

Elusive Safety: The New Geography of Capital Flows and Risk  
Laura Alfaro, Ester Faia, Ruth A. Judson, and Tim Schmidt-Eisenlohr  
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### **ABSTRACT**

Using a unique confidential data set with industry-level disaggregation of U.S. cross-border securities claims and liabilities, we find that the growing U.S. securities are also increasingly intermediated by tax haven financial centers (THFC) and by less regulated funds. These securities are risky and respond to tax rates and regulation, suggesting tax avoidance and regulatory arbitrage. Issuers are mostly intangible-intensive multinationals, and investors require a high Sharpe ratio, suggesting search for yield. In contrast, safe Treasuries are mainly held by the foreign official sector and increased with quantitative easing policies. Facts on private securities are rationalized through a model where multinationals with heterogeneous default probabilities endogenously choose to shift profits and are funded by global intermediaries with endogenous monitoring intensity. A fall in the costs of global funds, by increasing firms' profits, shifts the distribution of entrants toward riskier ones and also reduces intermediaries' incentives to monitor both the extensive (fraction of monitored firms) and intensive margin, hence raising ex post risk. Firms appear elusively safe.

Laura Alfaro  
Harvard Business School  
Morgan Hall 263  
Soldiers Field  
Boston, MA 02163  
and NBER  
lalfaro@hbs.edu

Ruth A. Judson  
Global Financial Flows Section,  
International Finance  
Federal Reserve System  
20th Street and Constitution Avenue, NW  
Washington, DC 20551  
ruth.a.judson@frb.gov

Ester Faia  
Goethe University Frankfurt  
Theodor W. Adorno Platz 3  
Frankfurt am Main, 60323  
Germany  
and CEPR  
faia@wiwi.uni-frankfurt.de

Tim Schmidt-Eisenlohr  
Federal Reserve System  
20th St NW & Constitution Ave NW  
Washington, DC 20551  
and University of Illinois at Urbana-Champaign  
t.schmidteisenlohr@gmail.com

# Elusive Safety: The New Geography of Capital Flows and Risk\*

Laura Alfaro<sup>†</sup>

HBS and NBER

Ester Faia<sup>‡</sup>

Goethe University Frankfurt and CEPR

Ruth Judson<sup>§</sup>

Federal Reserve Board

Tim Schmidt-Eisenlohr<sup>¶</sup>

Federal Reserve Board

September 2020

## Abstract

Using a unique confidential data set with industry-level disaggregation of U.S. cross-border securities claims and liabilities, we find that the growing U.S. securities are also increasingly intermediated by tax haven financial centers (THFC) and by less regulated funds. These securities are risky and respond to tax rates and regulation, suggesting tax avoidance and regulatory arbitrage. Issuers are mostly intangible-intensive multinationals, and investors require a high Sharpe ratio, suggesting search for yield. In contrast, safe Treasuries are mainly held by the foreign official sector and increased with quantitative easing policies. Facts on private securities are rationalized through a model where multinationals with heterogeneous default probabilities endogenously choose to shift profits and are funded by global intermediaries with endogenous monitoring intensity. A fall in the costs of global funds, by increasing firms' profits, shifts the distribution of entrants toward riskier ones and also reduces intermediaries' incentives to monitor both the extensive (fraction of monitored firms) and intensive margin, hence raising ex post risk. Firms appear elusively safe.

*JEL: F2, F4, G15. Keywords: Tax havens, Profit shifting, Tax avoidance, Regulation Arbitrage, Risk, Safe Assets, Endogenous entry, Geography of flows*

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<sup>†</sup>Contact: lalfaro@hbs.edu.

<sup>‡</sup>Contact: faia@wiwi.uni-frankfurt.de.

<sup>§</sup>Contact: rjudson@frb.gov.

<sup>¶</sup>Contact: t.schmidteisenlohr@gmail.com.

# 1 Introduction

The large and growing capital flows of dollar-denominated securities between the United States and the rest of the world and its consequences for the macroeconomy have long been and still are an important part of research in international finance (reviewed in the next subsection). Yet, no paper has studied the micro origins, especially the motives and incentives, behind these flows. This was due to a lack of reliable data with an exact quantification of the inflows and outflows across years and countries and with granular information on investors, issuers and asset type.

In this paper, we use a unique, granular, and confidential data set derived from the Treasury International Capital (TIC) reporting system (annual survey of US portfolio securities claims on foreigners, and annual survey of U.S. portfolio securities liabilities to foreigners) which collects data on U.S. residents' holdings of foreign securities and on foreign residents' holdings of U.S. securities. By delving into the micro motives for the dynamic of the flows geography, we also consequentially draw a new global securities' risk map, with important implications also for firms' funding decisions abroad.

Our analysis proceeds in three steps. We first examine country-level flows per type of assets and issuers and draw a set of macro facts. Motivated by those we inspect further the sectorial level securities flows and draw an additional set of quantitative facts that speak more closely of the micro motives. The granularity of our data indeed allows us to match them with sectoral measures of risk, Sharpe ratios and intangibility. Drawing on all of the above facts we construct a model to rationalize the facts.

It is important to stress that our data represent the most accurate available measurements of U.S. cross-border asset positions. The confidential TIC data are based on required reporting by all significant U.S. custodians and U.S. end-investors holding securities abroad and by all significant U.S. custodians and issuers of U.S. securities held by foreigners.<sup>1</sup> Hence, contrary to data used in previous studies and extracted from industry analysts' reporting, credit agencies, or other private industry reporting, our data represent an official source with extremely broad and granular coverage.<sup>2</sup>

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<sup>1</sup>The TIC system is a joint effort of the Treasury Department and the Federal Reserve.

<sup>2</sup>See Chen et al. (2019) for recent remarks on this issue.

At the country level, we find that U.S. privately held capital flows, which are largely dollar-denominated, are increasingly intermediated by tax havens financial centers (THFC hereafter) and non-bank financial institutions. In contrast, safe assets, namely U.S. Treasuries, are mainly held by foreign official investors.<sup>3</sup> Figure 1 presents a first glance of the facts for securities flows into a THFC, which we then detail further below. The figure shows the trends for the period 2007-2018 in U.S. securities claims and liabilities to the Cayman Islands, the THFC that accounts for the largest proportion of the flows.<sup>4</sup> Both claims and liabilities have increased significantly (first two panels on the top of the figure), particularly so for equities (third panel in the bottom) and for US-dollar denominated assets (fourth panel on the bottom). To give a sense of the magnitude and significance of the increase, note that U.S. equity claims on the Cayman Islands have seen a 700 percent increase over the period 2007-2018 and liabilities have increased 483 percent in equities and 108 percent in corporate debt.

The increase in U.S. securities claims and liabilities channelled through THFC has been particularly marked around 2010. Around that year there were important financial reforms throughout advanced economies, ranging from the Dodd-Frank Act (approved in 2010), to the end of the banking secrecy approved by the G20 leaders in 2009 to the Basel III agreements also in 2010. Many of those reforms included restrictions on portfolio management and increased investors' protection, both of which have encouraged investors and mutual funds to shift their activity to less regulated financial centers. The growth has been larger for equities of multinationals or investment funds with foreign residence.<sup>5</sup> Notably, the majority of U.S. equity shares in the Cayman Islands is in less-regulated mutual funds.

As for Treasuries, the safe assets, over half (\$4.1 trillion out of \$6.7 trillion as of December 2019) of those are held by the official sector. Overall Treasury holdings (that is, official and

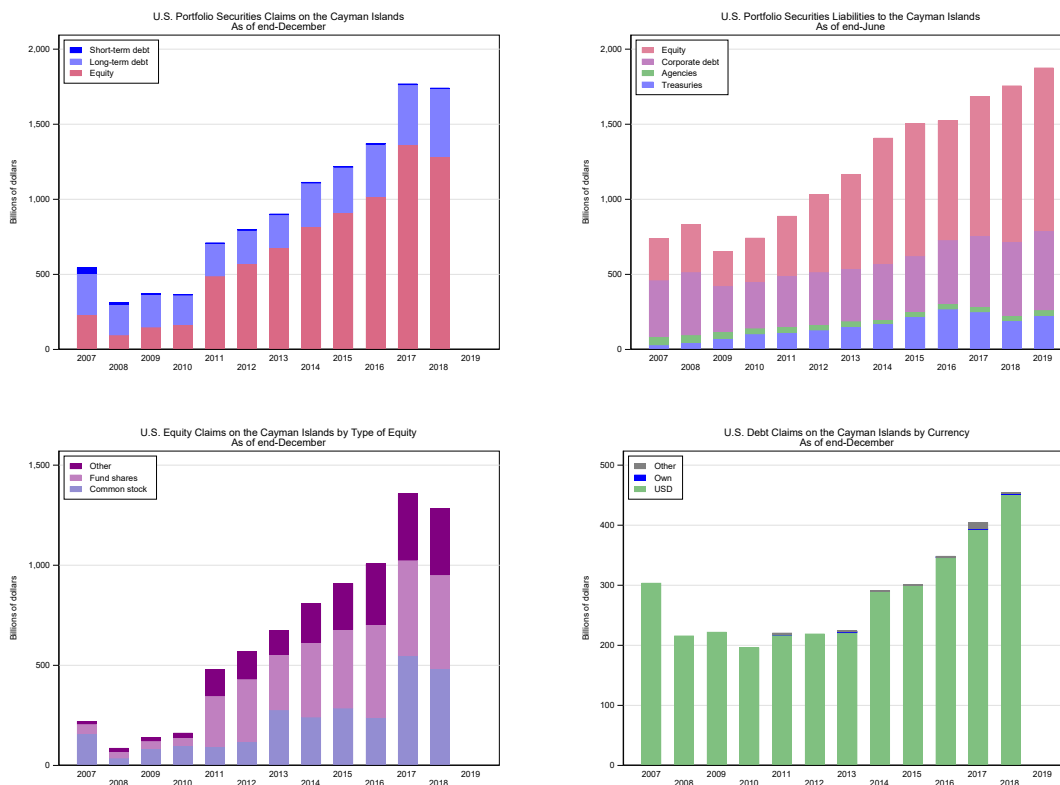
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<sup>3</sup>The TIC system collects data separately by country for foreign official and private investors, but breakdowns by country for foreign official and private holdings are not published.

<sup>4</sup>As noted above, data are not separately released by country for official and private flows. But total Cayman Island official foreign exchange reserves and U.S. foreign exchange reserves are both minimal, and as a result these data overwhelmingly represent private investment flows.

<sup>5</sup>An important caveat is that some of the increase from 2011 to 2012 represents an expansion in the reporting universe that accompanied the introduction of the TIC SLT in 2011. See Brandner and Judson (2012) and Bertaut and Judson (2014) for more details. Note this would not systematically explain a growth concentrated in equities.

Figure 1. U.S. Portfolios Claims and Liabilities To the Cayman Islands–Total, Equities and Dollar-denominated Assets (2007-2018)



Source: TIC SHL/SHLA and SHC/SHCA.

private holdings combined) are dominated by Japan and China, with other large holders in emerging markets and also the euro area. Their growth picked up at the time of quantitative easing policies or during the euro area sovereign crisis. Scarcity of safe Treasuries, coupled with the higher returns paid by U.S. Treasuries compared to German Bunds, fostered their demand.

Next, we move to examine the patterns in sector-level data. Before that we check for correlations in the aggregate data using standard global financial and dollar cycle regressions (results are presented in Appendix C).<sup>6</sup> That literature has so far focused on the macro determinants of flows. Our regressions include traditional variables, such as the growth rate of the VIX, dollar exchange rate, Federal Funds Rate or shadow rate, Excess Bond Premium,

<sup>6</sup>See Rey (2013), Avdjiev et al. (Forthcoming) or Niepmann and Schmidt-Eisenlohr (2019) for some recent papers.

and the Variance Risk Premium (VRP), but also new ones such as uncertainty measures. In a nutshell we find that privately held flows mostly react to the VIX and uncertainty measures, while Treasuries, mainly held by the official sector, also react to the dollar exchange rate.<sup>7</sup> All in all, however most of those macro variables do not seem to have much predictive power and they would not provide any rationale for as why flows gravitate primarily toward countries specialized in tax and regulatory arbitrage.

Motivated by all of the above macro findings we move to search for the micro origins of the flows geography by examining facts at the sector level. For this part we focus on private securities, as those are the ones mostly gravitating toward THFC.<sup>8</sup> The goal of this part of the analysis is to sort securities according to issuing firms' characteristics. Using the unique granularity of our dataset we match our securities data with estimates of industry-level risk and uncertainty metrics metrics and Sharpe ratios.<sup>9</sup> Risk and uncertainty of privately held U.S. liabilities (debt and equities) are higher in THFC and have increased over time. Also, the distribution of liabilities' risk across countries shows a shift rightward in 2019 compared to 2007 and is more similar between THFC compared to non-THFC. This overall suggests that assets issued and intermediated through THFC are associated with riskier firms. Second, Sharpe ratios have also increased, especially in THFC, suggesting that investors buying from there are searching for yield rather than for safety.

Given the above facts we conjecture that firms holding intangible capital, which are typically riskier, might have incentives to seek out funding in financial centers with large availability of highly liquid investors, possibly in search for yield. Given the nature of their activity it is also easier for those firms to seek funds in locations that are not near their headquarters. Note also that section 23A of the Dodd-Frank Act prohibits firms to use intangible capital as collateral for loans. This provides an additional strong incentive for those firms to seek funds else-where and could explain why their debt or equities appear riskier. To this purpose we further match our securities data with an intangibility index and indeed we do find that the risky flows intermediated through THFC correlate with the

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<sup>7</sup>Dollar sensitivity suggests reserve management (Alfaro and Kanczuk (2009); Alfaro et al. (2014)).

<sup>8</sup>In some cases we include Treasuries for robustness checks.

<sup>9</sup>We measure risk with realized volatility at the industry level and uncertainty with the proxy proposed in Gopinath and Stein (2018). Sharpe ratios are given by excess returns at industry level divided by the volatility of the excess returns. Data described in detail in the appendix section.

intangibility index.<sup>10</sup> Those firms therefore seems to be the ones which can best exploit the regulatory and tax advantage. To check this we run a regressions of U.S. liabilities at country and sector level against the statutory corporate tax rate interacted with the intangibility metric.<sup>11</sup> We find lower taxes significantly increase debt held by foreign investors, particularly so for intangible intensive firms.

We rationalize the facts related to privately held securities with a model featuring endogenous entry in tax havens and endogenous risk-taking. We analyze the possibility of entry and funding in THFC through global unregulated intermediaries. The model explains the double occurrence of profit shifting to THFC and the increased risk-taking by the combination of the increase in global savings/imbalance and tax/regulatory arbitrage. Low rates prevailed even before 2007, but it is only the regulatory and tax advantage, desirable after the tightening in industrialized countries' regulation, that can explain the recent concentration of the risky flows in THFC. To study the interaction of these different factors, we construct a general equilibrium model with multinationals entering THFC and funded by lightly regulated global intermediaries. Firms are heterogeneous in their default probabilities and choose whether to shift profits to the THFC, which implies a cost but generates a tax benefit. Firms fund their activities with risky debt obtained from global intermediaries. These intermediaries have access to a global market for liquidity and, as they are only lightly regulated, can offer funds at low costs. Loan spreads are chosen based on an incentive-compatible contract and intermediaries choose their monitoring intensity endogenously. Debt issued in THFC corresponds to U.S. debt or equity liabilities held privately from investors located in THFC.

