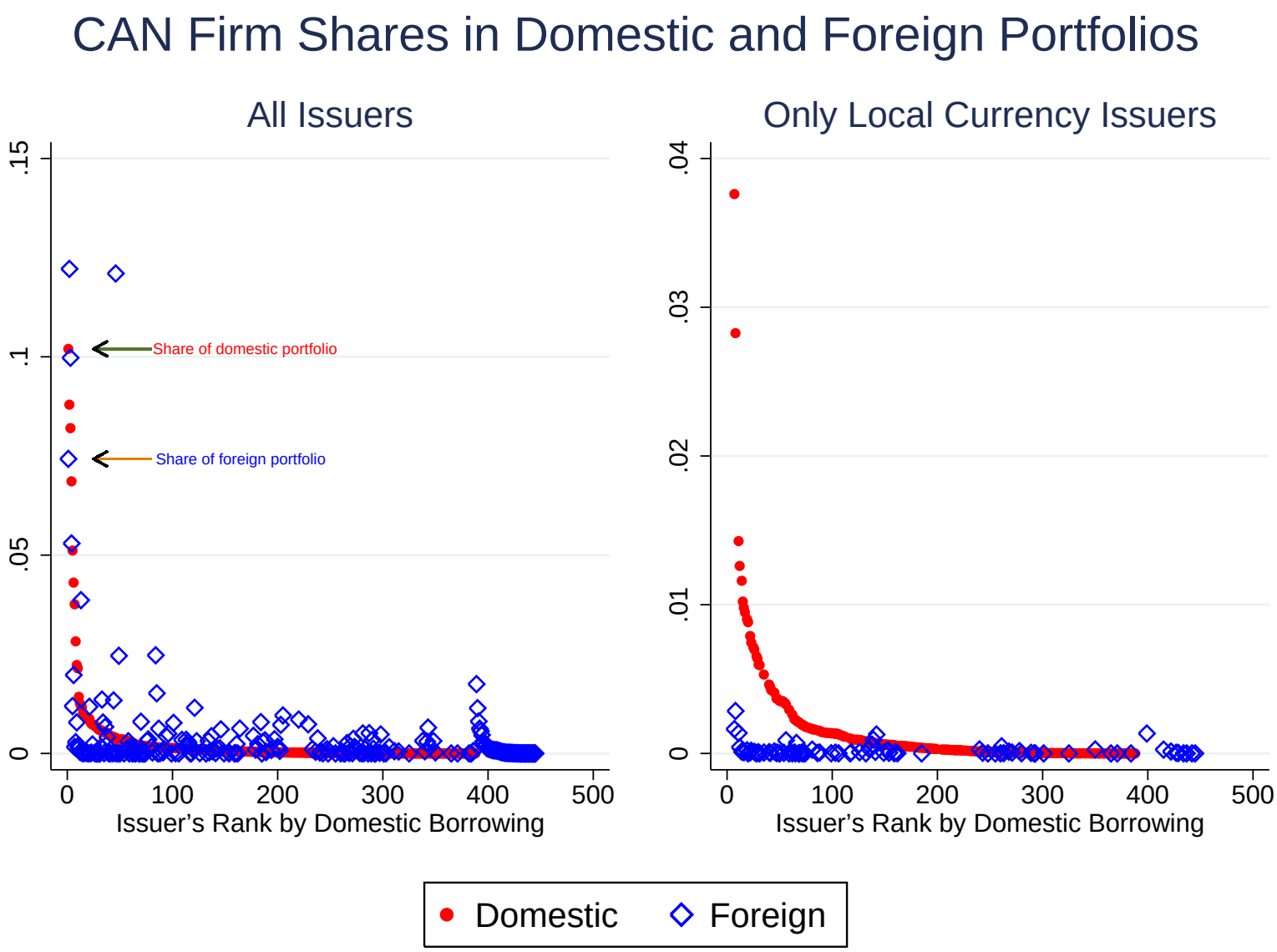
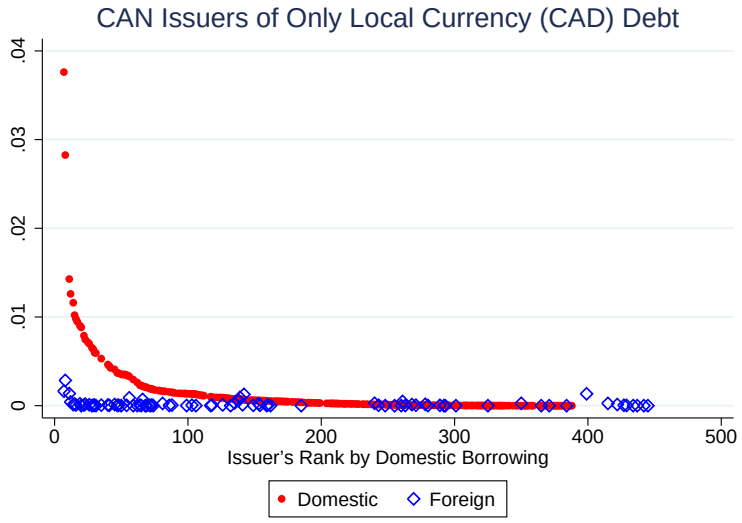
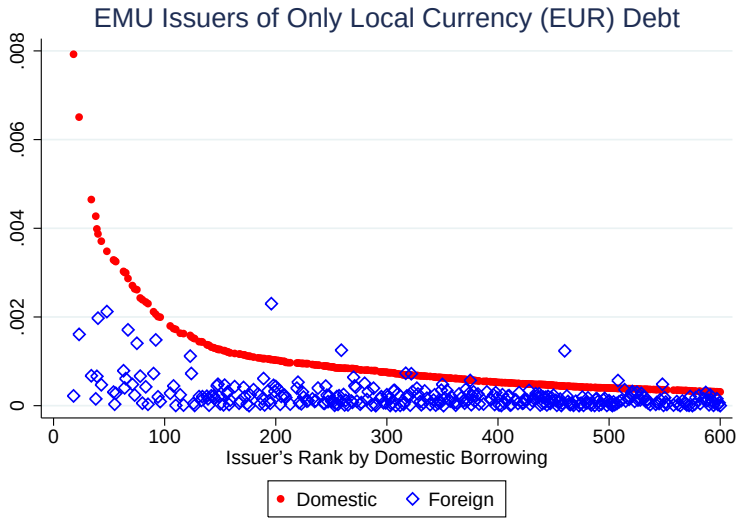


