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Elusive Safety: The New Geography of Capital Flows and Risk

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Abstract

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JEL Classification: F2, F4, G15

Keywords: Tax havens/Financial Centers, Tax avoidance, regulatory arbitrage, risk, uncertainty, Heterogeneous Firms, Endogenous entry, endogenous monitoring

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

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1 Introduction

The large and growing capital flows of dollar-denominated securities between the United States and the rest of the world, its macro determinants and its consequences for the macroeconomy have long been and still are a fundamental part of research in international finance.[1] Yet, the micro origins and incentives behind the trends in flows are still largely unexplored due to data limitations. This indeed requires a granular dataset from official reporting. In this paper, we use a confidential data set at industry-level classification derived from the Treasury International Capital (TIC) reporting system, which collects data on U.S. residents' holdings of foreign securities and on foreign residents' holdings of U.S. securities from two official surveys.[2]

We examine both macro and sectoral facts and conduct an empirical analysis whose main findings are that private flows largely gravitate toward tax havens financial centers (THFC since now on), intermediated by unregulated funds, and that those flows are riskier. This last aspect also provides implications on the macro consequences of those facts. To rationalize those facts we build a general equilibrium model with heterogenous firms which endogenously enter the THFC to seek funds from global intermediaries, who choose monitoring endogenously. Tax advantages and cheap debt encourage riskier firms to enter and raise their profits: appearing elusively safer, their debt is monitored less.

Importantly the confidential TIC data represent a very accurate measure of U.S. cross-border asset positions, as they 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. Hence, contrary to data extracted from industry analysts' reporting, credit agencies, or other private industry reporting, they are

[1] Literature reviewed in the next sub-section.

[2] One is an annual survey of US portfolio securities claims on foreigners and the other is an annual survey of U.S. portfolio securities liabilities to foreigners. The TIC system is a joint effort of the Treasury Department and the Federal Reserve. The data provides exact quantification of the inflows and outflows across years and countries and, most importantly, with granular information on issuers and asset type.

not affected by partial coverage or reporting mis-incentives.[3] Beyond that they contain observations on both claims and liabilities at granular level.

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 and non-bank financial institutions. In contrast, safe assets, namely U.S. Treasuries, are mainly held by foreign official investors. Figure 1 presents a first glance of the facts for U.S. securities claims and liabilities for the period 2007-2018 to the Cayman Islands.[4] The latter accounts for the bulk of the growth, though U.S. liabilities toward THFC have been generally growing more than those from other countries (See figure A.1). Both claims and liabilities have increased significantly (first two panels on the top of the figure), particularly so 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.

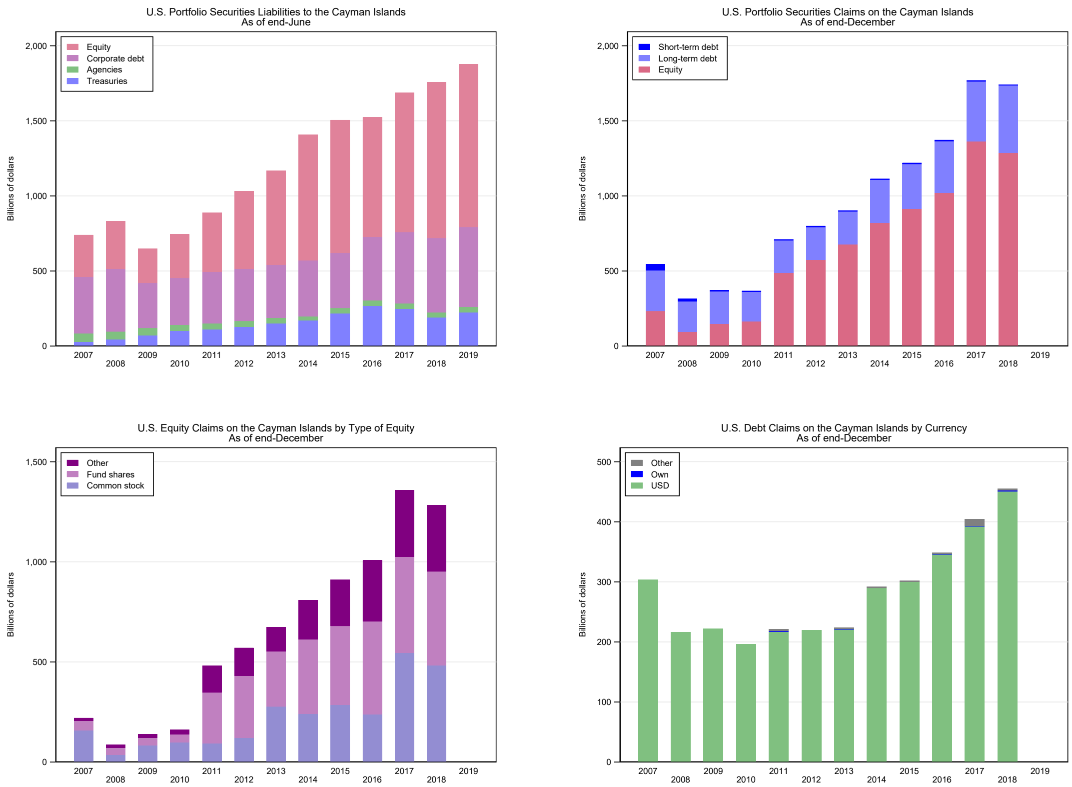
The increase in U.S. securities, liabilities and claims, channelled through THFC has been larger for debt securities of multinationals or in less-regulated mutual funds and has been particularly marked around 2010, a year in which all advanced economies approved stricter financial regulation reforms. Those included the 2010 Dodd-Frank Act, the 2009 G20 agreement on banking secrecy, the 2010 Basel III agreements and the creation in 2011 of the Consumer Financial Protection Bureau. Those reforms contained restrictions on loans' issuance and higher standards for collateral, but also stricter investors' protection. All of this may encourage both, debt issuers to seek funds also elsewhere and portfolio managements funds to shift their activity to less regulated financial centers.

As for Treasuries, namely 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

[3]See Chen et al. (2019) for recent remarks on this issue.

[4]Aggregate TIC data are released by including official and private flows, however Cayman Island official foreign exchange reserves and U.S. foreign exchange reserves are both minimal. Hence flows in the figure overwhelmingly represents private ones.