We use the model to examine the effect of an increase in global liquidity on the direction of flows and on the riskiness of firms' debt. Increasing global liquidity has been discussed extensively and has been linked with the growth in U.S. liabilities (See Bernanke (2005) or Summers (2014)). We show that a fall in debt costs, triggered for instance by an exogenous increase in global liquidity, raises firms' profits. This has two effects. First, a higher fraction of firms can afford to enter the THFC, leading to a shift in the default distribution of entrants toward riskier ones. This generates a novel "risk selection" effect. Second, more profitable

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<sup>10</sup>We use the intangibility measure constructed by Peters and Taylor (2017), which combines both R&D and marketing expenditures.

<sup>11</sup>Tax data are from the KPMG database.

firms appear elusively safer and global intermediaries endogenously reduce their monitoring intensity at both the *extensive* (fewer firms are monitored) and the *intensive* (each firm is monitored less) margins. This in turn increases firms' default probabilities and the overall aggregate risk in each sector. In sum, the model explains well the double occurrence of shifts in the flows toward THFC and the increase in average risk as well the shift in its distribution.

***Relation to Literature*** The increase in foreign direct investment (FDI) in tax havens has been noted in a recent literature measuring the extent of profit shifting. Guvenen et al. (2017) and Tørsløv et al. (2018) both find, using different data sets, that much of the productivity slowdown observed in the U.S. since 2004 can be explained by profit shifting and is larger for R&D intensive industries.<sup>12</sup> Similarly, Liu et al. (Forthcoming) document substantial profit shifting through transfer pricing by U.K. multinationals, also concentrated in the R&D-intensive sectors. Wright and Zucman (2018) examine the evolution of taxes paid by U.S. multinationals on their foreign profits since 1966 and show that an exorbitant tax privilege explains half of the U.S. cross-border return differential.<sup>13</sup> Our works highlights the pursuit of risk in addition to the role of regulation and tax arbitration.

We rationalize the empirical facts through a model, whose novelty lies in introducing moral hazard contracts with endogenous monitoring intensity (see in Martinez-Miera and Repullo (2017)) in a model where heterogeneous firms a' la Melitz (2003) enter the THFC also for funding purposes. The tax advantage provides incentives for entry. Firms are assumed to be heterogeneous in terms of their default probabilities. Due to this heterogeneity, when more firms enter, there is a shift in the firms' distribution toward riskier firms. We dub this new mechanism the risk-selection effect.

The paper also relates to the literature that study the connection between multi-nationals, capital flows, and credit frictions: Froot and Stein (1991) focus on informational frictions, Klein et al. (2002) on constraints faced by bank-dependent firms and Antràs et al. (2009) on contracting frictions. We highlight a novel dimension linking multinationals entry and their risk distribution to moral hazard and endogenous monitoring intensity. The paper is also related to the theoretical literature on tax competition and profit shifting (see Ottaviano

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<sup>12</sup>See Hines (1996), Hines and Rice (1994) for early work on this front and also Desai et al. (2004).

<sup>13</sup>See also Curcuro et al. (2008).



and van Ypersele (2004) or Krautheim and Schmidt-Eisenlohr (2011)). Our model rationalizes the emergence of foreign direct investment flows for the purpose of regulation and tax arbitrage to complement the large literature on the motives of multinational firms.

In the international finance literature, the research by Lane and Milesi-Ferretti (2018) and Obstfeld (2018) began to document the changing landscape of capital flows geography, including the shift toward tax havens or financial centers. More recently the policy reports from Bertaut et al. (2019) use the TIC data to document an increasing share of U.S. equity and debt claims in firms incorporated in low-tax jurisdictions and intermediated through mutual and hedge funds. Furthermore the policy report by Liu and Schmidt-Eisenlohr (2019) uses TIC data to document a rapid growth in the use of CLOs, which, contrary to other safer debt-instruments, facilitate risk-recycling. In this paper we provide a full-fledged empirical analysis with firms' sorting to uncover the micro origins of the new geography of flows and rationalize the mechanism with a model.

Our paper also relates to the literature documenting the increase of cross-border flows in U.S. dollar-denominated securities and the role of dollar as reserve currency and global provider of liquidity, (see Lane and Milesi-Ferretti (2001), Obstfeld (2004), Gourinchas and Rey (2010), Goldberg and Tille (2009), Forbes (2010), Gourinchas and Rey (2014), Caballero et al. (2016) or Gopinath and Stein (2018) among others). Early works attributed the growth in dollar-denominated debt to the safe haven properties of the U.S. dollar and the specialty of Treasuries (Caballero et al. (2008), Mendoza et al. (2009), Gourinchas et al. (2011), among others) and documented the role currency bias in accounting for home bias (Burger et al. (2018)). Recent papers (Maggiori et al. (Forthcoming) and Coppola et al. (2019)) use private proprietary data to document that the dollar dominance might be even stronger than previously thought while documenting as well the increasing role of tax havens. An advantage of the TIC data is that it provides shares for both inflows and outflows obtained from official reporting to the U.S. government which allow to document the two-way intermediation and risky nature of these flows.<sup>14</sup> Moreover the granular nature of the TIC data allows us to

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<sup>14</sup>Recent literature notes measurements concerns in the Balance of Payments entries due to the more complex structure of multinationals. Avdjiev et al. (2018) and Bertaut et al. (2019), for example, note differences in U.S. cross-border flows based on the nationality rather than on the residence of the ultimate owner and Coppola et al. (2019) expand for a broader set of countries.

match them with other micro variables and to uncover the incentives behind the shift of the flows toward THFC.

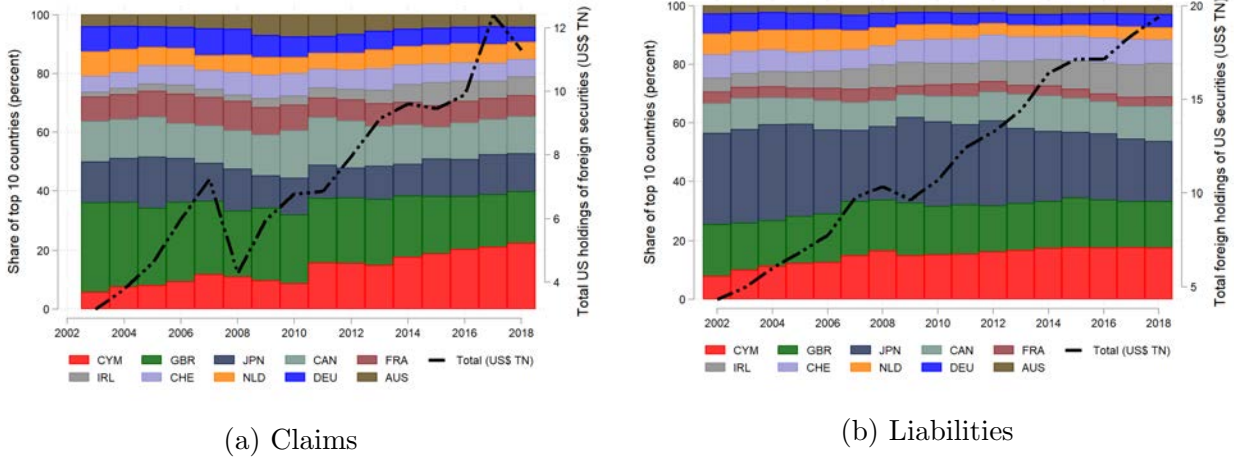
In terms of highlighting the risky nature of the growth of U.S. securities, our works relates to the research of Bruno et al. (2018) and Avdjiev et al. (Forthcoming) which questions the safe-assets hypothesis for dollar-denominated privately held securities and conjecture that global banks leverage in dollars to cover for the exposure in dollar assets. We also find that cross-border flows in dollar-denominated assets are increasing, and uncover new motives such as tax avoidance and regulatory arbitrage, noting that most of the private flows are actually risky and related more broadly to non-bank financial intermediaries as well. As for the outflows of U.S. Treasuries, very safe assets, we find that they are mainly held within the official sector and sovereign flows and their growth coincides with quantitative easing policies (Alfaro and Kanczuk (2009) and Alfaro et al. (2014).)

The paper is organized as follows. Section 2 presents the main facts. Section 3 contain the regression analysis of macro determinants and micro origins. In section 4 we present the model. The last section concludes.

## 2 Country-Level Facts

We start by documenting some facts from the TIC data at the country level and for different types of securities, taken from the annual surveys of U.S. portfolio securities claims on foreigners (SHC/SHCA) and of U.S. portfolio securities liabilities to foreigners (SHL/SHLA). These surveys have collected cross-border position data at the individual security level annually since the early 2000s. The data include information on the security characteristics (type of security, currency, issue and maturity date, type and name of issuer, country of issuer, industry of issuer) as well as information on the types of holders. As a result, it is possible to calculate breakdowns across countries, type of securities (treasuries, debt, equities, ABS, etc.), type of investors (official versus private) and issuers, and on the ultimate destination of the claims (equities of multinationals or of mutual funds). Reporting is required by law. In addition to the annual surveys, the TIC-SLT has collected aggregate monthly data on

Figure 2. U.S. Claims and Liabilities of Top 10 Countries (2001-2018)



Source: Aggregate TIC Data.

cross-border positions since late 2011.<sup>15</sup> Appendix A describes the data in detail.

In the data analysis below, we uncover the main trends, such as the change in the size of holdings, their main location, and the securities that are most in demand. Facts and empirical results are reported for both U.S. holdings of foreign securities (referred to as claims) and foreign holdings of U.S. securities (referred to as liabilities). When reporting country level data breakdowns in the figures below, we choose the 12 countries that account for the largest share and we quantify the percentage change over the sample period and the average percentage change per year for the largest destination of flows. In section 2.1, we analyze facts and trends at the more granular sectoral level. The data are based on both the SHL/SHLA (liabilities) and SHC/SHCA (claims) surveys, which collect data on individual cross-border security holdings from custodians, end-investors, and issuers.<sup>16</sup>

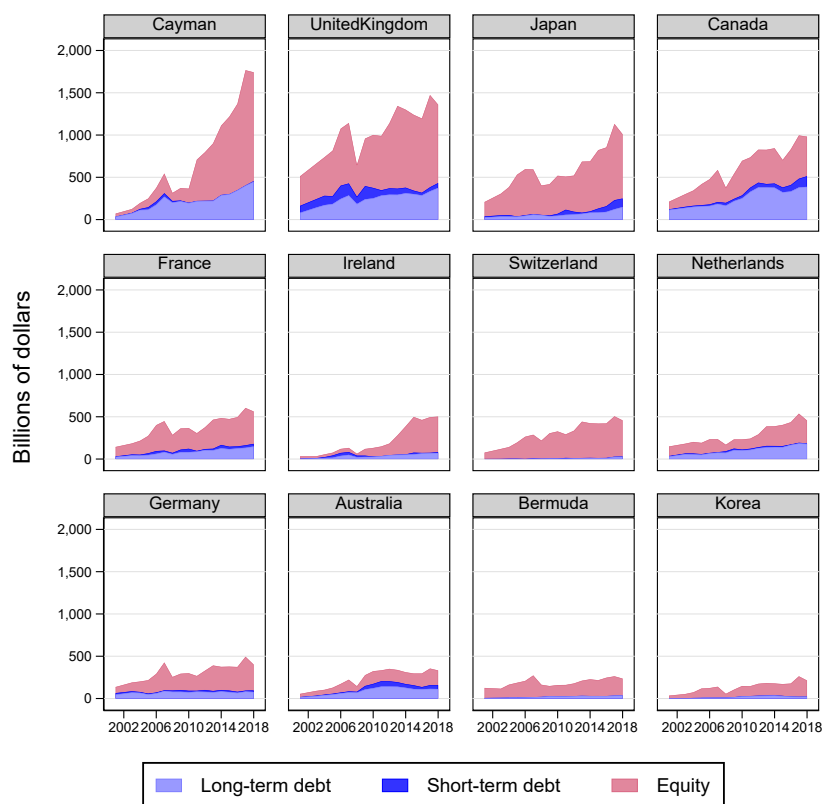
First, figure F.1 in Appendix F confirms that both inflows and outflows from and to the United States have been growing in recent years even further. Figure F.1 shows that tax havens, and in particular the Cayman Islands, rank in the top 10 destinations for both U.S. claims and liabilities and that their share has increased over time with a jump around 2010.

Next we examine the breakdown of the data by country, asset class, currency of denomination, and other features. We start with U.S. claims. Figure 3 shows U.S. cross-border

<sup>15</sup>In the analysis, when relevant, we use the longest available sample from the “modern survey” era. Since the liabilities and claims surveys are collected at different times of the year, the samples are slightly different.

<sup>16</sup>Surveys are conducted annually. “Benchmark” surveys are conducted every five years and have a more comprehensive reporting panel. Annual surveys are formally designated as SHCA and SHLA.

Figure 3. U.S. Holdings of Foreign Securities (Claims) by Top 12 Countries and Type of Asset (2001-2018)

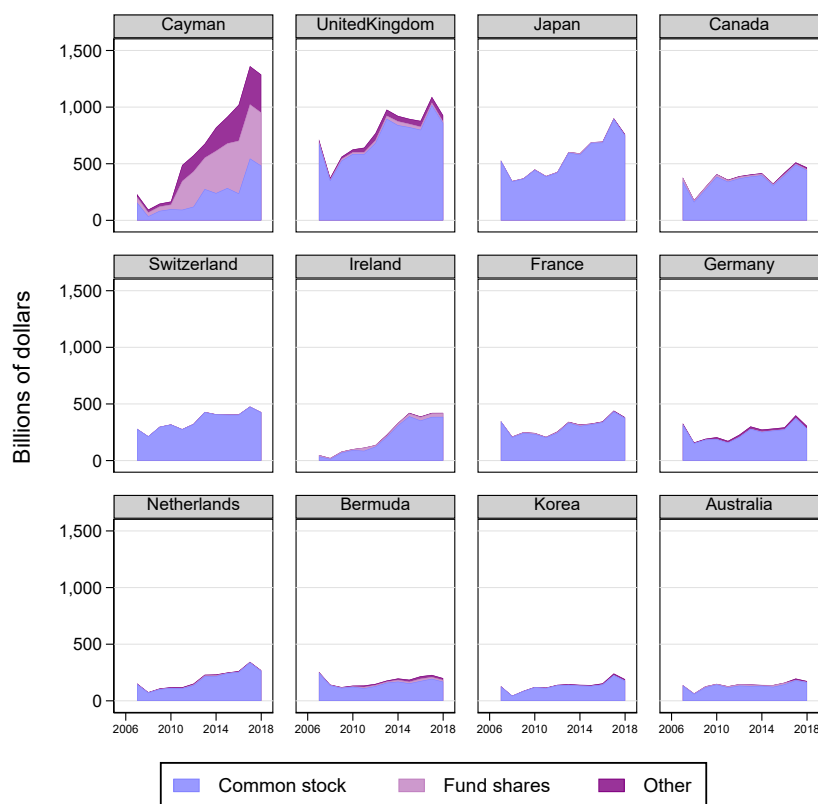


Source: TIC SHC/SHCA.

securities claims by country and security type (on a common scale), for the set of countries attracting the most U.S. investment. To appreciate the magnitude of the increase, note that claims in equities have increased 700 percent over the sample period 2006-2018, with an average annual percentage change of 18.9 percent. Long-term debt claims on the Cayman Islands have increased 152 percent, an 8 percent average annual increase. In contrast, short-term debt claims have declined. Most of the increase in flows was in equities. The increasing share of equity in total claims emerges also from Figure F.2 in the Appendix, which shows the time series evolution of the flows. The unprecedented growth of securities from the Cayman Islands and other offshore centers is evident starting in 2010. Thus, in the next figures we focus on the sample period 2007-2018 (subject to data availability).