Figure 10: Canadian Corporate Debt Held in Domestic and Foreign Portfolios, 2015

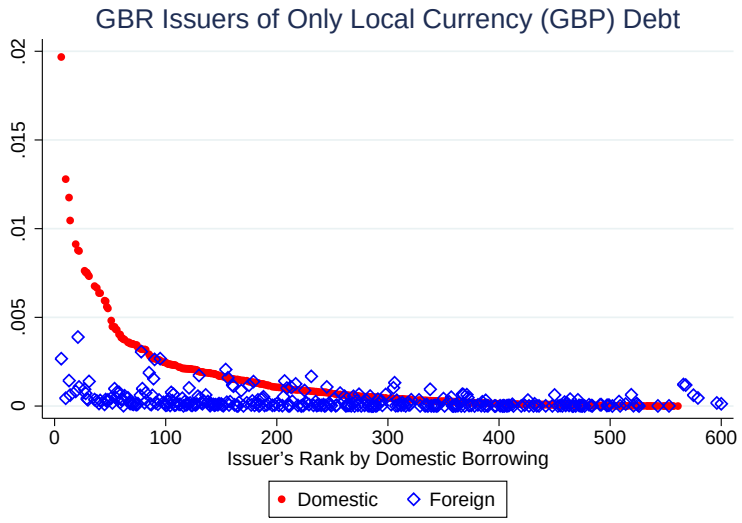
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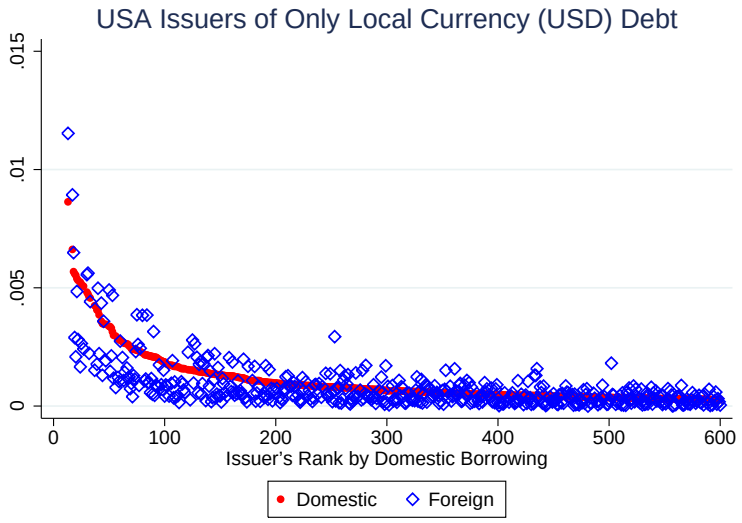
(a) CAN