Figure 1. U.S. Portfolios liabilities and claims to the Cayman Islands, the largest tax haven financial center for the U.S. and the one that grew the most after 2010. The top panels show liabilities and claims for all type of assets and their break-down, the bottom panels show the break-down for equity (and their categories) and debt claims (broken down by dollar-denomination). Sample period is 2007-2018. Source: Treasury International Capital, SHL/SHLA and SHC/SHCA surveys.



is, official and 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, to uncover micro motives we examine sectoral flows, focusing on privately held ones. The goal is to uncover micro motives. The granularity of our dataset allows us to match them with several sectoral indicators. We find that flows to THFC positively correlate with risk and uncertainty metrics, with Sharpe ratios and with intangibility indices.[5] This suggest either

[5]Risk is measured as realized volatility; for uncertainty we use the the measure proposed in Gilchrist et al. (2014); the Sharpe ratio is excess returns at industry level divided by the volatility of the excess returns; the intangibility measure is from Peters and Taylor (2017), which combine both R&D and marketing.

that riskier firms enter the THFC or that lax monitoring is exerted in there. Higher Sharpe ratio also suggest search for yield. At last, sectors with high shares of intangible capital have perhaps the highest incentives to shift: their entry costs are lower, as the transfer of royalties is cheaper than plant establishment, and they face stricter funding relocation domestically due to the uncertain nature of their collateral.[6]

All of the above suggests that tax avoidance or regulatory arbitrage might stand out as most visible micro motives. This conjecture is further examined by estimating, through Poisson pseudo maximum-likelihood, gravity equations are country and sectoral level. Beyond the extended class of gravity controls, the THFC dummy, the post-regulation dummy and their interaction all positively and significantly predict the U.S. flows, particularly so liabilities. The effect is stronger for debt than for equities. This is understandable since equities are mostly associated with voting rights and varying monitoring incentives mainly apply to debt.

Then facts and the empirical results serve as motivation for a theory of the link between offshoring incentives and endogenously risk-taking, both in the form of a selection of risky firms seeking fund in the THFC and lax monitoring from global intermediaries. More specifically, we rationalize facts related to privately held securities with a two-country general equilibrium model featuring monopolistically competitive firms, heterogenous in their default probability, which produce domestically and endogenously decide whether to shift debt issuance to THFC. The endogenous entry coupled with heterogeneity in default probability leads to a novel "risk selection" channel. If they enter the THFC, firms obtain funds from unregulated global intermediaries, which channel global savings and endogenously choose monitoring intensity, both at extensive (how many firms) and intensive margin. Debt issued in THFC corresponds to U.S. corporate debt liabilities held privately from investors located in THFC. The firms' entry decision balances the entry cost with the tax advantage and the low debt costs. The intermediaries' loans decisions are based on an incentive-compatible

[6] Section 23A of the Dodd-Frank Act restricts U.S.banks from accepting intangible capital as collateral.

contracts and its monitoring decision balances the cost of global liquidity and of monitoring against firms' risk of default. Importantly it is firms' offshore profits that enter the contract incentive compatibility constraint, hence entry and monitoring decisions are intertwined. The interaction between endogenous entry and endogenous risk-taking generates a novel *risk-selection* channel. Analytically and with simulations it is shown that, a reduction in taxes in the haven and a fall in the interest of global liquidity, both encourage riskier firms to enter. The ensuing raise in profits also makes the firms appear elusively safe, thereby reducing intermediaries' monitoring incentives. 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 with firm level data. Guvenen et al. (2017) link the U.S. productivity slowdown to profit shifting, particularly from firms in R&D intensive industries.[7] Tørsløv et al. (2018) confirm the importance of profits shifting for the U.S. and Wright and Zucman (2018), by examining the evolution of taxes paid by U.S. multinationals on foreign profits, argue that an exorbitant tax privilege explains half of the U.S. cross-border return differential (See also Curcuru et al. (2008)). An advantage of our data is that of providing observations for both claims and liabilities, hence it is best suited for an international finance study.

Our model merges the heterogenous firms Melitz (2003) tradition with debt contracts featuring endogenous monitoring, as in Dewatripont and Maskin (1995) or Martinez-Miera and Repullo (2017), and offshore profits. Since firms are heterogenous in the their default probabilities, this leads to a novel "risk selection" channel. Our theory also connects more broadly to an earlier literature studying the connection between multi-nationals, capital flows, and information or contracting frictions: Froot and Stein (1991), Klein et al. (2002)

[7]See Hines (1996), Hines and Rice (1994) and Desai et al. (2004). Liu et al. (Forthcoming) documented profit shifting also for the U.K..

or Antràs et al. (2009).

In the international finance literature, the research by Lane and Milesi-Ferretti (2018) and Obstfeld (2018) began to document the shift toward THFC.[8] Recent papers (Maggiori et al. (Forthcoming) Lilley et al. (2019) and Coppola et al. (2019)) use private proprietary data for U.S. claims to document that the dollar dominance (a currency bias had been documented previously by (Burger and Warnock (2018)) has increased and also find flows' concentration in THFC. Our paper has an extended and granular coverage of both claims and liabilities and finds a connection with risk, something which we also rationalize with a theory.[9] 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 focused on the growth in dollar-denominated debt highlighting the safe haven properties and the specialties of the U.S. Treasuries (Caballero et al. (2008), Mendoza et al. (2009), Maggiori (2017) among others).[10] Our data confirm that U.S. Treasuries are an important component of U.S. liabilities and further documents that they are largely held within the official sector and sovereign flows (See also Alfaro and Kanczuk (2009) and Alfaro et al. (2014).)

[8] Policy reports from Bertaut et al. (2019) and Liu and Schmidt-Eisenlohr (2019) with TIC data also point in that direction.

[9] A recent literature discusses the potential measurements errors in balance of payment statistics, see Avdjiev et al. (2018) or Bertaut et al. (2019).

[10] Bruno et al. (2018) and Avdjiev et al. (Forthcoming) discuss a risk-taking channel behind the US denominated assets. The raise in global savings, and the ensuing fall in the safe return, has been for long indicated as the main driver of the growth in U.S. liabililities and of risk-taking (See Bernanke (2005) or Summers (2014)).