Figure 4 breaks down the equities claims by type of equity: common stock, fund shares, and other equity. The Cayman Islands stand alone as receiving the vast majority of U.S.

Figure 4. U.S. Holdings of Foreign Equities—Common Stocks, Fund Shares and Others—by Top 12 Countries (2007-2018)



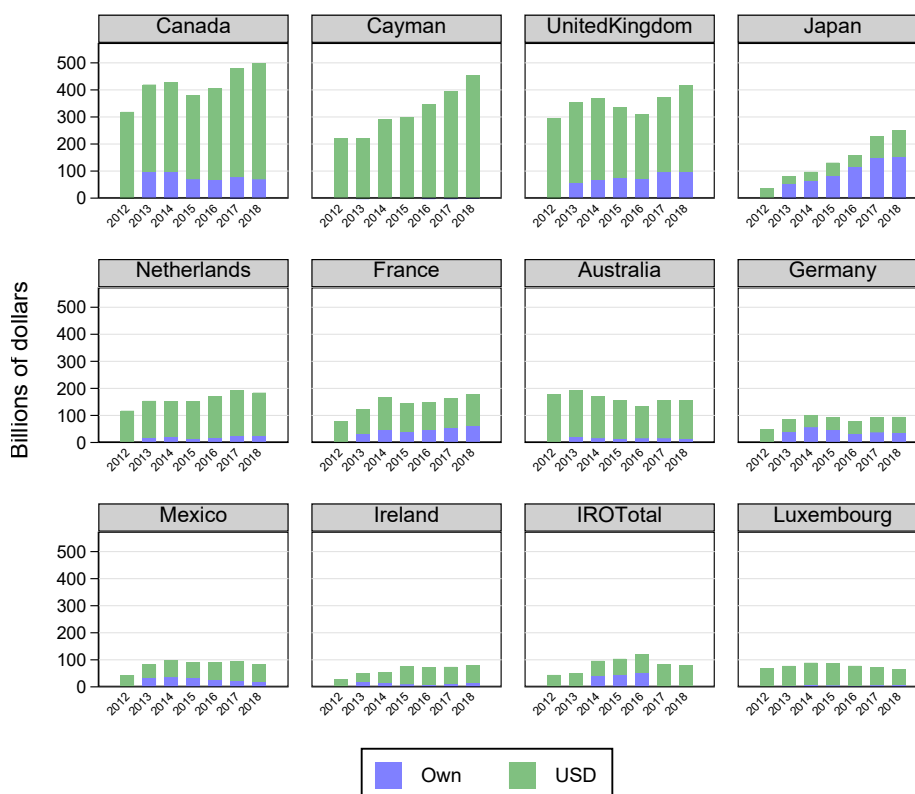
Source: TIC SHC/SHCA.

inflows the form of fund shares, reflecting ownership by U.S. residents of funds (i.e. non-banks) that intermediate capital in the Cayman Islands. Similarly, figure F.3 in the Appendix shows that the holdings of common stock and foreign depository receipts are the largest in the Cayman Islands, too. These claims are most likely holdings of equities by affiliates of multinationals.

In summary, recent data show an increase of U.S. claims on THFC, which mainly the form of equities or corporate debt investments in multinationals or less-regulated funds intermediated from the Caribbean.

In terms of currency denomination, Figure 5 shows that asset holdings in THFC are nearly all in U.S. dollars. Over the sample period 2010-2018, the growth in dollar-denominated debt claims on the Cayman Islands has grown 129 percent, while in other countries (Europe or EMEs) the share of foreign currency-denomination has increased since 2012.

Figure 5. U.S. Holdings of Foreign Debt (Claims) by Top 12 Countries and Currency Denomination (2011-2018)

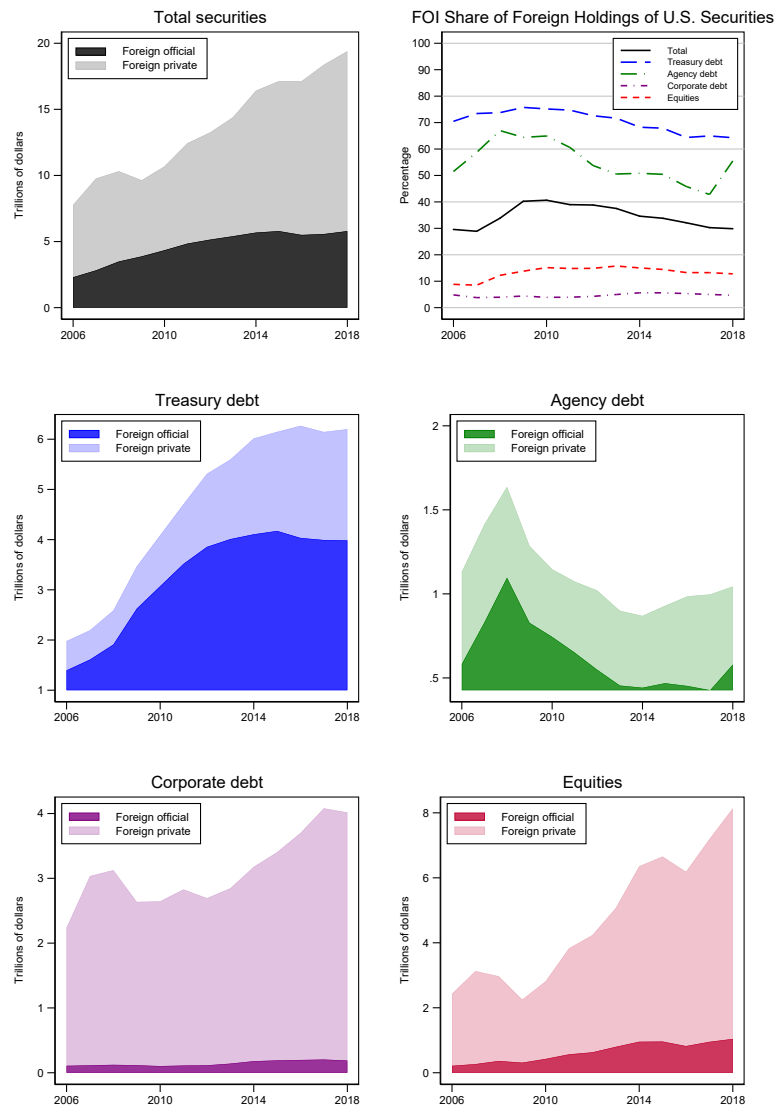


Source: TIC SHC/SHCA.

Next we examine U.S. liabilities, an essential dimension of the data for a country whose global imbalances have been under the microscope for long. Figure 6 shows the breakdown of foreign holdings of U.S. securities by the official and the private sectors. The most interesting aspect is the dominance of U.S. Treasuries in the foreign official sector. Equities and corporate debt are instead held by private investors. The growth of Treasuries within the official sector has increased significantly at the time of quantitative easing policies. Note, on the other side, that U.S. official securities claims are minimal (and not shown for this reason).<sup>17</sup> This confirms the safe asset hypothesis for U.S. Treasuries. Last, as for claims, U.S. liabilities privately held in the Cayman Islands are mostly in the form of equities and corporate bonds and have been growing since 2010.

<sup>17</sup>At end-2019, U.S. official holdings of foreign securities were about \$12 billion. See Table 2 in <https://www.newyorkfed.org/medialibrary/media/newsevents/news/markets/2019/fxq419.pdf>.

Figure 6. Foreign Holdings of U.S. Securities by the Official and Private Sector (Liabilities), 2006-2018



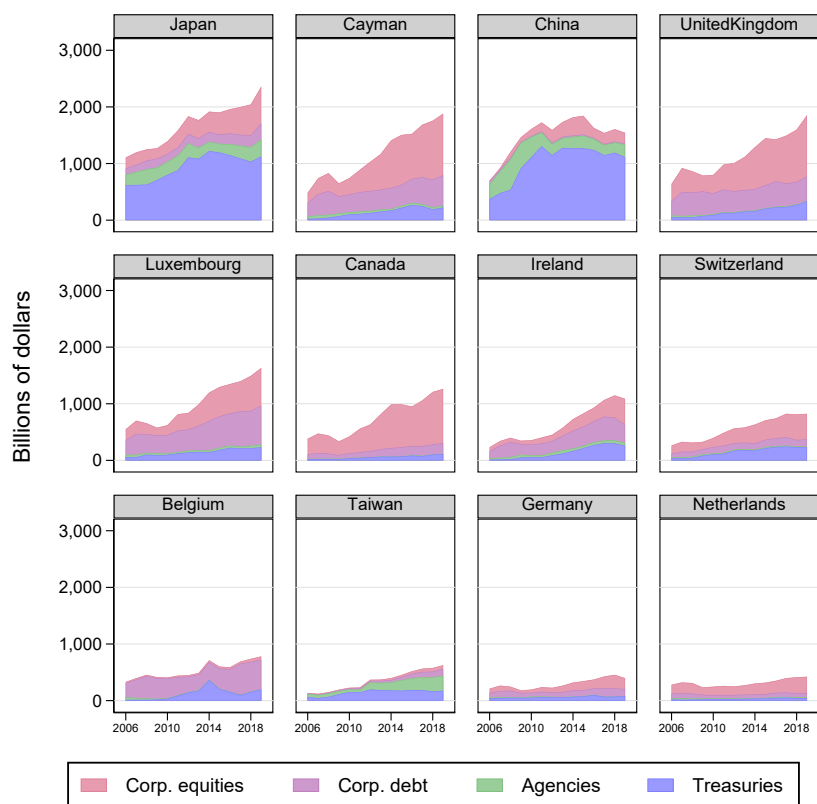
Source: TIC SHL.

Source: TIC SHL/SHLA.

Figure 7 shows the breakdown of U.S. liabilities by country. Again, most of the equities are held by investors in the Cayman Islands and Luxembourg, while most of the Treasuries are held by Japan and China and increased at the time of quantitative easing.<sup>18</sup> The increase

<sup>18</sup>Still, from a lower base, the Cayman Islands have seen an increase in liabilities in U.S. Treasuries of 674 percent over the period 2006-2018, with an average annual increase of 18 percent.

Figure 7. Foreign Holdings of U.S. Securities (Liabilities) by Top 12 Countries and Type of Asset (2006-2018)



Source: TIC SHL/SHLA.

in equities and corporate debt over the same period has been 108 percent and 483 percent, respectively.

Finally, Figure F.4 in Appendix F shows that most of the debt in the Cayman Islands is in the form of asset-backed securities (ABS). ABS are a method to recycle risk onto the market and, as such, they have often been linked to reduced debt monitoring and higher ex post risk. We will examine the risk profile of THFC assets in the next section.

To sum up, two main trends emerge from the previous data analysis, beyond an increase in flows of U.S. securities. First, there is an increase in U.S. private security claims and liabilities toward THFC. The flows have trended up mostly around 2010, a year in which most advanced economies tightened prudential regulations. The fact that most of these flows



are intermediated through less-regulated funds suggests a link to those events. Second, one can see an increase of U.S. Treasury securities abroad, mostly held by the official sector and mostly around the dates of quantitative easing policies.

These facts together suggest that a combination of macro and micro factors are behind the recent trends in flows. To further examine the macro side in Appendix C we run regressions of the monthly flows over variables from the financial and dollar cycle literature<sup>19</sup> but also some new ones related to uncertainty measures.<sup>20</sup> The variables include the growth rate of the VIX, dollar exchange rate, Federal Funds Rate or shadow rate, Excess Bond Premium and the Variance Risk Premium (VRP). We find that privately held flows mostly react to VIX and uncertainty measures, while Treasuries, mainly held by the official sector, also react to the dollar exchange rate<sup>21</sup>. All in all, however most of those macro variables do not seem to have much predictive power. Beyond that they would surely not provide any rationale for as why flows gravitate primarily toward countries specialized in tax and regulatory arbitrage. For this reason we move straight to the analysis of sector-level data by sorting securities according to characteristics of issuing firms. This will provide the best indicators for the micro motives of THFC gravitation.

## 2.1 Micro Origins of Capital Flows: Tax Haven and Risky Firms

The stylized facts in section 2 show that most flows are recently gravitating toward THFC, suggesting that tax avoidance and regulatory arbitrage might be behind those trends. This trend has been more marked after 2010, a year in which most industrialized countries tightened regulations, including investors' protection. The empirical analysis in section C highlighted that privately issued and held flows are little correlated with most macro variable. The only correlation that appears robust and significant is the one with market risk and uncertainty. Overall those facts combined suggest that factors, other than traditional macro determinants, might explain the new geography of the flows and why they gravitated toward centers specialized in regulatory arbitrage.

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<sup>19</sup>See Rey (2013) or Avdjiev et al. (Forthcoming) for some recent papers in the empirical literature on global financial and dollar cycle.

<sup>20</sup>See also Niepmann and Schmidt-Eisenlohr (2019).

<sup>21</sup>Dollar sensitivity suggests reserve management (Alfaro and Kanczuk (2009); Alfaro et al. (2014)).

We now therefore examine the micro incentives that might be driving the flows. To this purpose, we exploit the granularity of the annual TIC survey data, collected at the individual security level. Specifically, we match our industry-level flow data with the corresponding volatility risk metrics and Sharpe ratios. Both measures provide us with information on the incentives behind the shift of flows toward THFC. Higher risk indicates that tax avoidance and regulation arbitrage are the most likely cause of the shift. A high Sharpe ratio indicates a search for yield behaviour.