(b) EMU



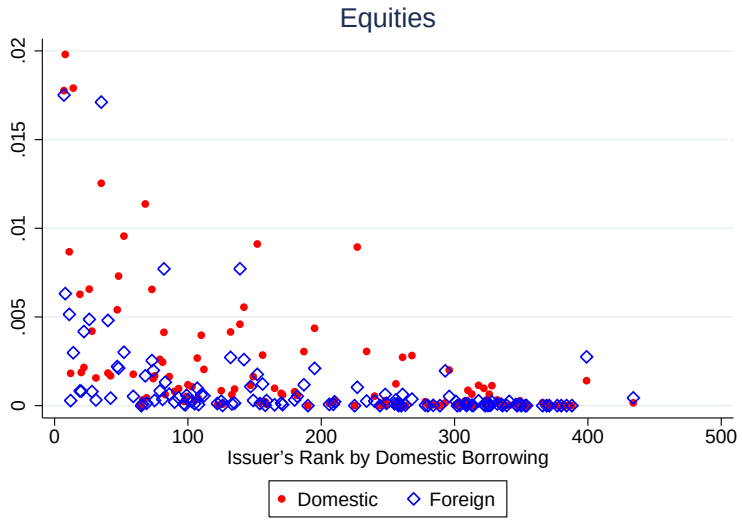
(c) GBR



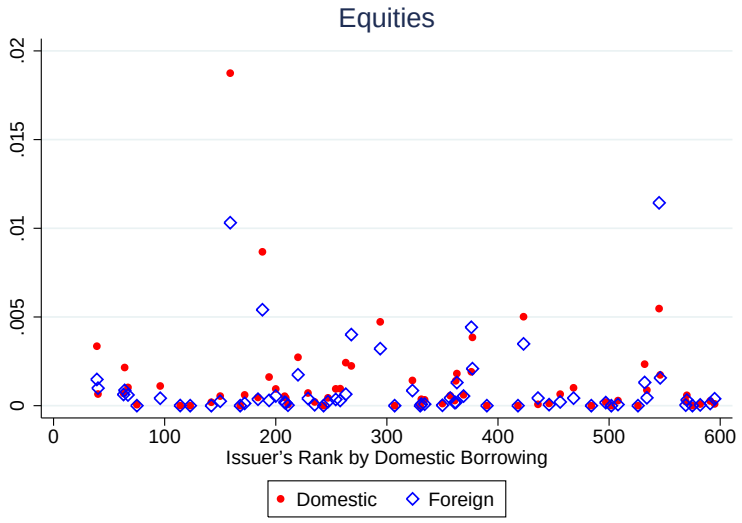
(d) USA

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

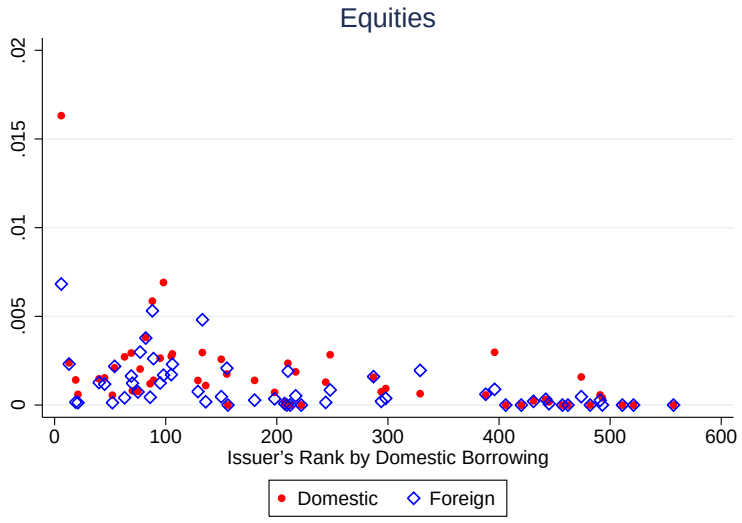
Note: TBD