2 Country Level Facts and Data

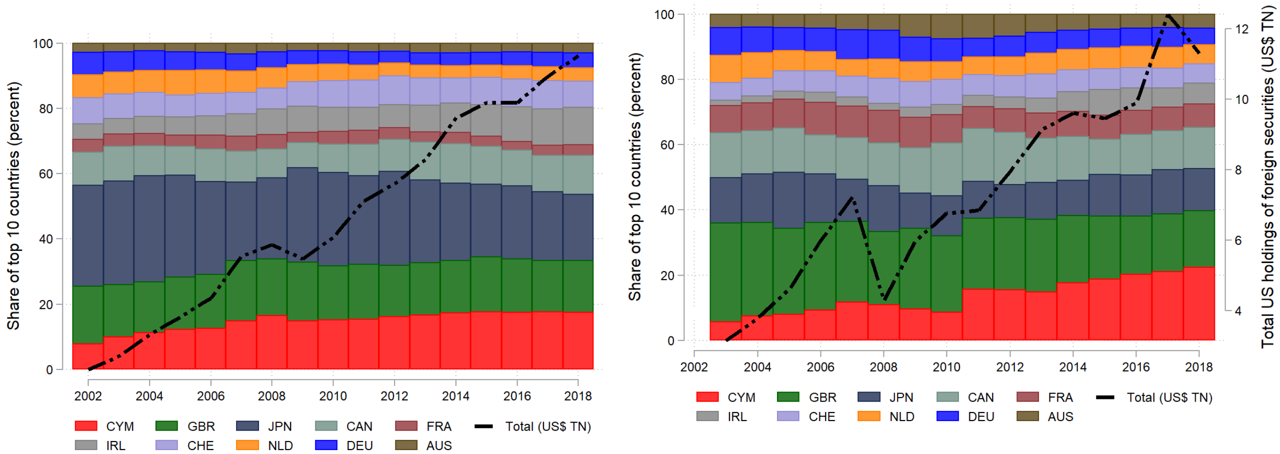
This section presents the main motivating facts at country level. Prior to that we describe the data used, particularly the TIC data. The latter is publicly available at country level, but we exploit also the confidential sectoral dataset. The granularity of the latter also allows us matching with other datasets.

2.1 Country and Sectoral TIC Data and Other Data Matching

The TIC data are 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 securities, which includes treasuries, debt, equities or ABS; currency; issue and maturity date; type and name of issuer; country of issuer; industry of issuer) as well as information on investors (official versus private), issuers, and on the ultimate destination of the claims (equities of multinationals or of mutual funds. Reporting is required by law.

In terms of time period 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. At last, we employ the yearly observation which are purged from valuation effects, hence provide indication on the actual size and direction of the flows. Appendix A describes the data in detail. The TIC dataset at sectoral level is also matched with risk, uncertainty, Sharpe ratio, which are constructed using Compustat data, and intangiblity measures (see Appendix A). Data details are again in Appendix A. Finally, the list of tax havens countries is in Appendix A.

Figure 2. U.S. Liabilities and claims toward and from top 10 countries in their respective order of holdings. Vertical axis shows the share held by and toward each country. Sample period is 2002-2018. Source is aggregate Treasury International Capital Data.



(a) Liabilities

(b) Claims

2.2 Country-Level Facts

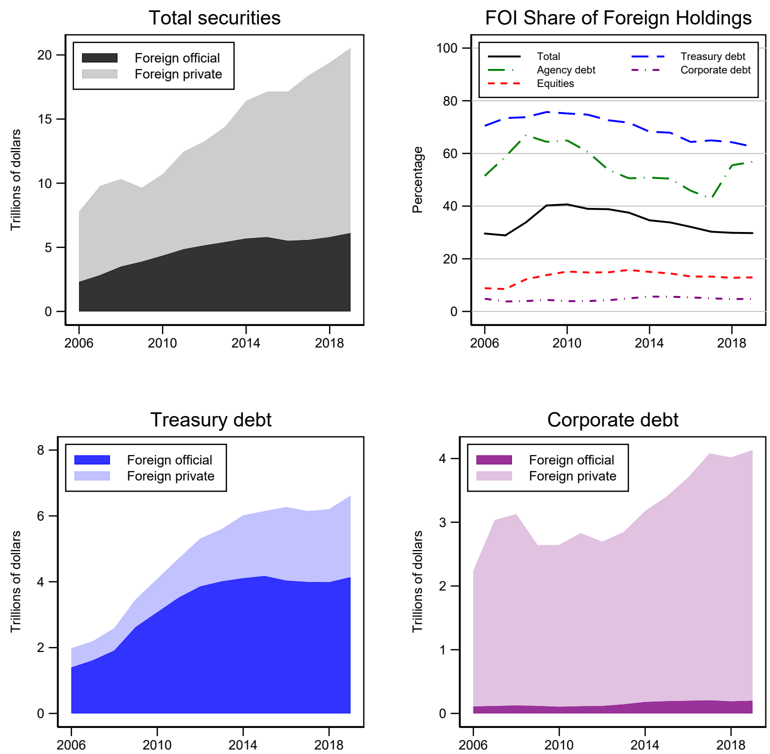
The growth in U.S. liabilities and claims has already been largely documented and is further confirmed by Figure A.2 reported in Appendix A.2, which shows the growth of total flows and the decomposition by type of security. In what follows the main recent trends are documented particularly the growing gravitation toward THFC.

Facts and empirical results are reported for both U.S. holdings of foreign holdings of U.S. securities (referred to as liabilities) and foreign securities (referred to as claims). Country level data breakdowns in all figures below are done by selecting the 10 or the 12 countries that account for the largest share. The percentage change over the sample period and the average percentage change per year for the largest destination of flows are also quantified.

First, Figure 2, which shows the decomposition by top 10 countries, confirms that both U.S. liabilities (left panel) and claims (right panel) have been growing further in recent years and that tax havens, and in particular the Cayman Islands, rank in the top destinations. Their share has increased over time with a jump around 2010.

Next we examine the breakdown of the data by country, currency of denomination, and other features. We start with U.S. liabilities since they are larger and, as well known, have

Figure 3. Foreign holdings of U.S. securities by the official and private sector (Liabilities). Top panel shows the total, mid-panel shows Treasuries and bottom panel shows private debt. Sample period is 2006-2018. Source is Treasury International Capital, survey SHL/SHLA.