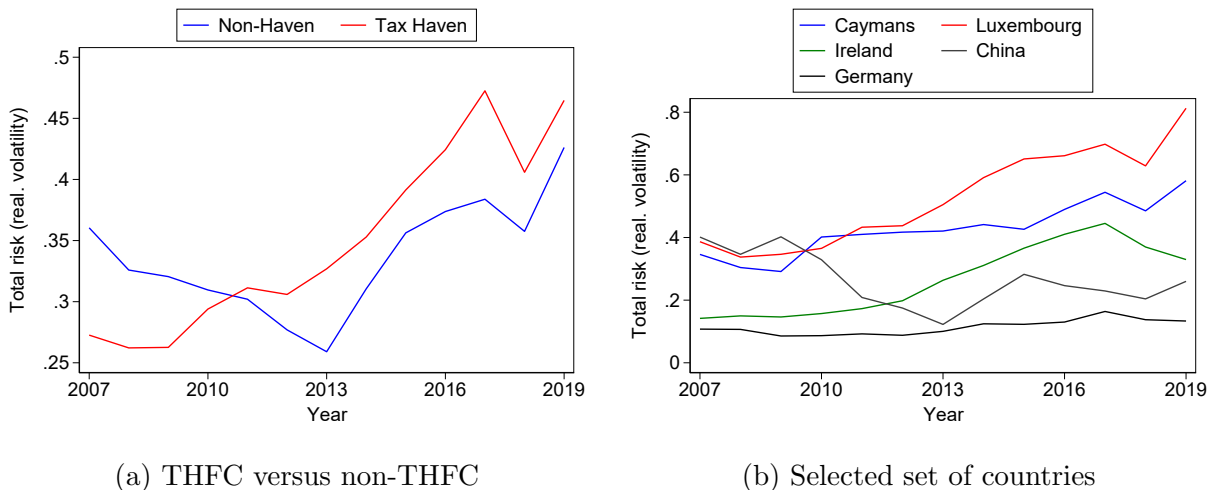
The analysis in this section uses total U.S. liabilities against other countries, that is, it combines liabilities against foreign private and foreign official investors (FOI). As noted earlier, most private U.S. securities are held by private foreign investors, but there are some notable holdings by FOI that we want to also capture in our analysis. The analysis of realized volatility, Sharpe ratios, and intangibility focuses on private U.S. liabilities for which these measures can be calculated. Most importantly, the baseline analysis therefore excludes the large foreign holdings of U.S. Treasuries. However, we provide some analysis where we include U.S. Treasuries in the analysis, assigning a risk and Sharpe ratio of zero to these holdings. When including U.S. Treasuries in the analysis, the difference in the average risk of debt holdings between tax havens and non-havens, documented below, becomes much more pronounced. Then, the average risk of tax havens is substantially higher than that of non-havens, as the latter have much larger holdings of save U.S. Treasuries.

### **2.1.1 Risk and Sharpe Ratios of U.S. Liabilities**

As a measure of risk we use yearly realized volatility at the firm level which is aggregated to the industry level based on NAICS codes. Realized volatility is given by the square root of the sum of squared daily stock returns in a given year. Yearly Sharpe ratios are computed first at firm level using yearly averages and standard deviations of daily excess stock returns. They are then aggregated by taking means at the industry level. Both variables are winsorized at the 1% and 99% level before aggregating them to the industry level. We also use a risk measure from Gilchrist et al. (2014) that captures time-varying equity volatility for firms cleaned of the forecastable variation in expected returns, which we label GSZ. The data appendix presents additional details on the construction of the variables.

Given the long standing interest in the determinants of the large and growing US current account deficit, we start by examining liabilities. The availability of detailed information on inflows is also another novel aspect of the dataset compared to other security-level data examined in related literature that focus mainly on claims.

Figure 8. Total Realized Volatility for U.S. Debt Liabilities



*Notes:* This figure plots the total realized volatility for U.S. liabilities for the years 2007-2019. The left panel shows THFC versus non-THFC, while the right panel shows a selected set of countries. For the left panel, total realized volatility is calculated by multiplying all holdings of THFC (non-THFC) countries in industry  $j$  in year  $t$  with the average realized volatility of industry  $j$  over the years 2010-2013 and then dividing by the average U.S. debt liability holdings across the two country groups over the period 2007-2019. For the right panel, country  $i$ 's holdings in industry  $j$  in year  $t$  is multiplied with the average realized volatility of industry  $j$  over the years 2010-2013 and then divided by the average U.S. debt liability holdings across the five countries over the period 2007-2019.

Figure 8 shows the total realized volatility for U.S. liabilities for the years 2007-2019. Exact formulas for all the variables below are described in Appendix E. The left panel compares THFC versus non-THFC, while the right panel shows a selected group of countries. The total realized volatility at the country-year level is computed by multiplying country  $i$ 's holdings in industry  $j$  in year  $t$  with the average Sharpe ratio of industry  $j$  over the years 2010-2013 and then dividing by the average U.S. debt liability holdings across the five countries over the period 2007-2019. Our purpose here is to highlight mainly a composition effect across industries within a country's portfolio. For this reason, we use the average

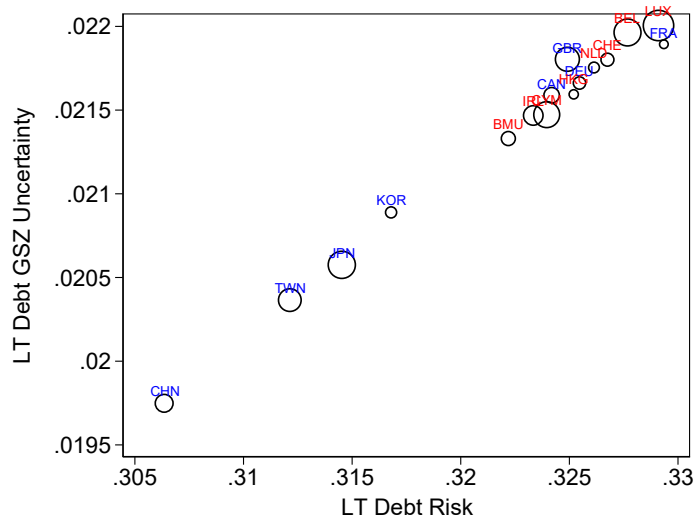
realized volatility for each industry between 2010-2013 when constructing the time series. Alternatively, one could use time-varying measures of realized volatility at the industry-level.

The left panel shows that risk has been increasing over time. In addition, it shows that the flows gravitating toward THFC are significantly riskier than those from other countries. So the overall growth in U.S. liabilities held by tax havens does not seem to be driven by an appetite for safe U.S. assets, as it is increasingly concentrated in securities of riskier industries. To further illustrate the result, the right panel plots again the total risk computed as before but now shows specific countries. We compare Caymans, Ireland, Luxembourg, namely some THFC with large holdings of U.S. liabilities, with China and Germany, two large countries with sizable holdings of U.S. assets. The figure shows higher risk in the THFC countries. While the figure excludes Treasuries, the finding is consistent with the previously documented fact that China largely holds Treasuries, hence safe assets.

Next, we check robustness of our results by examining other risk measures. Specifically we compute the uncertainty measure from Gilchrist et al. (2014) (GSZ hereafter). The measure has two advantages. First, it focuses on uncertainty as opposed to risk, thereby providing an important and complementary aspect compared to the realized volatility. Second, it proxies idiosyncratic uncertainty using high-frequency firm-level stock market data, a measure that arguably reflects exogenous changes in uncertainty, rather than the endogenous effects of informational and contractual frictions. Figure 9 below plots the weighted average GSZ metric against the weighted average realized volatility in 2019 and for the countries with the largest holdings of U.S. debt liabilities (at least \$50 billion in 2019). The averages are computed with the same procedure described for the previous figure and like before we focus on U.S. debt liabilities. The circles around the country names indicate the size of the positions. The figure shows that average GSZ uncertainty and average realized volatility of U.S. debt liabilities are highly correlated at the country level. Most importantly, it shows that both are higher in THFC countries (indicated with letters in red). Hence, in sum both average risk and average uncertainty of U.S. debt liabilities are higher for tax havens.

If debt securities issued by U.S. multi-nationals have become increasingly risky and uncertain it is of interest to examine which compensation is required by investors buying U.S. assets from THFC. This would indeed inform on whether investors are searching for yield or

Figure 9. Average Uncertainty against Average Realized Volatility for U.S. Debt Liabilities



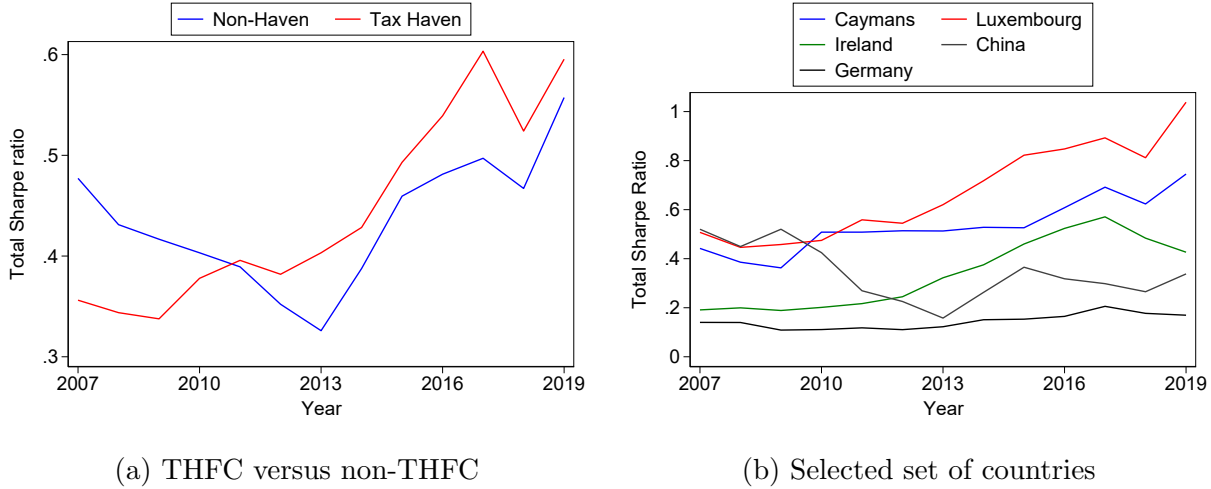
*Notes:* The figure plots the weighted average GSZ metric against the weighted average realized volatility in 2019 for the countries with the largest holdings of U.S. debt liabilities (at least \$50 billion in 2019). Averages at the country-year level are computed by multiplying country  $i$ 's holdings in industry  $j$  in year  $t$  with the average realized volatility or GSZ Uncertainty of industry  $j$  over the years 2010-2013 and then dividing by the sum of country  $i$ 's positions across all industries in year  $t$ .

for safety.

Figure 10 plots the total Sharpe ratio of U.S. Debt liabilities for the years 2007-2019. The left panel shows that the total Sharpe ratios have been increasing over time and again are higher for THFC countries. Total Sharpe ratios are higher for THFC, indicating that investors from THFC get compensated for the additional risk they take on and suggesting some search-for yield as opposed to search for safety. As before, to further illustrate our findings, in the right panel we plot the trends in the total Sharpe ratios comparing three THFC, namely Caymans, Ireland and Luxembourg, with China and Germany. Again, we highlight the significantly higher total Sharpe ratios in the THFC countries.

The connection between the shift to tax havens and an increase in risk will be rationalized in the model that we present in Section 3. In there, we argue that the double coincidence of an increase in global liquidity and a tax arbitrage induces multi-nationals to issue debt abroad through global intermediaries located in THFC and that this debt is increasingly risky. The reason for the increased risk is due to a combination of investors' search for yield and a reduction on intermediaries' monitoring incentives. We will return to this mapping in

Figure 10. Total Sharpe ratio of U.S. debt Liabilities



*Notes:* This figure plots the total Sharpe ratio for U.S. liabilities for the years 2007-2019. The left panel shows THFC versus non-THFC, while the right panel shows a selected set of countries. For the left panel, the total Sharpe ratio is calculated by multiplying all holdings of THFC (non-THFC) countries in industry  $j$  in year  $t$  with the average Sharpe ratio of industry  $j$  over the years 2010-2013 and then dividing by the average U.S. debt liability holdings across the two country groups over the period 2007-2019. For the right panel, country  $i$ 's holdings in industry  $j$  in year  $t$  is multiplied with the average Sharpe ratio of industry  $j$  over the years 2010-2013 and then divided by the average U.S. debt liability holdings across the five countries over the period 2007-2019.

section 3.

### 2.1.2 Intangibles and Risky Firms

The incentives to shift profits and to obtain funding in less regulated centers is likely to be stronger for firms that can more easily move their activities. This is the case for firms with a high share of intangible assets. Firms heavy on physical capital are more likely to request funds from local banks which are located closer to their working capital. Additionally current regulation in the United States does not allow banks to hold intangible capital as part of capital reserves to be re-deployed during crises, the reason being that royalties and patents have highly uncertain valuations.<sup>22</sup> This implies two things. First, that intangible firms have higher incentives to search for funds elsewhere. Firms with intangible inputs and capital hold very risky collateral, something which can prevent them from obtaining funds in the traditional banking system (see chapter 8 of Haskel and Westlake (2018)). Second the

<sup>22</sup>See <https://www.federalreserve.gov/bankinforeg/stress-tests/2014-revised-capital-framework.htm>.

uncertain nature of their capital makes their debt and equity issuance highly risky.

We verify those two aspects below, namely whether U.S. liabilities to THFC are not only riskier but also concentrated in industries with more intangibles and whether tax avoidance incentives are indeed higher in these industries.

First, to shed light on the firms' characteristics that make riskier assets flow through tax havens, we match our data set with an intangibility index that is based on the measure constructed by Peters and Taylor (2017), which combines both R&D and marketing expenditures.<sup>23</sup> As in the previous figures, we again focus on private securities, in particular U.S. debt liabilities.

The recent rapid growth of the intangible-intensive economy is well-known. Less known is the strong link between intangible-intensive industries and asset-risk and most importantly between intangible risky assets and tax havens. We are particularly interested in U.S. liabilities, such as debt and equity, often issued by multinationals, that is bought by investors in THFC. The correlation between securities' risk and intangibility index is illustrated in Figure 11 that shows the countries with the largest U.S. debt liability holdings in 2019. At the country-level, there is a strong positive correlation between the average realized volatility and the average intangibility of U.S. debt liability holdings. The figure also shows how holdings of tax havens are on average in industries with a higher realized volatility and a higher intangibility index.