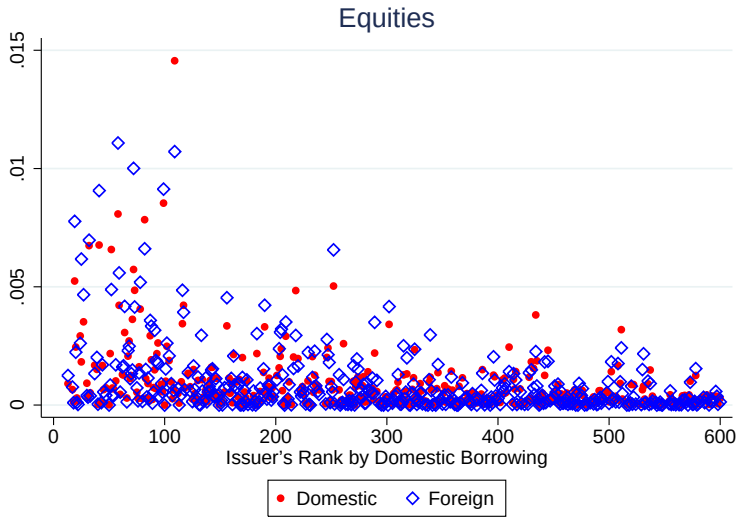
(a) CAN



(b) EMU



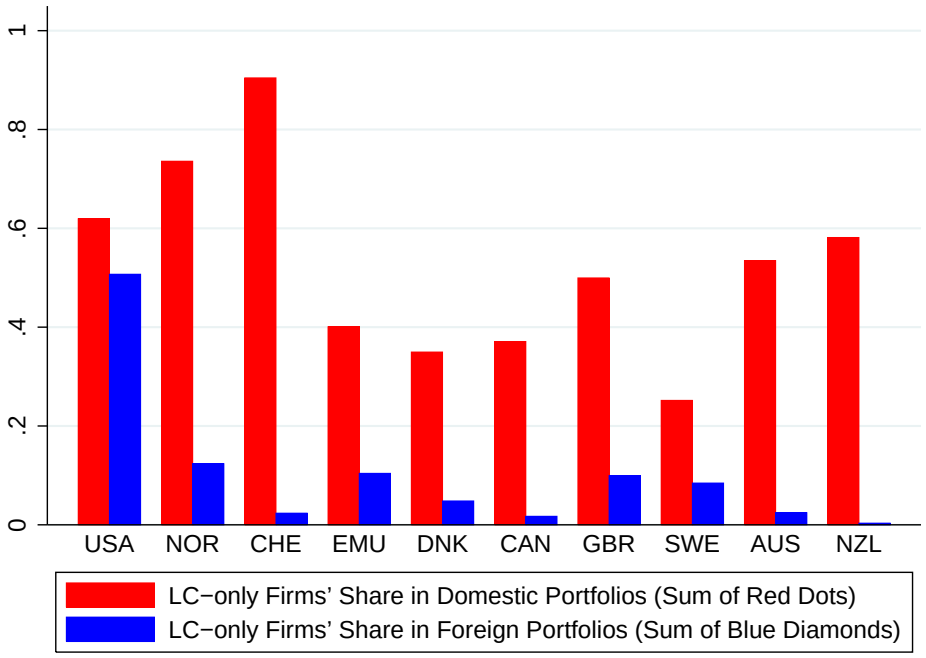
(c) GBR



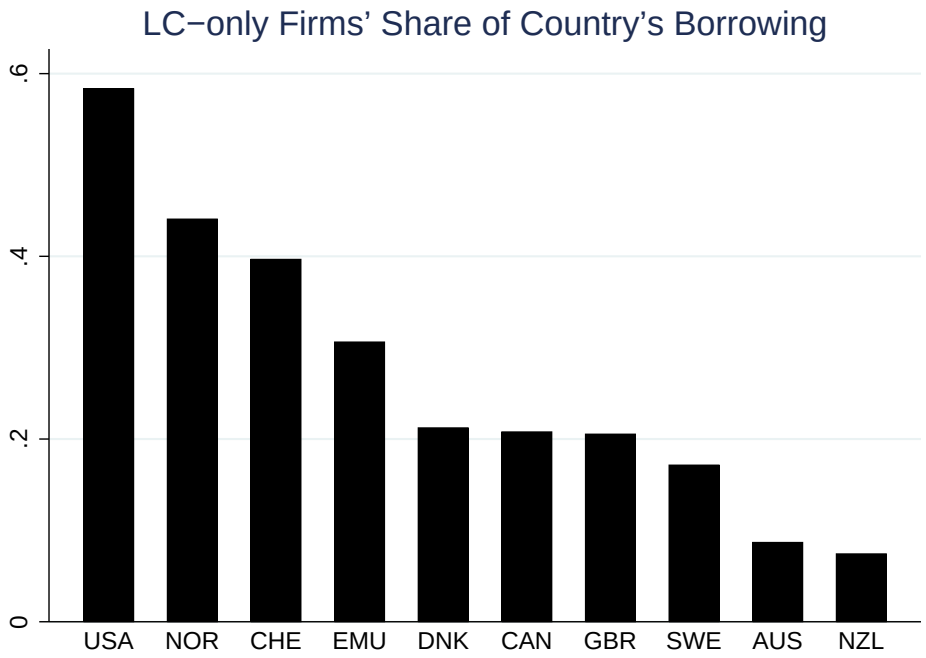
(d) USA

Figure 12: Equities from LC-only Issuers in Domestic and Foreign Portfolios, 2015