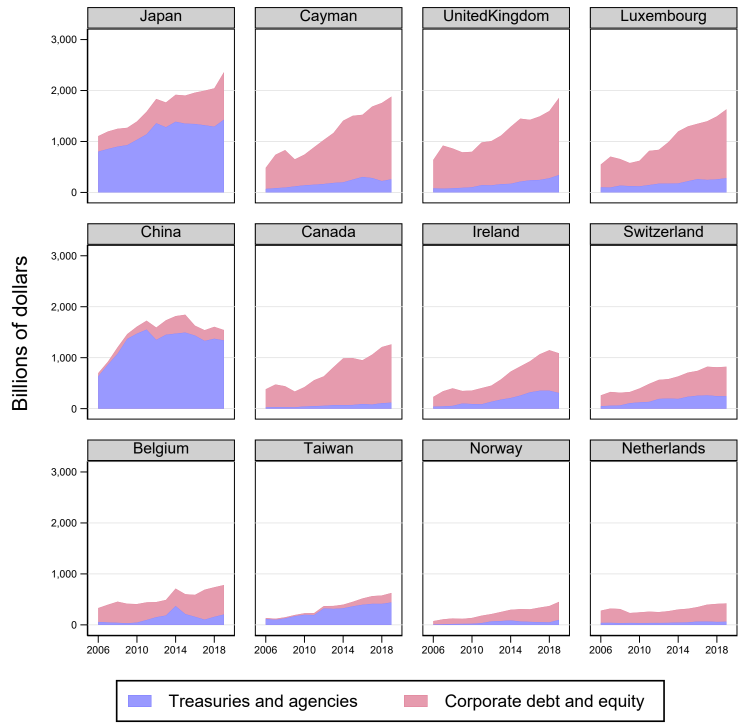


been growing steadily in recent years. Figure 3 shows the breakdown of foreign holdings of U.S. securities by the official and the private sectors. An interesting and perhaps surprising aspect is the dominance of U.S. Treasuries in the foreign official sector. Corporate debt is instead held by private investors. The growth of Treasuries within the official sector has been particularly marked 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).[11] This confirms the safe asset hypothesis for U.S. Treasuries. The left panels also show that U.S. liabilities privately held in the Cayman Islands are mostly in the form of corporate debt and equity or funds' shares and have been growing since 2010.

Figure 4 shows the breakdown of U.S. liabilities by country. Again, corporate debt and

[11] 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 4. Foreign holdings of U.S. securities (Liabilities) by top 12 countries. Each panel also shows the break-down per type of asset, which include corporate debt and equities (pink) and Treasuries and agencies (light blue). Sample period is 2006-2018. Source is Treasuries International Capital, survey SHL/SHLA.

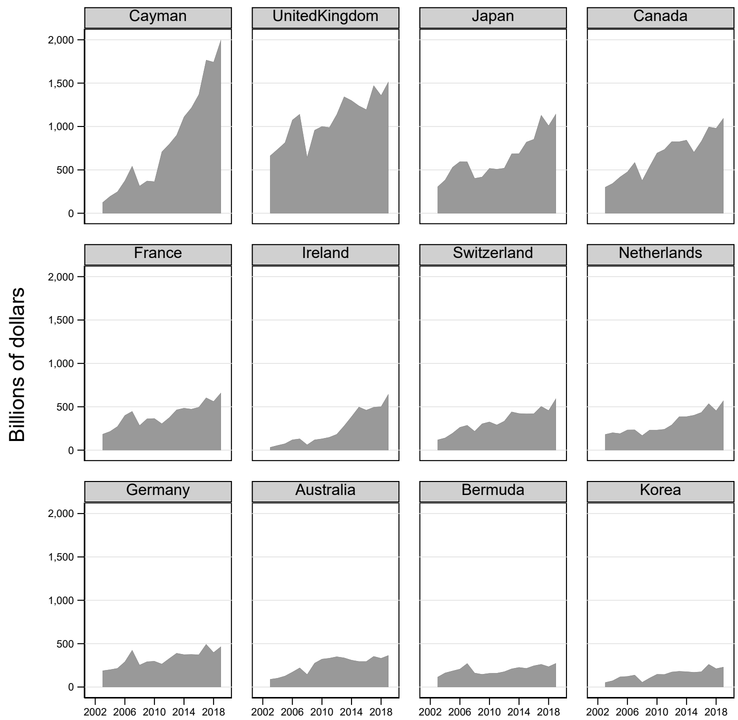


equities are mainly held by investors in the Cayman Islands and Luxembourg, while most of the Treasuries are held by Japan and China.[12] The increase in corporate debt and equities over the same period has been 108 percent and 483 percent, respectively. Figure A.3 in Appendix A.2 shows that most of the debt in the Cayman Islands is in the form of asset-backed securities (ABS), which by allowing credit risk recycling may foster lax monitoring. The risk profile of the flows in and out THFC is examined in the next section.

Next, we explore claims. Figure 5 shows U.S. cross-border securities claims by country (on a common scale), for the set of countries attracting the most U.S. investment. To appreciate the magnitude of the increase, note that long-term debt claims on the Cayman Islands have increased 152 percent, an 8 percent average annual increase. In contrast, short-term debt

[12]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 5. U.S. holdings of foreign securities (Claims) toward the top 12 Countries in their respective order of share. Sample period is 2001-2018. Source is Treasury International Capital, survey SHC/SHCA.



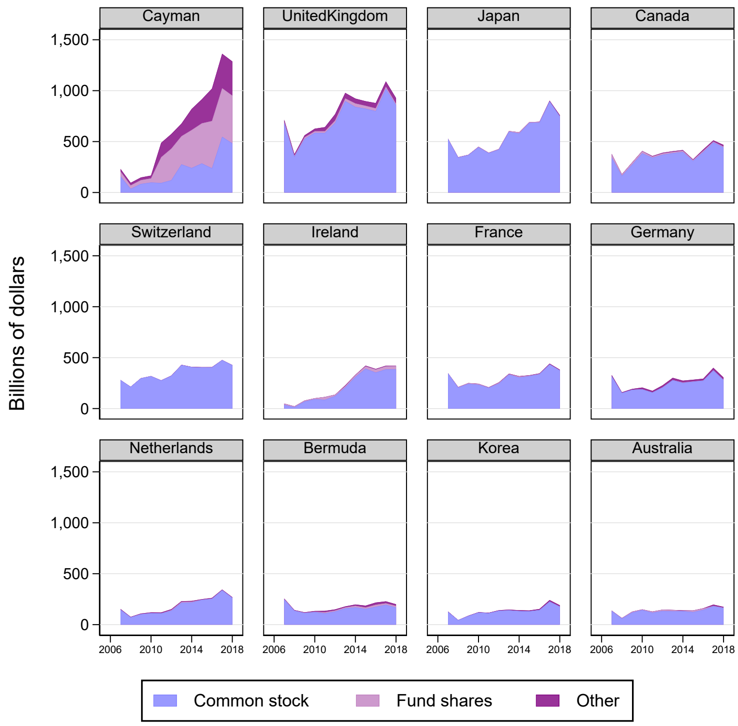
claims have declined. Most of the increase in flows has been again in corporate debt and equities. The unprecedented growth of securities from the Cayman Islands and other offshore centers is evident starting in 2010. Thus, in the next figures we focus on the sample period 2007-2018 (subject to data availability).