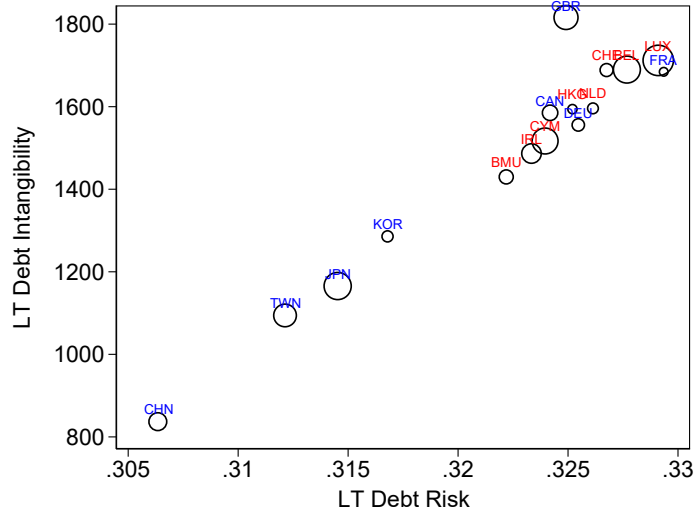
Figure 12 shows kernel densities of average realized volatility across countries separately for U.S. debt liabilities held by THFC (red lines) and non-THFC (blue lines), for the years 2007 (dashed lines) and 2019 (solid lines). There are two main takeaways. First, in both years, the distribution for THFC is shifted to the right from that of non-THFC, implying that on average THFC hold debt liabilities in riskier industries. Second, both densities shifted to the right from 2007 to 2017, indicating an overall shift in holdings towards riskier industries across all countries. Finally, in 2019, the density for THFC is more narrow, which shows that THFC are more similar in the average risk of their holdings than other countries.

The model that we present in section 3 not only predicts a correlation between firms' debt issued and bought in THFC and risk but also has detailed implications for the risk

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<sup>23</sup>See D for more details on the construction of the data.

Figure 11. Realized Volatility and Intangibility for U.S. Debt liabilities



*Notes:* The figure plots the weighted average asset intangibility index against the weighted average realized volatility in 2019 for the countries with the largest holdings of U.S. debt liabilities (at least \$50 billion in 2019). Averages at the country-year level are computed by multiplying country  $i$ 's holdings in industry  $j$  in year  $t$  with the average realized volatility or asset intangibility index of industry  $j$  over the years 2010-2013 and then dividing by the sum of country  $i$ 's positions across all industries in year  $t$ .

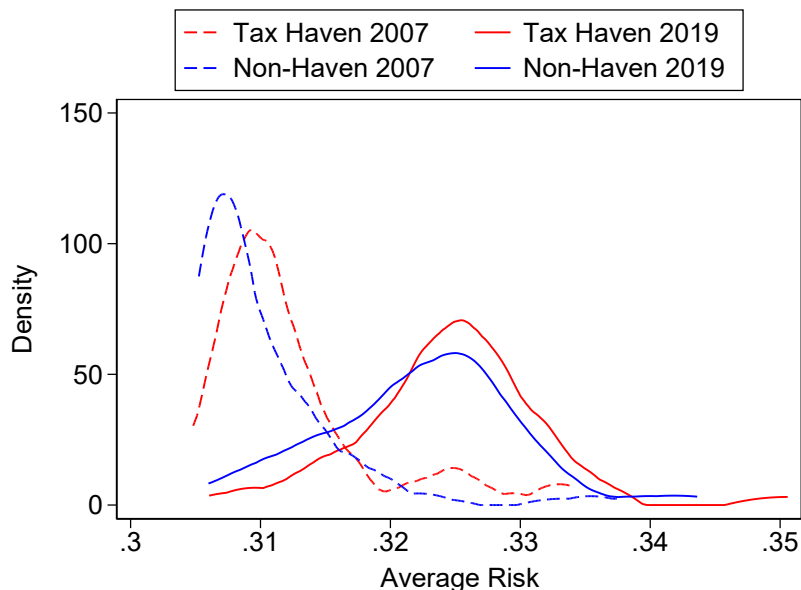
distribution of firms entering the THFC. If a larger fraction of firms issues debt in THFC, this raises the default threshold for the debt securities traded there.

Tax havens have traditionally kept lower corporate tax rates than other countries. It is therefore legitimate to ask what factors increased incentives to relocate in more recent years. The growth in the intangible firms' economy can again provides an answer. For those firms relocation is easier and in some case necessary. Hence, those are the firms that more easily can exploit the tax advantage. To test this we regress liabilities (debt and equities) of U.S. firms on statutory corporate taxes <sup>24</sup> and also interact the latter with the intangibility index. Table 5 presents regression results at the country-industry level, where holdings of U.S. private assets by foreign investors are regressed on the source country tax rate. The dependent variable is the log of the sum of U.S. corporate bond and equity holdings of foreign investors. Corporate tax rate is the statutory corporate tax rate from KPMG. Intangibility is the average intangibility index at the industry level for the years 2010 to 2013. The sample runs at an annual frequency from 2007 to 2019. The coefficient

<sup>24</sup>Data are from the KPMG database.



Figure 12. Distribution of Realized Volatility for U.S. Debt Liabilities



*Notes:* The figure plots kernel densities of the average realized volatility at the country level separately for U.S. debt liabilities held by THFC (red lines) and non-THFC (blue lines), for the years 2007 (dashed lines) and 2019 (solid lines).

on the interaction term between the corporate tax rate and the average intangibility index is negative and highly significant in both specifications. The negative coefficient implies that when a country lowers its tax rate, its holdings of U.S. liabilities in intangible-intensive industries increase relative to industries with fewer intangibles. This finding confirms that tax considerations do provide powerful incentives for intangible firms' debt to be held in THFC. It suggests a complementarity between tax arbitrage and asset intangibility, which is central to the model we present in the next section where intangible asset intensive firms issue debt in TFHC.

### 3 A Model of Multinationals and Risky Funding

Our data have highlighted that, for privately held securities, the recent raise in US imbalances has been accompanied by a shift in flows toward THFC and by an increase in the risk of the assets held there. We have also shown that tax avoidance and regulatory arbitrage are two key factors that contributed to the increase in holdings by THFC and the shift in

THFC holdings towards riskier firms. We conjecture that the increase in global savings in a world of tax differences and where securities can be intermediated by funds not subject to capital regulations can explain the double occurrence of profit shifting and the increased risk. Motivated by this we develop a simple model that captures the main elements described above and that can rationalize the contemporaneous shift toward THFC and riskier assets. In the model, heterogeneous firms, in the tradition of Melitz (2003), are combined with a moral hazard contracting problem along the lines of Martinez-Miera and Repullo (2017).

In the model, multinationals, heterogeneous in their default probabilities, endogenously choose, against the payment of an entry cost, to shift profits to a THFC, where they enjoy a lower tax rate.<sup>25</sup> A subsidiary in the THFC allows a multinational to shift profits and to issue debt through global intermediaries located in unregulated THFC. The entry condition determines the default threshold for the marginal firm which enters the THFC. Those firms operate under monopolistic competition, producing varieties which are then aggregated into a single homogeneous good consumed by households. Each variety is obtained by assembling intermediate inputs produced within different units of the conglomerate. To produce those intermediate goods, the conglomerate needs to invest. Investment is funded through risky debt obtained from global intermediaries. Firms set prices by applying a markup over marginal cost, where the latter reflect the cost of loan services.

Global intermediaries have access to a global liquid market of risk-neutral investors that enjoy a light regulation and can offer funds at low costs. Loan spreads and monitoring intensity are chosen based on an incentive-compatible contract that affects firms' default probability and risk. The endogenous choice of monitoring intensity determines both the extensive (how many firms are monitored) and the intensive margins (how much each firm is monitored) of monitoring, hence firms' risk. In equilibrium some of the domestic firms will enter the tax havens; of those entering some are monitored according to their default probability and some are not; the optimal degree of monitoring for each firm (intensive margin) will depend upon the safe return paid to global investors and the cost of monitoring.

Equipped with this model, we examine the impact of an increase in global liquidity,

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<sup>25</sup>Beyond our own facts, there is extensive empirical evidence on the relevance of profit shifting, see e.g. Guvenen et al. (2017) or Liu et al. (Forthcoming)).

that would fund U.S. imbalances, on the distribution of firms entering the THFC and on the extensive and intensive margin of risk. A fall in debt costs, triggered for instance by an exogenous increase in global liquidity channeled through the intermediaries, raises firms' profits. This has two contemporaneous effects. First, a higher fraction of firms can afford to enter the THFC. This shifts the distribution of firms that enter the THFC toward those with higher default probability and generates a novel "risk selection" effect. Second, more profitable firms appear elusively safer and global intermediaries endogenously reduce their monitoring intensity, both at the extensive and the intensive margin. This result is consistent with the fact that the increase in U.S. global imbalances, triggered by a global saving glut, went together with an increase in the size and riskiness of THFC holdings.

### 3.1 Model Structure

There are two countries, a large country,  $F$ , and a tax haven. We will continue to use the label THFC. For simplicity, we assume that firms can only produce in the large country. In the large country, there are two sectors, one producing a homogeneous good that serves as the numeraire, and one sector with heterogeneous firms producing different varieties.

Firms are heterogeneous with respect to their default risk and endogenously decide whether to become multinationals. This requires opening an affiliate in the THFC. Firms have a fixed cost of entering the THFC, where they benefit from tax savings through profit shifting.

Given the heterogeneity in default probabilities, only a fraction of them opens an affiliate in the THFC. Production is funded through risky debt, whose rate is determined within an incentive compatible contract with a global intermediary. The latter chooses monitoring intensity endogenously (see Martinez-Miera and Repullo (2017)). Riskier firms pay higher credit spreads, with the latter given by the safe rate plus a premium related to the monitoring intensity. Lenders are global funds located in the THFC, which collect savings worldwide and issue corporate debt to multinationals.<sup>26</sup>

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<sup>26</sup>It is possible to include in the model banks operating in the large country. However, to the extent that banks are subject to regulatory requirements, they would be offering less competitive lending conditions compared to unregulated global funds. The latter can also access savings world-wide. In equilibrium, multinationals will only seek funds from the global funds located in off-shore places and banks of the large

### 3.1.1 Consumers' Preferences

There is a unit mass of identical workers that share the same quasi-linear preferences over consumption of the two goods:

$$U = \alpha \ln Q + q_0 \text{ with } Q = \int_{\Omega} \left( q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}, \quad (1)$$

where  $q(\omega)$  is the quantity consumed of variety  $\omega$ . The elasticity of substitution between varieties is given by  $\sigma > 1$ .  $Q$  is aggregate consumption of a preference weighted basket of differentiated goods. The consumption of the numeraire good is given by  $q_0$ .  $\alpha$  is a preference parameter with  $0 < \alpha < 1$ . The demand for one particular variety is:

$$q(\omega) = p(\omega)^{-\sigma} P^{\sigma} Q, \quad (2)$$

where  $p(\omega)$  is the price of variety  $\omega$ . The aggregate price index of the differentiated goods sector is  $P = \int_0^{r_h} (p(r)^{1-\sigma} dF(r))^{\frac{1}{1-\sigma}}$ , which is the price aggregator over the distribution of firms  $F(r)$ , whose support is  $[0, r_h]$  and  $Q = \frac{\alpha}{P}$ . Firms are heterogeneous in their level of risk,  $r$ , which denotes their probability of default and which is distributed according to  $F(r) = \left(\frac{r}{r_h}\right)^{\gamma}$ .

### 3.1.2 Production of Each Variety

To produce varieties each entrepreneur  $r$  has to invest in intermediate inputs. Within the firm, there are several units that assemble the intermediate inputs. The units have a productivity  $\theta_p$ , which is distributed according to  $g(\theta_p) = a\zeta(\theta_p)^{-(\zeta+1)}$  with  $a > 0$  and  $\zeta > 0$ . Each unit of intermediate input has a price  $R_p$  and each unit of the firm transforms one unit of intermediate input into  $\theta_p$  units of the final good variety. Only units for which  $\theta_p > R_p$  will operate. Hence, given an aggregate supply of intermediate inputs,  $x_p$ , we have that:

$$\int_{R_p}^{\infty} g(\theta_p) d\theta_p = a(R_p)^{-\zeta} = x_p, \quad (3)$$

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country would specialize in serving local domestic businesses.

which implies:

$$R_p = R(x_p) = \left(\frac{x_p}{a}\right)^{-\frac{1}{\zeta}}. \quad (4)$$

Investment is funded through loans whose returns are derived from the contractual agreement described in the next section. Given the return on debt,  $R_b$ , the mass of firms that operate is obtained by the condition  $R_b = R(x_p)$ . To solve the model, we will use the market clearing condition between the aggregate demand for investment and the aggregate supply of savings.

### 3.2 Firms' Pricing Decision

In the homogeneous good sector, firms produce with a constant returns to scale technology and earn zero profits. In the differentiated good sector, firms produce different varieties under monopolistic competition, funding production with debt. Firms are heterogeneous in their riskiness or probability of default,  $r$ , which determines the loan rate they pay, according to the contractual agreement derived in the next section. The probability of default implies that firms' revenues are stochastic:

$$\tilde{R} = \begin{cases} R & \text{with probability } 1 - r + m \\ 0 & \text{with probability } r - m \end{cases} \quad (5)$$

where  $R > 0$  are firms' revenues,  $r \in (0, 1)$  which is distributed according to the density  $F(r)$ , and  $m \in [0, p]$  is the bank's monitoring intensity. Monitoring reduces the default probability, but, as we discuss later, it entails a convex cost for the lender. Firms' costs of loans,  $R_b(r)$ , are heterogeneous and depend upon the firm's default probability. The exact relation is derived within the contractual agreement solved in the next section.

Under monopolistic competition, firms optimally charge a constant mark-up over marginal cost:

$$p(r) = \frac{\sigma}{\sigma - 1} R_b(r) \quad (6)$$

Firms profits are given by expected revenues,  $(1 - r + m)p(r)q(r)$ , minus the cost of debt:

$$\pi(r) = (1 - r + m)p(r)q(r) - R_b(r) \quad (7)$$

Post-tax profits are given by  $\pi^E(r) = (1 - t)\pi(r)$ . The marginal tax rate will depend upon the location of a firm's profits, which is determined endogenously further below. Entering the tax haven entails lower taxes, and this provides the incentives for firms to enter, but also entails an entry cost. We discuss the sorting of firms across locations further below.

### 3.2.1 Debt Rate and Firms' Risk—The Contractual Agreement

Firms are funded by an intermediary that raises funds globally. There is a large set of risk-neutral investors and a representative risk-neutral intermediary. The latter does not necessarily represent traditional banks, but can also be thought of as a mutual fund that sells credit in the market. The intermediary extends debt to firms, but in turn, needs to raise funds from foreign investors, which are characterized by an infinitely elastic supply of funds at an expected safe return equal to  $R_S$ . Intermediary monitoring entails a convex cost,  $c(m)$ . Note that since the contract structure applies equally to all firms, for notational convenience since now on we omit the dependence of the loan rates on firms' default distribution.