Note: TBD



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



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

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

Note: TBD

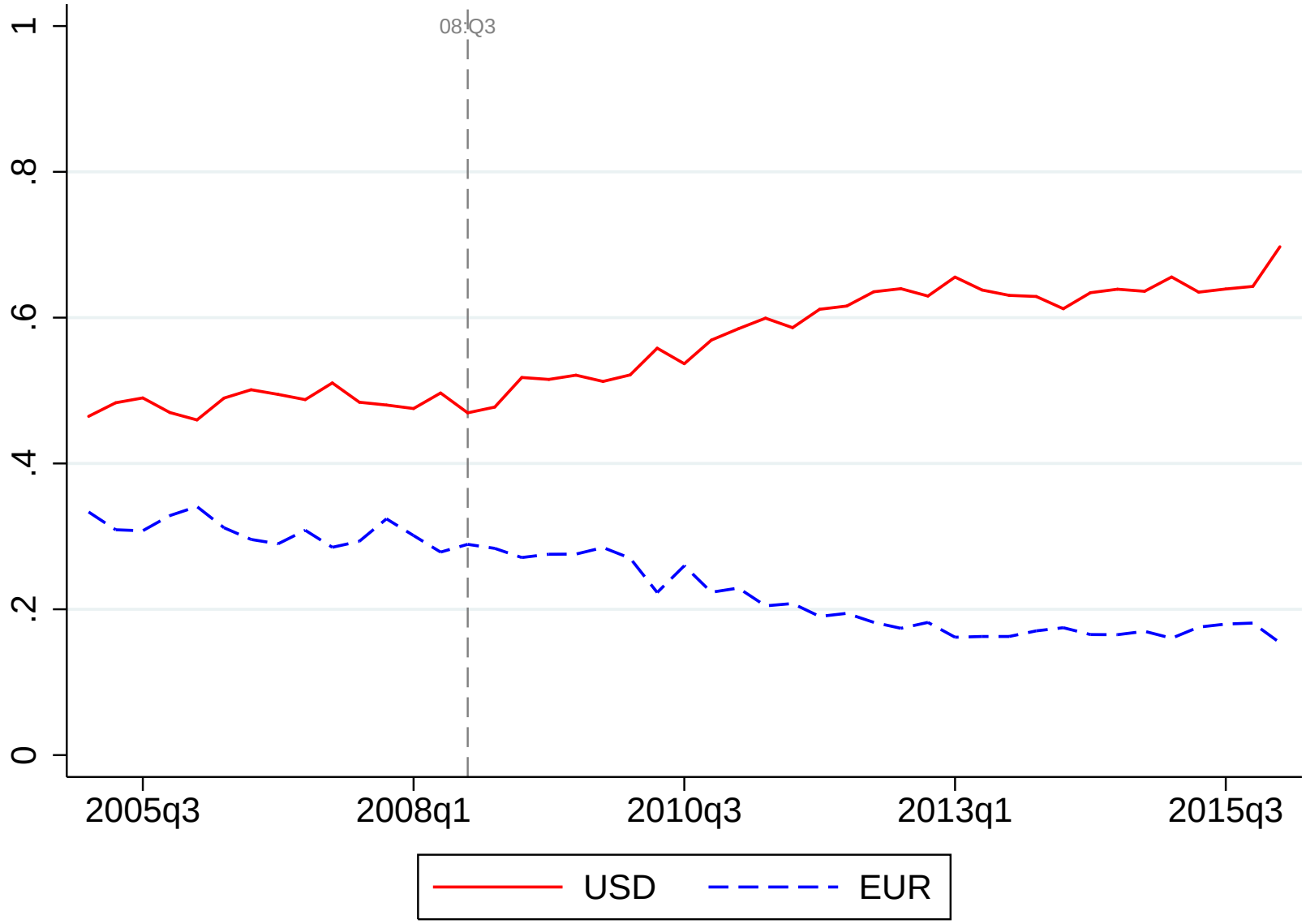
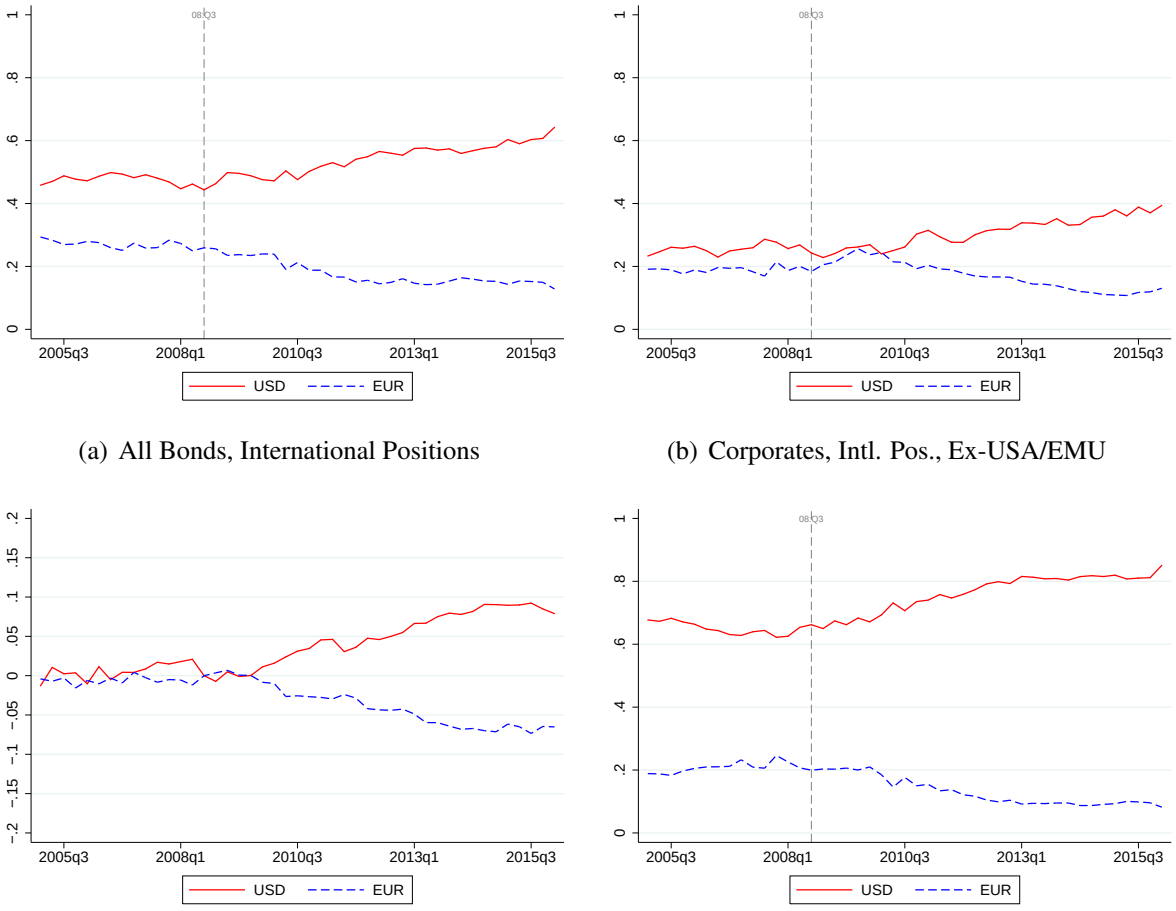


Figure 14: Dollar and Euro Shares of Cross-Border Coroporate Bond Positions

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 analogus 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 (22) on the dataset constructed with fixed exchange rates at 2015 levels. Finally, Panel (d) shows that these trends hold also for non-financial borrowers.