Figure 6 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. inflows in the form of fund shares, reflecting ownership by U.S. residents of funds (i.e. non-banks) that intermediate capital in the Cayman Islands.[13]

In terms of currency denomination, Figure A.4 in Appendix A.2 shows that asset holdings in THFC are nearly all in U.S. dollars. The intense use of dollars in financial centers is linked to network externalities (See Krugman (1984)). As several parties need to be connected in

[13]Similarly, Figure A.2 in the Appendix shows that the holdings of common stock and foreign depository receipts are the largest in the Cayman Islands.

Figure 6. U.S. holdings of foreign equities toward top-12 countries in their respective order of share. Each panel shows the break-down in common stocks (light blue), fund shares (pink) and others (dark pink). Sample period is 2007-2018. Source if Treasury International Capital, survey SHC/SHCA.



the transaction the use of dollar facilitates trading. Over the sample period 2010-2018, the growth in dollar-denominated debt claims on the Cayman Islands has been 129 percent, while in other countries (Europe or EMEs) the share of foreign currency-denomination has increased since 2012.

To sum up, there has been a large increase in privately held flows, both claims and liabilities, toward THFC, while Treasuries are largely held by the official sector. The increase has been particularly marked around 2010 and most of the flows are intermediated by less-regulated funds. Combined those facts already indicate the importance of tax and regulatory arbitrage motives.

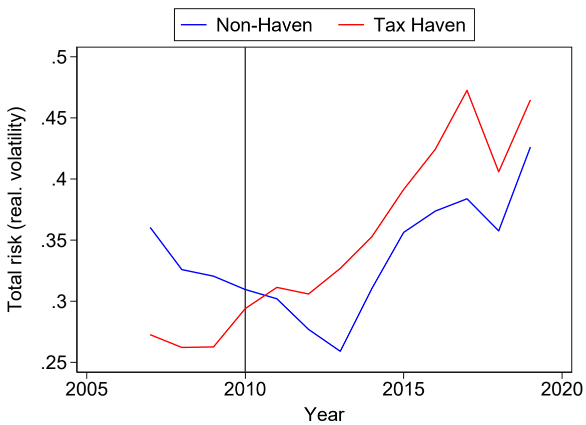
3 Micro Origins of THFC Flows: Risk, Uncertainty, Sharpe Ratio, Intangibility

The facts uncovered so far suggest that an analysis of the determinants and the consequences of the recent geography of capital flows shall focus toward the micro motives and origins. To this purpose, and by exploiting the granularity of TIC survey data, our industry-level flow data are matched with several sectoral metrics, which include risk, uncertainty, Sharpe ratios and degree of intangibility. Those metrics provide indications on possible regulatory arbitrage or avoidance motives, eventually leading to lax monitoring, and/or on the riskiness of the pool of entrants (for instance in sectors with high share of intangible). The industry classification used is a broad NAICS. The analysis here focuses on privately held securities as those are the ones mainly gravitating toward THFC. Also the focus is on U.S. liabilities since they are large and growing. Also, most previous analyses using granular data focused on claims, while the TIC dataset also provides observations for liabilities.

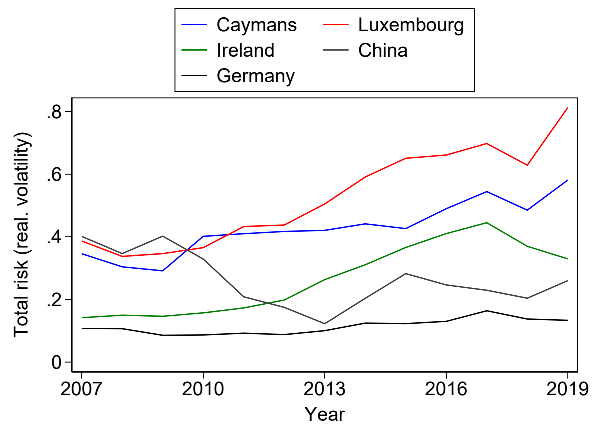
3.1 Risk, Uncertainty and Sharpe Ratios of U.S. Liabilities

Risk is measured using yearly realized volatility at the firm level then 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 at firm level using yearly averages and standard deviations of daily excess stock returns and 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. Next, the risk metric is complemented by an uncertainty index measured using the proxy in Gilchrist et al. (2014) and is labelled as GSZ since now on. This measures captures time-varying equity volatility for firms purged of the forecastable variation in expected returns. Also 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

Figure 7. 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.



(a) THFC versus non-THFC

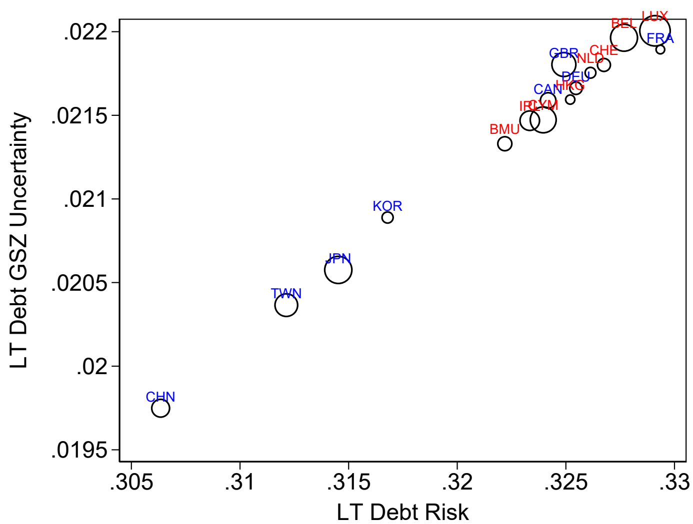


(b) Selected set of countries

informational and contractual frictions. The data appendix A presents additional details on the construction of the variables.