The firms' debt rate,  $R_b$ , is determined within an optimal contract between the intermediary and the firm on one side and the intermediary and the international investors on the other. For this, we follow Martinez-Miera and Repullo (2017). In the optimal contract, intermediaries choose the monitoring intensity,  $m$ , as well as the rate to offer to investors to maximize the expected profit, net of returns to investors,  $R_I$ , given intermediaries' incentive compatibility constraint and the participation constraints of intermediaries and investors. Therefore the optimal contract reads as follows:

$$\max_{\{R_I, m\}} [(1 - r + m)(R_b - R_I) - c(m)] \quad (8)$$

subject to the intermediaries' incentive compatibility constraint:

$$m^* = \arg \max_m \{[(1 - r + m)(R_b - R_I^*) - c(m)]\}, \quad (9)$$

the intermediaries' participation constraint:

$$(1 - r + m^*)(R_b - R_I^*) - c(m) \geq 0 \quad (10)$$

and the international investors' participation constraint:

$$(1 - r + m^*)R_I^* \geq R^S \quad (11)$$

The incentive compatibility constraint (9) characterizes the intermediary's choice of monitoring  $m^*$ , given the rate on the intermediary's external funds,  $R_I$ , and the loan rate,  $R_b$ . The participation constraints (10) and (11) ensure that the intermediary makes profits in excess of the market outside option, and net of the monitoring cost, and that international investors get the required expected return on their investment.

### 3.2.2 Monitoring Intensity—Extensive and Intensive Margin of Risk

The debt contract can be solved sequentially and by backward induction to deliver the loan rate and the equilibrium monitoring. The latter is defined by an *extensive* and an *intensive margin*. In equilibrium some firms will be monitored according to their default probability and some will not. The monitoring threshold will determine the *extensive margin* of risk, that is how many firms are not monitored. The degree according to which each firm is monitored, namely the *intensive* margin, will depend upon the return on global liquidity and the cost of monitoring. Finally, the optimal debt rate is a function of firms' risk or default probability. First, intermediaries choose the monitoring intensity. The first order condition to equation (9) delivers the incentive-compatible schedule linking monitoring intensity to the bank margins:

$$(R_b - R_I^*) - c'(m^*) = 0 \quad (12)$$

Given the return on outside funds that satisfies investors' participation constraint:

$$R_I^* = \frac{R^S}{(1 - r + m^*)} \quad (13)$$

we can re-write (12) as follows:

$$R_b = \frac{R^S}{(1 - r + m^*)} + c'(m^*) \quad (14)$$

The latter allows us to determine the loan rate for monitored firms, which will vary according to their type,  $r$ . To determine the loan rate we also assume contestability. By the latter, an intermediary lending to entrepreneurs of type  $p = 0$  sets a rate equal to the safe return,  $R_S$ , since at a lower rate it will make negative profits and at a higher rate it will be undercut by another intermediary. Similarly, for all other firms the loan rate will be set at the minimum given by equation (14). The convexity of the monitoring cost function implies that a corner solution with zero monitoring materializes when  $c''(0) - \frac{R_S}{(1-r)^2} \geq 0$ . The latter condition also determines a cut-off:

$$\hat{r} = 1 - \sqrt{\frac{R_S}{c''(0)}} \quad (15)$$

below which firms are not monitored as considered safe by the global intermediary. Above the cut-off firms are monitored according to their probability of default. The default threshold  $\hat{r}$  defines the *extensive* margin of risk. The intensive margin of risk or the monitoring intensity of each project is either zero or positive, when  $r > \hat{r}$ . For monitored firms the optimal monitoring intensity,  $m^*$ , is obtained by taking first order condition of 14, upon assuming the following cost function,  $c(m) = k(m)^2$ :

$$m^* = r - \left(1 - \sqrt{\frac{R_S}{2k}}\right) \quad (16)$$

Equation 16 provides the *intensive* margin of risk. To sum up, monitoring intensity is given by

$$m^* = \begin{cases} 0 & \text{when } r < \hat{r} \\ r - \left(1 - \sqrt{\frac{R_S}{2k}}\right) & \text{when } r > \hat{r} \end{cases} \quad (17)$$

### 3.2.3 Endogenous Internationalization and Risk Distribution of Entrants

Firms which become a multinational face an entry cost,  $\varkappa$ . Whether the firm will internationalize depends upon the tax saving and its level of profits. Let us define the ‘profit shifting cutoff cost level’ as the cost level  $r^*$ , for which a firm is indifferent between paying taxes



at home and paying taxes in the tax haven. The cut-off,  $\tilde{r}$ , is determined by the following condition:

$$(1 - t_i^F) [(1 - r + m^*)p(r)q(\tilde{r}) - R_b(\tilde{r})q(\tilde{r})] = (1 - t_i^H) [(1 - r + m^*)p(\tilde{r})q(\tilde{r}) - R_b(\tilde{r})q(\tilde{r})] + \varkappa \quad (18)$$

Using the optimal pricing equation, 6, the above equation leads to:

$$(1 - t_i^F) \left[ (1 - r + m^*) \left( \frac{\sigma}{\sigma - 1} - 1 \right) R_b(\tilde{r}) \right] - \varkappa = (1 - t_i^H) \left[ (1 - r + m^*) \left( \frac{\sigma}{\sigma - 1} - 1 \right) R_b(\tilde{r}) \right] \quad (19)$$

When substituting the expression for  $R_b = \frac{R^S}{(1-r+m^*)} + c'(m^*)$ , one can recover the default threshold of the firm that is indifferent between opening an affiliate in the THFC or not. The threshold,  $\tilde{r}$ , identifies the fraction of risky firms that enter the THFC:

$$\pi(r) = \begin{cases} (1 - t_i^F) [(1 - r + m^*) \left( \frac{\sigma}{\sigma - 1} - 1 \right) R_b(\tilde{r})] - \varkappa & \text{when } r < \tilde{r} \\ (1 - t_i^H) [(1 - r + m^*) \left( \frac{\sigma}{\sigma - 1} - 1 \right) R_b(\tilde{r})] & \text{when } r > \tilde{r} \end{cases} \quad (20)$$

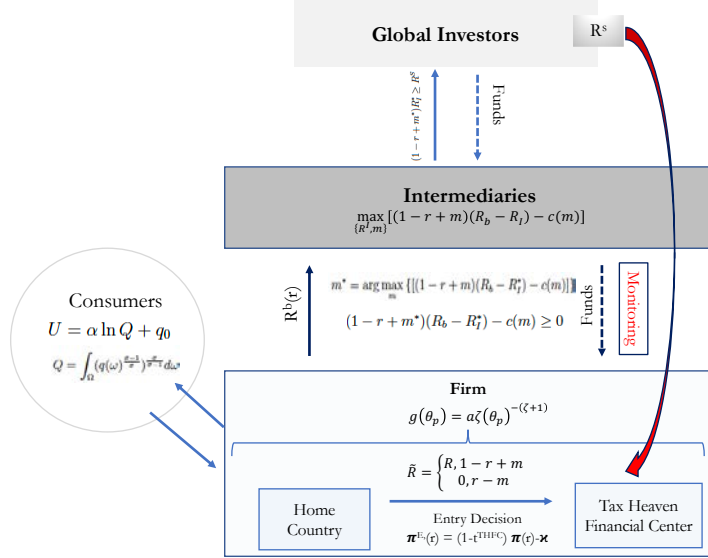
After substituting the loan rate from equation 14, the default threshold for entrants is determined by the following condition:

$$(t_i^H - t_i^F) \left[ \left( \frac{\sigma}{\sigma - 1} - 1 \right) (R^S + (1 - \tilde{r} + m^*))c'(m^*) \right] = \varkappa \quad (21)$$

where  $m^*$  is given by equation 16.

Note that the risk distribution of firms and the extensive margin of risk derived in the model find a mapping in our data, more specifically with the density distribution shown in figure 12. In there we have shown that the average risk of firms has increased over time. In the model this would correspond to a decline in the share of monitored firms. Also the density of risk seems to be less diversified in THFC, in other words riskier firms are more concentrated in there. An additional goal of our model would be to replicate those facts.

Figure 13. Structure of the general equilibrium model



### 3.2.4 Global Market Clearing of Debt and Equilibrium

Global demand and supply of debt clears to satisfy the following market clearing condition:

$$F(R_S^*) = \int_0^1 R^{-1}(R_p^*) dr = w, \quad (22)$$

where  $w$  is the exogenous amount of worldwide wealth and where  $x_p = R^{-1}(R_p^*)$  is the inverse of  $R(x_p) = R_p^*$ . Given the equilibrium conditions of the model we will now conduct some comparative static exercises, examining how a fall in the corporate tax, in regulation costs of global banks and in entry costs of the THFC or a fall in the debt costs can impact the share of firms endogenously entering the THFC and the extensive and intensive margin of risk.

**Definition 1. Competitive Equilibrium.** A competitive Equilibrium is a an optimal variety,  $q(\omega)$ , that satisfied 2, an optimal price,  $p(r)$ , that satisfies 6, an investment schedule,  $x_p$ , and corresponding loan rate,  $R(x_p) = R_p^*$ , that satisfies,  $R_p^* = \min_{m \in [0, p]} (\frac{R^S}{(1 - r + m^*)} + c'(m^*))$  and a market clearing,  $\int_0^1 x_p^* dr = w$ .

The structure of the model can be summarized in figure 13 below. Below we examine the implications of the model and how it can replicate empirical stylized facts in two steps.

First, we derive analytically some comparative static exercises by examining the responses of the risk distribution of entrants and the risk margins (intensive and extensive) to changes in corporate taxes and regulation costs in the THFC and to the cost of global funds. Next, we present some simulations that allows us to graphically visualize the same relations for empirically reasonable parameters.

### 3.2.5 A Raise in Global Savings Shifts: Profit Shifting and Risk

The growth in U.S. liabilities is associated with an increase in global saving. The latter in turn reduces the level of long-term real interest rate (Bernanke (2005)) and affects financial risk (Summers (2014)). Our evidence uncovered that much of those asset flows are channelled through THFC and are associated with higher risk indicators. Our model can shed light on the connection between the shift of the flows to the THFC and the increase in debt risk.

**Proposition 1.** *In presence of a tax advantage, an increase in global savings, which induces a fall in  $R^S$ : i) raises the fraction of entrants and shifts its distribution toward riskier firms; ii) it also increases risk at the intensive and extensive margin.*

**Proof.** Since  $R'(x_p) < 0$  and since  $R_p^*$  is decreasing in  $R_S^*$  we have:

$$\frac{dR_S}{dw} = \frac{1}{F'(R_S^*)} < 0 \quad (23)$$

From equation 21 a decline in  $R^S$  induces an increase in  $\tilde{r}$ , hence a larger fraction of firms shifts profits and the distribution of entrants shifts toward riskier ones. This proves part a. Also an increase in the supply of global savings leads to an increase in investment (visible from  $x_p = R^{-1}(R_p^*)$ ) and a fall in the loan rate as per equation:

$$R_b = \frac{R^S}{(1 - r + m^*)} + c'(m^*) \quad (24)$$

It also leads to an increase in the number of firms that are not monitored, as per equation  $\hat{r} = 1 - \sqrt{\frac{R^S}{c''(m^*)}}$ . This leads to an increase in the extensive margin of risk. Finally, a fall in the safe rate leads to a decrease in the monitoring intensity. To see this total differentiation of equation 24 leads to:

$$\frac{dm^*}{dR^S} = -\left(\frac{1}{(1-p+m^*)}\right)[c''(m^*) - \frac{R^S}{(1-p+m^*)^2}]^{-1} \quad (25)$$

The latter is negative if the cost of monitoring is convex. The joint increase of non-monitored firms and the fall in monitoring intensity leads to an increase in risk. So an increase in global liquidity coupled with a tax arbitrage induces more and riskier firms to enter the tax haven and also reduces the extensive and the intensive margin of monitoring.

To sum up a reduction in debt costs, due to an increase in global funds, allows us to rationalize why the increasing U.S. global imbalances has been also increasingly associated with shifts of flows and risk toward THFC.<sup>27</sup> Indeed, an increase in global liquidity intermediated through mutual funds resident in tax havens induces firms to create an affiliate in a THFC. The increase in liquidity raises firms' profits for two reasons. First, it directly lowers loan spreads due to increased liquidity supply. Second, it lowers firms' tax bills due to increased profit shifting. The ensuing boost in profits induces global intermediaries to economize on monitoring. This in turn results in an ex post increase of firms' default risk.

### 3.2.6 Simulations of the Model

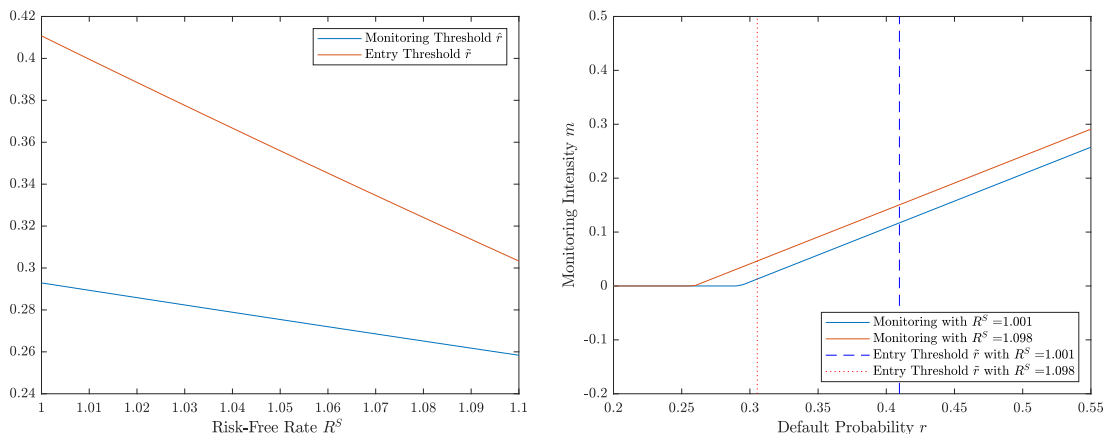
In this section we run some model simulation to graphically visualize the above derived relations for empirically reasonable parameters. Specifically we solve the model for different values of the global safe rate.

Figure 14 shows the results. The left panel shows the responses of the entry threshold,

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<sup>27</sup>Note that changes in taxes alone do not unambiguously lead to entry of more risky firms due to two opposing effects. On the one hand, the tax advantage might induce riskier firms to enter. However, intermediaries would in turn adjust their monitoring intensity and transfer the higher monitoring costs onto loan rates. This second effect might neutralize the tax advantage. In the model the elasticity in monitoring intensity depends upon the assumed cost function. The results are consistent to the fact that is the combination of the increase in global savings in a world of tax differences that lead to riskier firms in THFC. Lower entry costs have similar unambiguous effects.

Figure 14. Simulation: Changes in Global Safe Rates



Left panel shows the responses of the entry threshold and the monitoring threshold to change in in safe rates. Right panel show changes in the relation between monitoring intensity and default probability with respect to changes in safe rate.

$\tilde{r}$ , and of the monitoring threshold,  $\hat{r}$ , to change in in safe rates,  $R_S$ . The right panel show changes in the relation between monitoring intensity and default probability with respect to changes in safe rate. Below the threshold,  $\hat{r}$ , monitoring intensity is zero. Above it, monitoring intensity increases with the firms' default probability,  $r$ . In line with our results in Proposition 1, a fall in the global safe rate raises the entry threshold (left panel) and thus shifts the distribution of entrants toward riskier firms. It also raises the monitoring threshold, implying that the fraction of firms which is not monitored raises. This increases the extensive margin of risk. And at last, it reduces the monitoring intensity (right panel) for each project above the monitoring threshold. Note however that the largest effects come from the shifts in entrants' distributions and from the increase in the extensive margin of risk.