Figure 7 shows the total realized volatility for U.S. liabilities for the years 2007-2019. 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 realized volatility 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. Exact formulas for all the variables below are described in Appendix A. The purpose is to highlight the change in composition effect across industries within a country's portfolio. The left panel shows that risky flows have been increasing over time. The more so toward THFC. The overall growth in U.S. liabilities held by tax havens is increasingly concentrated in securities of riskier industries. The right

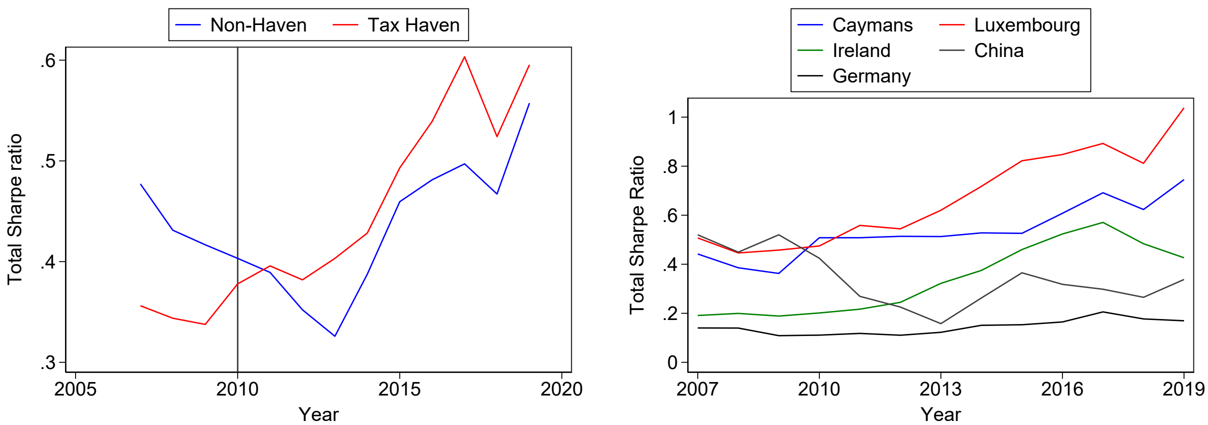
Figure 8. The figure plots the weighted average GSZ (see Gilchrist et al. (2014)) metric against the weighted average realized volatility in 2019 for the countries with the largest holdings of U.S. debt liabilities (at least $50 billion in 2019). Averages at the country-year level are computed by multiplying country i's holdings in industry j in year t with the average realized volatility or 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.



panel plots again risk by comparing a set of THFC countries, namely Caymans, Ireland and Luxembourg, against China and Germany, namely two large countries with sizable holdings of U.S. assets. Risky flows toward the first group have been growing and by much more.

Next, Figure 8 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. The focus is again 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, both are higher in THFC countries (indicated with letters in red). In sum, both average risk and average uncertainty of U.S. debt liabilities are higher for THFC. If U.S. debt securities issued 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 for

Figure 9. 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.

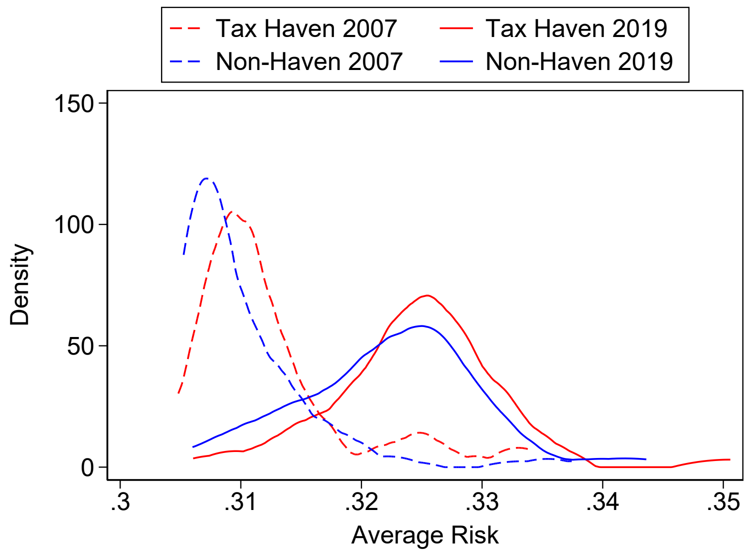


(a) THFC versus non-THFC

(b) Selected set of countries

safety. Figure 9 plots the total Sharpe ratio of U.S. Debt liabilities for the years 2007-2019. Total Sharpe ratios have been increasing over time and again are higher for THFC countries (left panel). The right panel compares Caymans, Ireland and Luxembourg against China and Germany. Again, Sharpe ratios are higher in the first group. This trend indicates that either that investors perceive debt intermediated in THFC as riskier and they wish to be compensated for it or they are in search for yield (they require higher returns for given risk). Next, Figure 10 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 are 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

Figure 10. 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).

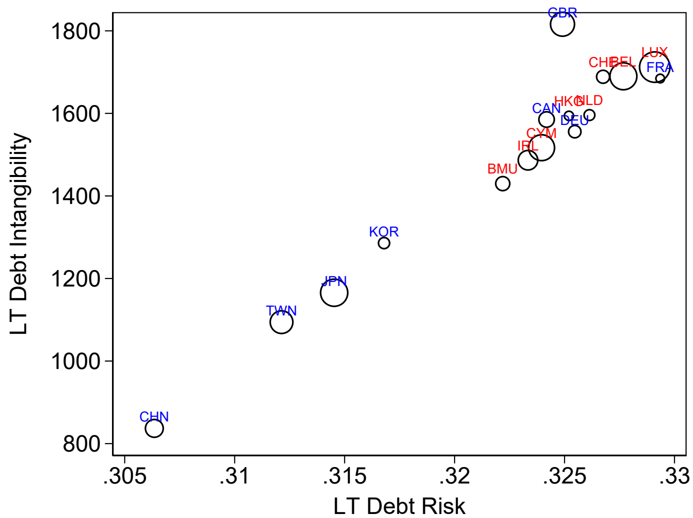


narrow, indicating that THFC are more similar in the average risk of their holdings than other countries. The connection between the shift to tax havens and an increase in risk is rationalized in the model presented in Section 4. In there lower taxes and lower debt services induce a riskier pool of firms to enter the THFC (risk selection effect). Hence, the model has direct implication for the risk distribution of firms in THFC. Also, once in, firms' profits are higher, due again to lower taxes and debt costs. Higher profits make firms appear elusively safe and global intermediaries reduce monitoring, raising risk ex post.

3.2 Link between Intangible, THFC and Risk

Several tax havens had their corporate taxes set to zero since very long. So additional factors have contributed to the recent flight toward THFC. The tightening of financial regulation in industrialized countries has provided incentives to shift. But the growth in sectors with high shares of intangible also facilitated it. Firms operating in those sectors face lower entry barriers, as the shift of royalties is much less costly than the establishment of plants.

Figure 11. 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 (see Peters and Taylor (2017)), which includes R&D and marketing expenditures, computed at industry-level, j, over the years 2010-2013 and then dividing by the sum of country i's positions across all industries in year t.



Second, the recent financial regulations make it harder for those firms to obtain funds in the U.S., increasing their incetnievs to seek funds elsewhere.[14] To ascertain the role of those sectors, the sectoral liabilities are further matched with an intangibility index. The latter is taken from Peters and Taylor (2017), who combine R&D and marketing expenditures.[15] 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.

[14] Article 23 of the Dodd-Frank Act prohibits banks to hold intangible capital, which is highly uncertain, as part of capital reserves to be re-deployed during crises. See https://www.federalreserve.gov/bankinforeg/stress-tests/2014-revised-capital-framework.htm. See also chapter 8 of Haskel and Westlake (2018).

[15] See A for more details on the construction of the data.

Table 1. **Average Realized Volatility, Sharpe ratios, Uncertainty, and Intangibility of U.S. Liabilities, for Debt and equities and THFC Status.** This table presents regression results where the weighted average realized volatility, Sharpe ratios, GSZ Uncertainty (see Gilchrist et al. (2014)), and Intangibility index (see Peters and Taylor (2017)) 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 and year fixed effects. All regressions include year fixed effects. 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%.

	Real. Volatility		Sharpe Ratio		GSZ Uncertainty		Intangibility	
	Equity	Debt	Equity	Debt	Equity	Debt	Equity	Debt
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tax Haven	0.136***	0.297***	0.0679	0.271***	0.0122***	0.0263***	18.08	122.5***
	(0.0474)	(0.0377)	(0.120)	(0.105)	(0.00419)	(0.00338)	(13.69)	(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

3.3 Econometric Validation

Motivated by the facts above we move a step further with an additional econometric validation. At first we verify that simple OLS regressions confirm the positive correlation between a THFC dummy and the sectoral indeces discussed so far, namely realized volatility, uncertainty, Sharpe ratios and intangibility index. Table 1 reports results confirming a positive and significant correlation between flows going to THFC and risk, uncertainty, Sharpe ratio and intangibility. Such correlation may of course be driven by other factors which affects capital flows. To rule out this possibility, some gravity specifications are estimated. The goal is to verify the significance of the THFC dummy upon controlling for other economic motives which may drive the flows gravitation. Gravity specifications are estimated both at country and sectoral level. The latter allows us to further dissect the role of intangible by separately estimating the gravity for sector with high and low shares of them.

3.3.1 Gravity

Country Level Gravity Country level gravity regressions are estimated for both claims and liabilities on a sample running from 2002 to 2019, which includes 188 countries with (or toward which there are) positive U.S. holdings. The focus is again on privately held securities. Our dependent variables are either liabilities or claims. Regressions are also separately estimated for debt and for debt plus equities. Since the latter usually come with voting right, lax monitoring is more likely associated with corporate debt. The gravity specification, at country level, reads as follows:

$$Ks_{jt} = \beta_1 THFC_j + \beta_2 d_{reg} + \beta_3 THFC_j * d_{reg} + X_{jt} \cdot \beta + +\varepsilon_{jt}, \tag{1}$$

where Ks_{jt} are the country level liabilities or claims, and either debt or debt plus equities, depending on the specification, X_{jt} are standard gravity variables at country j level, such as Ln Distance, Ln GDP, Same Language, Contiguity, and Free Trade Agreement, $THFC_j$ is a tax heaven financial center dummy, and deg is a post-2010 dummy and $THFC_j * d_{reg}$ is an interaction between the two. The gravity equation (1) is estimated using Poisson Pseudo Maximum Likelihood (PPML).[16] The goal is to verify the THFC and post-regulation dummies significance even after controlling for standard economic motives of gravitation. Hence the coefficients of interest are β_1, β_2 and β_3.

Results are shown in Table 2. The first 3 columns show results for liabilities, with debt as dependent in the first two columns and debt plus equities in the third. Columns 4 to 6 show results for claims. Columns 2, 3, 5 and 6 include a post-2010 dummy to capture the role of regulation. As previously argued the 2010 has marked the surge of tightened financial reforms in all industrialized countries.[17] First and foremost the THFC dummy is always positive and significant for all US liabilities (shown in columns 1 to 3). This confirms the importance of tax and regulatory arbitrage for the large and growing U.S. liabilities. For claims the post-regulation dummy and its interaction with the THFC dummy are positive and significant. The raise of financial regulations may have encouraged various forms of incorporation that raised also the gravitation of claims toward THFC (see Desai (2009)). The interaction term in this case is of particular interest as it captures the double coincidence of extracting a tax

[16] See Head and Mayer (2014), Silva and Tenreyro (2006) or Faia et al. (2019).
[17] See Tørsløv et al. (2018) for similar considerations.

Table 2. **Gravity: U.S. Liabilities and Claims, Debt and Equities, Annual Positions, Country Level.** This table presents regression results for a gravity specification of U.S. debt liabilities or claims estimated with Pseudo-Poisson-Maximum-Likelihood at country level. Dependent variable is either the level of U.S. debt liabilities (columns 1, 2, 3) or claims (columns 4, 5, 6) at the country-year level. Dependent variables are either debt in columns 1 and 2 and 4 and 5 or debt plus equities in columns 3 and 6. The regressors are a tax haven dummy (TH) and the following standard gravity variables: Ln Distance, Ln GDP, Same Language, Contiguity, and Free Trade Agreement. Regressions in columns 4 and 5 and 9 and 10 also include a post-2010 dummy and an interaction term between the tax haven dummy. Regressions are run either on the full sample or pre-2010 or post-2010. Key: *** significant at 1%; ** 5%; * 10%.

	Liabilities			Claims		
	Debt		Debt+Equity	Debt		Debt+Equity
	(1)	(2)	(3)	(4)	(5)	(6)
Tax Haven (TH)	1.825**	1.694**	1.315***	0.336	0.149	0.288
	(0.742)	(0.768)	(0.638)	(0.588)	(0.627)	(0.629)
Post 2010		0.368*	0.700***		0.460**	0.345***
		(0.191)	(0.170)		(0.189)	(0.133)
TH X Post-2010		0.194*	0.004		0.248**	0.470*
		(0.115)	(0.142)		(0.103)	(0.254)
Observations	3321	3321	3321	3321	3321	3321
R^2	0.213	0.222	0.335	0.225	0.465	0.484

saving advantage and a light regulation.

Sectoral Gravity The above country level gravity specifications confirmed the link between THGC flows and risk. Our sectoral facts however have also highlighted the role of sectors with high shares of intangible. Their role is therefore further assessed by estimating gravity specifications at sectoral level and by also distinguishing sectors with high and low shares of intangible capital. The sectoral gravity specification reads as follows:

$$Ks_{jkt} = \beta_1 THFC_j + \beta_2 d_{reg} + \beta_3 THFC_j * d_{reg} + X_{jt} \cdot \beta + \nu_k + \varepsilon_{jkt}, \tag{2}$$

Variables are defined as before except that they are now at sector-country level. The regression is on industry-country-year level with industry fixed effects. Since for claims the THFC dummy becomes significant only after 2010, the focus is now on liabilities. The dependent variable is either debt or debt and equities. Estimation is again done with PPML.