## 4 Conclusions

The U.S. global imbalances are a well-known macro trend in international finance. Their growth is even more puzzling in light of the 2007-2008 financial crisis. A large and influential literature has addressed the macro determinants of the capital flows and of the global financial and dollar cycle. Less is known on the micro determinants that explain the direction of the

flows toward specific locations and the riskiness of those assets.

Using confidential and highly granular data from U.S. residents and foreign residents holdings of U.S. dollar-denominated assets, we uncover a set of new facts. Private holdings (inflows and outflows) are mainly intermediated through tax havens/ financial centers, have increased at around 2010, namely the year of the Dodd-Frank Act and the tightening of regulation in the most industrialized countries, and are largely intermediated by unregulated mutual funds. Furthermore, assets intermediated through THFC are riskier and pay higher Sharpe ratios. These assets are mainly linked to firms operating in intangible-intensive sectors. The remaining bulk of the flows is represented by holdings of the official sector. The latter invested mainly in safe assets, such as treasuries, and its holdings grew at around 2012, in correspondence with the world-wide expansion of liquidity associated with quantitative easing policies.

Motivated by the above facts we conduct an empirical analysis at country and sector level. While we confirm that some of the traditional global and dollar cycle variables, such as uncertainty indicators, play a role at country level, we find that much of the flows at sector level are explained by corporate tax differentials and asset intangibility.

We rationalize the connection between the growing flows of private holdings toward tax havens and the higher risk of these assets in a model which combines endogenous firms' entry into tax havens and endogenous monitoring intensity by global intermediaries. We introduce firms' heterogeneity at the level of firms' default probabilities, hence their riskiness. In the model, an increase in global savings, by reducing the cost of debt and raising firms profits, induces more of them to enter tax havens. Contemporaneously, more profitable firms appear elusively safe and this induces global intermediaries to reduce their monitoring intensity, a decision which ex post raises firms' default probability.

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# A Tables

Table 1. Aggregate Private Flows into the United States (Liabilities)

	Equity		Corporate Bonds		Treasuries	
	(1) One Variable at a Time	(2) All	(3) One Variable at a Time	(4) All	(5) One Variable at a Time	(6) All
D Log Vix	-0.609*** (0.208)	-0.213 (0.320)	-1.188*** (0.297)	-1.064* (0.597)	0.710 (1.384)	0.679 (2.062)
D Excess BP	-0.302* (0.164)	0.0621 (0.190)	-0.479 (0.411)	-0.108 (0.558)	-0.0255 (1.092)	-0.596 (1.144)
D Fed Funds R.	-0.436* (0.241)	-0.532** (0.253)	0.978** (0.422)	1.081** (0.426)	-2.150 (1.412)	-2.886* (1.539)
D Term Spread	0.0393 (0.182)	-0.0861 (0.202)	-0.296 (0.454)	-0.119 (0.531)	-0.338 (1.200)	-1.521 (1.393)
D Unempl. Outl.	-0.527 (0.436)	-0.0791 (0.591)	0.449 (1.208)	1.187 (0.864)	2.291 (2.291)	1.753 (2.140)
D Dollar	-0.130*** (0.0292)	-0.112** (0.0440)	-0.134** (0.0601)	-0.149* (0.0795)	0.0668 (0.169)	0.175 (0.214)
D VRP US	-0.00265** (0.00110)	-0.00178* (0.000906)	-0.00287* (0.00172)	0.000254 (0.00234)	-0.000959 (0.00553)	-0.00553 (0.00639)
D Treas. Basis 3y	-0.00871* (0.00484)	0.0100 (0.00745)	-0.00931 (0.0182)	0.0240 (0.0200)	0.0311 (0.0379)	0.0203 (0.0485)
D EMBI	-0.00403*** (0.00141)	-0.00279 (0.00237)	-0.00599*** (0.00227)	-0.00219 (0.00492)	0.00486 (0.00695)	-0.000475 (0.00990)
D Oil Price	0.00771 (0.00558)	-0.0134 (0.00836)	0.0107 (0.0155)	-0.0131 (0.0195)	-0.00148 (0.0426)	0.0335 (0.0507)
$N$		191		191		191
$R^2$		0.173		0.095		0.039

*Notes:* This table presents regression results on the aggregate flows into U.S. assets from abroad on monthly changes in a set of macro controls. The dependent variable is the ratio of foreign private purchases of a type of U.S. asset over the previous month's holdings of that asset by foreign private investors. Excess BP is the Excess Bond Premium. Fed Funds R. is the Federal Funds rate or the Wu-Xia shadow rate during the zero lower bound period. VRP US is the variance risk premium as in Londono and Zhou (2017). The treasury basis is from Du et al. (2018). EMBI is the emerging market bond index spread. The sample runs at a monthly frequency from 2002 to 2018. See the data appendix for details. Robust standard errors are shown in parentheses. Key: \*\*\* significant at 1%; \*\* 5%; \* 10%.

Table 2. Aggregate Official flows into the United States (Liabilities)

	Equity		Corporate Bonds		Treasuries	
	(1)	(2)	(3)	(4)	(5)	(6)
	One Variable at a Time	All	One Variable at a Time	All	One Variable at a Time	All
D Log Vix	-0.672 (0.474)	0.000555 (0.736)	-0.710 (0.582)	-0.854 (1.178)	-0.961** (0.387)	-0.512 (0.649)
D Excess BP	-0.418 (0.328)	-0.0954 (0.378)	-0.0864 (0.547)	0.255 (0.742)	-0.408 (0.292)	0.0860 (0.363)
D Fed Funds R.	-2.076*** (0.604)	-2.163*** (0.646)	1.214* (0.633)	1.249 (0.831)	-0.380 (0.468)	-0.181 (0.486)
D Term Spread	0.445 (0.483)	0.00748 (0.478)	-0.832 (0.737)	-0.755 (0.924)	0.323 (0.404)	0.337 (0.502)
D Unempl. Outl.	-1.533* (0.929)	-0.993 (1.097)	1.548 (1.401)	1.992 (1.509)	-1.284*** (0.498)	-0.566 (0.649)
D Dollar	-0.218*** (0.0675)	-0.138 (0.104)	-0.0959 (0.104)	-0.123 (0.164)	-0.230*** (0.0606)	-0.202** (0.0895)
D VRP US	-0.00228 (0.00214)	-0.00195 (0.00176)	-0.000975 (0.00221)	0.00151 (0.00245)	-0.00301** (0.00138)	-0.000600 (0.00202)
D Treas. Basis 3y	-0.0183 (0.0158)	-0.00706 (0.0262)	0.00414 (0.0163)	0.0388 (0.0294)	-0.0214* (0.0122)	0.00518 (0.0171)
D EMBI	-0.00384 (0.00247)	0.000419 (0.00437)	-0.00482 (0.00386)	-0.00604 (0.00896)	-0.00624*** (0.00230)	-0.000354 (0.00349)
D Oil Price	0.0280** (0.0142)	0.00840 (0.0192)	0.00213 (0.0208)	-0.00767 (0.0345)	0.0302** (0.0136)	0.000716 (0.0183)
$N$		191		191		191
$R^2$		0.130		0.042		0.087

*Notes:* This table presents regression results on the aggregate flows into U.S. assets from abroad on monthly changes in a set of macro controls. The dependent variable is the ratio of foreign official purchases of a type of U.S. asset over the previous month's holdings of that asset by foreign official investors. Excess BP is the Excess Bond Premium. Fed Funds R. is the Federal Funds rate or the Wu-Xia shadow rate during the zero lower bound period. VRP US is the variance risk premium as in Londono and Zhou (2017). The treasury basis is from Du et al. (2018). EMBI is the emerging market bond index spread. The sample runs at a monthly frequency from 2002 to 2018. See the data appendix for details. Robust standard errors are shown in parentheses. Key: \*\*\* significant at 1%; \*\* 5%; \* 10%.

Table 3. Aggregate Flows from the United States (Claims)

	Equity		Long Term Debt	
	(1) One Variable at a Time	(2) All	(3) One Variable at a Time	(4) All
D Log Vix	-0.535*** (0.160)	-0.0727 (0.198)	-0.551 (0.530)	0.933 (0.797)
D Excess BP	-0.338* (0.173)	-0.0986 (0.201)	-0.374 (0.316)	0.422 (0.282)
D Fed Funds R.	0.238 (0.206)	0.164 (0.150)	0.637 (0.479)	0.394 (0.429)
D Term Spread	-0.0178 (0.159)	-0.0514 (0.144)	-0.354 (0.484)	-0.377 (0.434)
D Unempl. Outl.	-0.549 (0.371)	-0.179 (0.256)	-1.216* (0.622)	0.122 (0.751)
D Dollar	-0.0756*** (0.0290)	-0.0329 (0.0378)	-0.301*** (0.0510)	-0.189*** (0.0668)
D VRP US	-0.00268*** (0.000580)	-0.00175** (0.000740)	-0.00323 (0.00214)	-0.000439 (0.00175)
D Treas. Basis 3y	-0.0109 (0.00721)	0.00779 (0.00686)	-0.0369*** (0.0137)	0.00509 (0.0200)
D EMBI	-0.00390*** (0.000753)	-0.00209 (0.00165)	-0.00975*** (0.00212)	-0.00868** (0.00428)
D Oil Price	0.0102 (0.00686)	-0.0000706 (0.00683)	0.0585*** (0.0157)	0.0309* (0.0182)
$N$		191		191
$R^2$		0.147		0.207

*Notes:* This table presents regression results on the aggregate investment flows from U.S. residents into foreign assets on monthly changes in a set of macro controls. The dependent variable is the ratio of U.S. residents' purchases of a type of foreign asset over the previous month's holdings of that type of asset by U.S. residents. Excess BP is the Excess Bond Premium. Fed Funds R. is the Federal Funds rate or the Wu-Xia shadow rate during the zero lower bound period. VRP US is the variance risk premium as in Londono and Zhou (2017). The treasury basis is from Du et al. (2018). EMBI is the emerging market bond index spread. The sample runs at a monthly frequency from 2003 to 2018. See the data appendix for details. Robust standard errors are shown in parentheses. Key: \*\*\* significant at 1%; \*\* 5%; \* 10%.

Table 4. Average Realized Volatility, Sharpe ratios, GSZ Uncertainty, and Intangibility of U.S. Liabilities, for Debt and equities and THFC Status

	Real. Volatility		Sharpe Ratio		GSZ Uncertainty		Intangibility	
	(1) Equity	(2) Debt	(3) Equity	(4) Debt	(5) Equity	(6) Debt	(7) Equity	(8) Debt
Tax Haven	0.136*** (0.0474)	0.297*** (0.0377)	0.0679 (0.120)	0.271*** (0.105)	0.0122*** (0.00419)	0.0263*** (0.00338)	18.08 (13.69)	122.5*** (13.57)
Observations	2407	1919	2407	1919	2407	1919	2407	1919
$R^2$	0.012	0.246	0.104	0.168	0.011	0.283	0.039	0.267

*Notes:* This table presents regression results where the weighted average realized volatility, Sharpe ratios, GSZ Uncertainty, and Intangibility of U.S. equity and debt liabilities at the country-time level are regressed on a dummy variable that takes the value of one if a country is a THFC. All regressions include year fixed effects. The sample runs from 2007 to 2019. The equity sample includes 220 countries and the debt sample includes 186 countries. Robust standard errors are shown in parentheses. Key: \*\*\* significant at 1%; \*\* 5%; \* 10%.

Table 5. Tax Rates, Asset Intangibility and U.S. Debt and Equity Liabilities

	Log Total Equity and Debt	
	(1)	(2)
Tax Rate	0.00730 (0.00674)	
Tax Rate X Intangibility	-0.0192*** (0.00659)	-0.0206*** (0.00646)
Year FE	Yes	No
Industry FE	Yes	No
Country FE	Yes	No
Country-Year FE	No	Yes
Ind.-Year FE	No	Yes
Observations	26091	26089
$R^2$	0.918	0.948

*Notes:* This table presents regression results on country-industry level holdings of U.S. assets by foreign investors. The dependent variable is the log of the sum of U.S. corporate bond and equity held by foreign investors. Corporate tax rate is the statutory corporate tax rate from KPMG. Intangibility is the average asset intangibility at the industry level over the years 2010 to 2013. The sample runs at an annual frequency from 2007 to 2019. Standard errors clustered at the country-year level are shown in parentheses. Key: \*\*\* significant at 1%; \*\* 5%; \* 10%.

## **B The Treasury International Capital (TIC) Reporting System**

### **B.1 Overview**

The TIC (Treasury International Capital) system collects data on cross-border banking and securities positions and flows. These data form the basis for U.S. official balance of payments and international investment position data on portfolio investment, and are also used in the Federal Reserve’s Financial Accounts (Z.1 release) data on rest-of-world portfolio positions and flows. Reporting is legally mandated.

For securities positions and flows, the primary TIC forms are: the TIC S, which has collected data monthly on gross and net long-term securities transactions by instrument and counterparty since the late 1970s; the annual TIC surveys, which have collected data on individual securities since the early 2000s; the TIC-SLT, which has collected monthly aggregate data on long-term securities positions by instrument and counterparty since late 2011; and the TIC BL-2, which has collected—along with custodial banking data—holdings of short-term securities by instrument and counterparty monthly since the late 1970s.

Responsibility for the TIC system is shared by the U.S. Treasury, the Federal Reserve Bank of New York, and the Federal Reserve Board of Governors. The Treasury oversees the TIC system and publishes a wide variety of tables and reports. The Federal Reserve Bank of New York is responsible for the primary collection and review of the data, and the Federal Reserve Board of Governors is responsible for additional data review, data adjustments, and production and dissemination of TIC tables and reports. Board of Governors staff with direct responsibility for TIC production have access to much more detailed breakdowns of the data than are available in the published data, and much of the data used in this paper relies on these unpublished breakdowns.

### **B.2 TIC Annual Surveys**

TIC annual surveys collect security-level data on U.S. residents’ debt and equity claims against foreign residents (that is, foreign securities held by U.S. residents) and on U.S. debt

and equity liabilities to foreign residents (that is, U.S. securities held by foreign residents). Liabilities surveys are conducted each year as of end-June and claims surveys are conducted each year as of end-December. Data are collected from U.S. -resident custodians, issuers, and end-investors, and reporting is mandated by law.

TIC benchmark surveys are conducted every five years (most recently in 2016 for claims and in 2019 for liabilities); in other years, the reporting panels are limited to the largest reporters and typically capture 98% or more of the benchmark reporting. The findings of these surveys are typically published ten months after each reporting date.<sup>28</sup>.

### **B.3 TIC Monthly Securities Holdings Data**

The TIC-SLT, the newest form, was introduced in late 2011 to improve timeliness and frequency of securities holdings data. While in principle it should be possible to estimate positions based on holdings in the prior period, reported transactions from the TIC-S, and estimated price changes, experience had shown that this approach applied to annual TIC survey data rarely produced position information that corresponded to the findings of the following annual TIC survey. As a result, reliable data on securities holdings were available only at a low frequency and with very long lags. In addition to providing much more timely data on securities positions, the TIC-SLT allows for estimation of flows based on the change in TIC-SLT position, estimated valuation change, and any other changes. In the context of this paper, it should be noted that the introduction of the TIC-SLT included a great deal of outreach to managed funds, and resulted in an increase in TIC reporting for these firms, many of which are domiciled in the Cayman Islands. As a result, increases in Cayman Islands positions between the 2011 and 2012 annual surveys include some effects from this increase in reporting.

### **B.4 Estimating securities flows from position data**

As noted above, combining TIC-S data with annual survey positions and estimated price changes in order to estimate positions for the following survey rarely produce figures that

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<sup>28</sup>TIC annual securities reports and the data collection forms are available at the Treasury's TIC website: <https://www.treasury.gov/resource-center/data-chart-center/tic/Pages/fpis.aspx>



match the following year’s survey. As a result, Bertaut and Tryon (2007) developed a method for estimating intra-year positions. Another option for estimating flows is then to calculate flows as [change in estimated position] less price change. We use these flow estimates, and their analogues based on monthly SLT data in this paper.

## B.5 Public and Confidential Data

As noted above, compilers of the TIC data at the Federal Reserve Board have access to more detailed breakdowns of the data than are published, and many of the calculations shown here use these confidential breakdowns. For the aggregate data, most notably we are able to separate securities liabilities (foreign holdings of U.S. securities) by country and also by type of holder—foreign official or foreign private. On the claims side, we are able to break bond positions and flows down by country and also by type of issuer—again foreign official or foreign private (nearly always corporate).

## B.6 Direct Investment

The TIC data do not include direct investment. The Bureau of Economic Analysis, part of the Department of Commerce, conducts a direct investment survey.

# C Empirical Analysis

## C.1 Macro Determinants of Capital Flows: Global Financial and Dollar Cycle

The empirical specification below revisits the classical analysis featured in the literature on the global financial cycle. Our benchmark regression specification takes the following form:

$$\Delta flow_t^{i,a} = B X_t + \epsilon_t, \tag{26}$$

where the dependent variable,  $flow_t^{i,a}$ , is the ratio of the capital flows in each asset class  $a$  (treasuries, equities or corporate bonds for U.S. liabilities; long-term debt and equities

for U.S. claims) for investor type  $i$  (foreign official or foreign private for U.S. liabilities) in month  $t$  over the previous month’s position for that asset class and investor.  $X_t$  is a set of macro controls, which include the growth rate of the CBOE Volatility Index (VIX), the change in the excess bond premium (from Gilchrist and Zakrajsek (2012)), the Fed Funds rate (or the Wu-Xia shadow rate during the zero-lower-bound period), the U.S. term spread, the quarterly U.S. unemployment outlook from the Survey of Professional Forecasters, the Federal Reserve Broad Dollar index, the U.S. variance risk premium, VRP (from Londono and Zhou (2017)), the 3-month Treasury basis (from Du et al. (2018)), the emerging markets bond index spread (EMBI), and the oil price. The VIX is taken as a measure of risk and the VRP as a measure of uncertainty. More details on the variables’ definitions are in the data Appendix.

The baseline sample for U.S. liabilities is at a monthly frequency for the years 2003 to 2018, while the baseline sample for U.S. claims is from 2002 to 2018.<sup>29</sup> Monthly flows are constructed from survey reports following the procedures developed in Bertaut and Tryon (2007). We present, for each dependent variable, each variable entered one at a time in the regression in the first column and then all variables in the same regression in the next column. One well known caveat of those specifications is that some of those variables might be multi-collinear. This is one additional reason for interpreting those results with caution.

Table 1 shows results for private foreign holdings of U.S. securities. Equities and corporate debt respond to some of the global financial cycle variables, while treasuries are unresponsive. This is well in line with our previous observation that the private sector mainly holds equities and debt, hence it is plausible that these flows are the most responsive. They seem to respond solely to the VIX, the VRP and the EMBI, both for liabilities and claims (shown in Table 3). In other words, the equity and debt demand declines when risk and uncertainty rise. Private flows seem to be unresponsive to numerous other financial cycle and macro variables. This suggest that other, rather micro determinants, might be affecting private flows — a fact that we examine in the next section.

Table 2 shows results for holdings of U.S. securities of the foreign official sector for all asset classes. In this case, it is mostly treasuries which react to some of the global financial

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<sup>29</sup>As mentioned, we try to use the longest “modern” series which differs slightly in collection dates.

cycle variables. During our time period and frequency, in general, they fall when the VIX and the VRP rise, or when the unemployment outlook and the EMBI spread worsen. Hence, when US risk and uncertainty raise, the official sector reduces its holdings. U.S. treasuries also respond to changes in the dollar exchange rate. This last result is in line with traditional motives of reserve management.

The effects from the risk and uncertainty measures on flows are economically meaningful. For example, a one standard deviation increase in the VIX (0.18 points) leads to additional sales of U.S. equity by foreign private investors of \$3.24 billion or 0.1 percent of total asset holdings. A one standard deviation increase in the dollar (1.4 points) leads to sales of \$5.8 billion or 0.18 percent. Looking at foreign official investors, a one standard deviation increase in the dollar would lead to sales of \$7.3 billion of Treasuries or 0.32 percent of their total holdings.

All in all, while we find a role for the macro determinants of the global financial cycle, those variables alone cannot explain the shift of capital flows toward THFC. In light of the above findings and of the facts uncovered in Section 2, we conjecture that the substantial shift in private flows toward THFC was largely driven by other factors related to issuers' and investors' incentives.

## D Other Data Sources

- Survey of Professional Forecasters: Information on expected unemployment rates, real GDP growth, short-term and long-term interest rates as the means of the 4-quarter ahead forecast values.
- Broad dollar index, EME and AFE dollar index: Trade-weighted dollar indices computed and published by the Federal Reserve.
- Standard macro and financial variables: Monthly values from Bloomberg and Haver.
- Excess bond premium: Downloaded from the Federal Reserve's website: <https://www.federalreserve.gov/econresdata/notes/feds-notes/2016/updating-the-recession-risk-and-the-excess-bond-premium-20161006.html>.

- Convenience yields provided by Wenxin Du: <https://sites.google.com/site/wenxindu/data/govt-cip> and Du et al. (2018).
- Variance risk premium provided by Juan-Miguel Londono used in Londono and Zhou (2017).
- World recession probability provided by Pablo-Cuba Borda: <https://www.federalreserve.gov/econres/notes/ifdp-notes/monitoring-the-world-economy-a-global-conditions-index-20180615.htm>.
- Corporate tax rates are taken from KPMG’s corporate tax rates table: <https://home.kpmg/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online/corporate-tax-rates-table.html>.
- Firm-level data on intangible assets are taken from Peters and Taylor (2017) (data provided, e.g., via WRDS) and aggregated by taking means at the industry-level based on naics codes after winsorizing at the 1% and 99% level.
- Firm-level data to calculate realized volatility and Sharpe ratios are taken from CRSP. The firm-level measures are aggregated by taking means at the industry-level based on naics codes after winsorizing at the 1% and 99% level.
- GSZ risk measure from Simon Gilchrist, Jae W. Sim, Egon Zakrajsek, 2014 ( "Uncertainty, Financial Frictions, and Investment Dynamics") is the time-varying equity volatility for firms purged of the forecastable variation in expected returns (i.e. excess returns are regressed on Fama and French 3 factors and Momentum and the corresponding standard deviation of the OLS residual).

## **E Constructing Average and Total Realized Volatility**

Below, we provide formulas for calculating the average and total realized volatility, Sharpe ratio, GSZ Uncertainty, and Intangibility. Let  $t$  denote year,  $i$  denote industry, and  $j$  the country.

## E.1 Country-year averages

**Step 1: Calculate industry averages**

$$x_i^{av} = \text{mean}(x_{i,t}) = \frac{1}{4} \sum_{t=2010}^{2013} (x_{i,t}), \quad (27)$$

for  $x \in \{\text{Realized Volatility, Sharpe ratio, GSZ Uncertainty, Intangibility}\}$ .

**Step 2: Calculate country-year averages**

$$x_{jt}^{av} = \sum_{i \in I} \left[ x_i^{av} \frac{MV_{i,j,t}}{\sum_{i \in I} MV_{i,j,t}} \right], \quad (28)$$

with  $MV_{i,j,t}$  the market value of positions in industry  $i$ , for country  $j$ , in year  $t$ .

## E.2 Country-year totals

**Step 1: Calculate average position over sample across countries**

$$MV^{av} = \text{mean}(MV_{i,j,t}) = \frac{1}{I * 13} \sum_{i \in I} \sum_{t=2007}^{2019} MV_{i,j,t}, \quad (29)$$

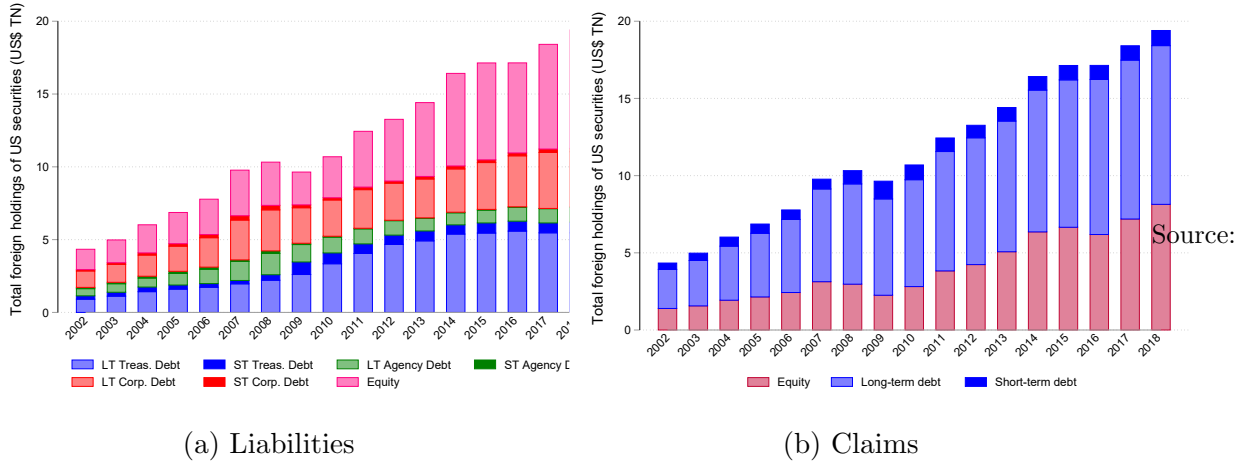
with  $I$  the set of countries included (5 in the paper right now).

**Step 2: Calculate normalized country-year totals as**

$$x_{jt}^{tot} = \sum_{i \in I} \left[ x_i^{av} \frac{MV_{i,j,t}}{MV^{av}} \right]. \quad (30)$$

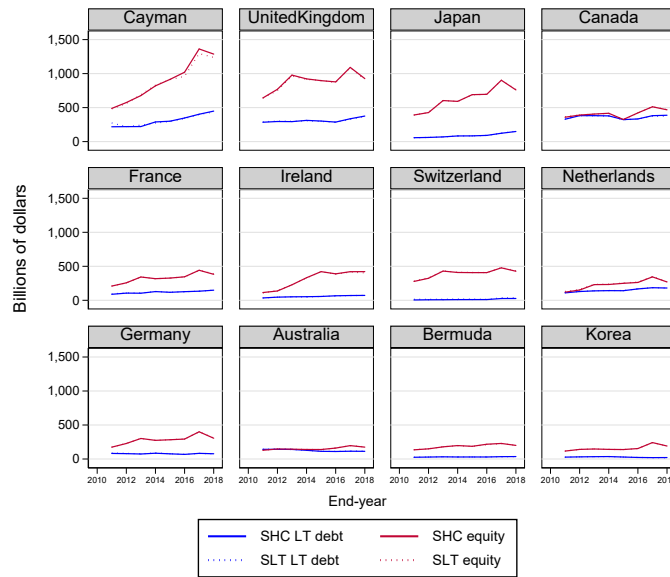
# F Additional Figures

Figure F.1. U.S. Liabilities and Claims per Type of Securities



TIC data, SHL and SHC Survey.

Figure F.2. U.S. Holdings of Foreign Long-Term Securities by Top 12 Countries—Equities and Debt (2008-2018)



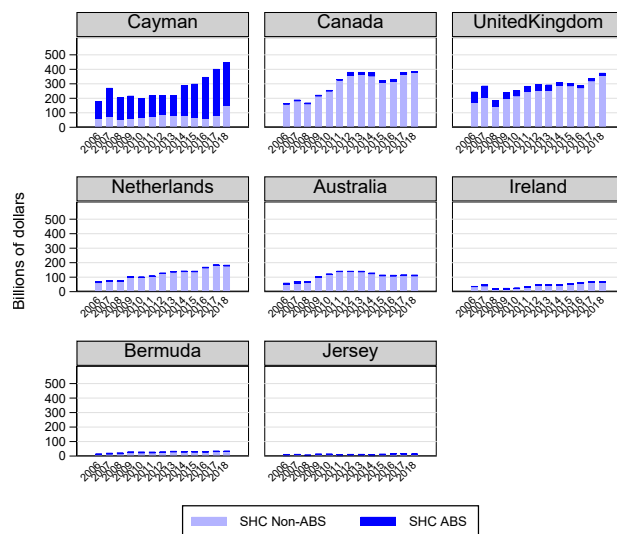
Source: TIC data, SHL and SHC Survey.

Figure F.3. U.S. Holdings of Foreign Common Stock Foreign Depository Receipts (2006-2018)



Source: TIC data, SHL and SHC Survey.

Figure F.4. U.S. Liabilities. Break Down between Asset Backed Securities Debt and Non Asset Backed Securities Debt (2006-2018)



Source: TIC data, SHL and SHC Survey.

## G Simulation

Parameter choice follows past studies and experiment with different values to check the robustness of our qualitative results. Monitoring costs values are taken from Martinez-Miera and Repullo (2017). Risk free rates are in line with annual T-bill rates. The baseline value of the elasticity of variety is set to 5. This value is compatible with most New-Keynesian and trade studies that use CES aggregators, as it generates a value of mark-up of 1.2. In some IO studies, with different production function, the elasticity of substitution is usually around 2. While this value is less in line with our set-up, we experiment with it and confirm the qualitative patterns in the model. In the U.S. current corporate tax rates are at 27 percent. However effective tax rates are around 15 percent. We then allow an average distance from various THFC tax rates of 10 percent. Table 9 summarizes the values.

Table 6

Parameter	Description	Value
$\gamma$	Monitoring Cost	1
$\varkappa$	Entry Cost	0.035
$t_H$	Domestic Tax-Rate	15%
$t_F$	Foreign Tax Rate	0%
$R^S$	Risk-Free Rate	2%
$\sigma$	Varities Elasticity	6