Table 3 shows results for debt (columns 1 to 3) and for debt and equities (columns 4 to

Table 3. **U.S. Liabilities, Debt and Equities, Annual Positions, Industry interaction, PPLM.** Regression results for a gravity specification of U.S. debt liabilities or claims estimated with Pseudo-Poisson-Maximum-Likelihood at sector level, with broad NAICS classification. Dependent variable is either the level of U.S. debt liabilities (columns 1, 1 and 3) or debt plus equity liabilities (columns 4, 5 and 6) at the sector-year level. Regressors include a tax haven dummy, a post-2010 dummy, the interaction between the former two, Ln Distance, Ln GDP, Same Language, Contiguity, and Free Trade Agreement. Regressions are run either on the full sample, or only on industries with low intangibility index or with high intangibility index. Key: *** significant at 1%; ** 5%; * 10%.

	Debt			Debt and Equity		
	Baseline	Intangibility		Baseline	Intangibility	
		Low	High		Low	High
	(1)	(2)	(3)	(4)	(5)	(6)
Tax Haven (THFC)	1.366**	1.270**	1.779***	1.155**	1.108*	1.223**
	(0.603)	(0.588)	(0.691)	(0.582)	(0.607)	(0.556)
Post 2010	-0.077	-0.263*	0.524***	0.422***	0.223	0.700***
	(0.138)	(0.141)	(0.109)	(0.118)	(0.139)	(0.087)
THFC X Post 2010	0.323**	0.226	0.244**	0.060	0.060	0.064
	(0.144)	(0.159)	(0.116)	(0.120)	(0.165)	(0.093)
Observations	33,014	12,244	20,770	33,014	12,244	20,770
R-squared	0.231	0.262	0.198	0.278	0.257	0.343

6). Results for sectors with a share of intangible above the median are shown in columns 3 and 6 and for sectors below the median in columns 2 and 5. The THFC dummy positively and significantly predicts the debt and debt plus equities flows liabilities. The coefficient is higher and more significant for high intangibility sample, confirming the fact that those firms are more likely to shift their debt there for the reasons highlighted before. Next, the interaction between the THFC and the post-regulation dummy is significant only for debt. As argued earlier for this asset class, which does not provide voting rights, the motives for gravitation toward a less regulated country may be stronger.

4 A Model of Multinationals and Risky Funding

Our facts and econometric analysis have shows that U.S. privately held flows have largely gravitating toward THFC and that those flows are riskier. Our econometric specification have pointed out the role of tax avoidance and regulatory arbitrage. Motivated by this evidence we develop a general equilibrium model that can accounts for the correlation between flows toward THFC and asset risk, as well as about other related facts. It is a two country general equilibrium model combining heterogenous firms in the Melitz (2003) tradition, albeit with respect to their default probabilities, with moral hazard contracting problem and endogenous monitoring along the lines of Dewatripont and Maskin (1995) or Martinez-Miera and Repullo (2017). The main channel runs as follows. Low taxes or low debt costs of global savings intermediated through THFC entice firms to open affiliates in them. In there they can save taxes and obtain cheaper funds from unregulated intermediaries channeling global savings. The tax and regulatory incentives raise profits of firms, which by appearing elusively safer, induce a decline in intermediaries' monitoring incentives. A riskier pool of firms enter and once inside they are also monitored less.

More specifically, in the model multinationals, heterogeneous in the Melitz (2003) tradition, though with respect to 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 and a global liquidity pool channeled by unregulated intermediairies. The latter gather global savings, so that an increase in the latter also reduce funding costs. Firms operate under monopolistic competition, producing varieties which are then aggregated into a single homogeneous good consumed by households in the home country. 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 reflects the cost of loan services. Global intermediaries have access to a global liquid market of risk-neutral investors. Loan spreads and monitoring intensity are chosen based on an incentive-compatible contract that affects firms' default probability and risk. Firms' offshore profits enter their incentive compatibility constraint setting a link between endogenous entry decisions and endogenous intermediaries' risk-taking. 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.

Equipped with this model, we examine the impact of either a reduction in taxes in the THFC or an increase in global liquidity, that would fund U.S. imbalances at lower costs. The tax or debt service advantage both induce more firms to enter. As the entry threshold raises, a riskier pool of firms enters. We dub this as a "risk selection" effect. As profits raise, due to the tax advantage and the low debt costs, firms appear elusively safer to intermediaries. This reduces intermediaries' monitoring incentives. Less firms are monitored and each firm is monitored less. Hence in equilibrium their debt risk raises.

Note that our model is mainly geared toward capturing multinationals' debt issuance in THFC. This may more likely represent the situation in which the parent holding and the affiliate retain residence in the home country, but issue debt with investors in THFC, hence a liability from the U.S. perspective. Our empirical analysis has show that the tax haven and the regulatory incentives are more evident for liabilities than for claims. The model is however amenable to rationalize other forms of incorporation, allowing domestically resident firms to issue debt abroad, albeit held by U.S. investors (see Desai (2009)). This would also rationalize the raise in U.S. claims toward THFC observed in our data mostly after 2010.

4.1 Model Structure

There are two countries, a large country, F, and a tax haven (THFC). Firms produce in the large country.[18] In the large country, there are two sectors, one producing a homogeneous good that serves as the numeraire, and another sector with heterogeneous firms producing different varieties. Monopolistic competition allows firms to extract rents and also to cover for the entry costs. Firms are heterogeneous with respect to their default risk and endogenously decide whether to become open an affiliate in THFC. This requires the payment of an entry cost, but allows the firm to save taxes and to get access to funding from an intermediary

[18]Indeed the model can be easily adapted to accommodate production through a global value chain or a within a third country.

that channel global savings. Given the heterogeneity in default probabilities, only a fraction of them will afford entrance.

Production is funded through risky debt, whose rate is determined within an incentive compatible contract with a global intermediary. The latter also chooses monitoring endogenously (see Dewatripont and Maskin (1995) or Martinez-Miera and Repullo (2017)) both at the extensive (which fraction of firms to monitor) and at the intensive margin (the extent of monitoring for each firm). 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 affiliates. Firms' offshore profits enter the contract incentive compatibility constraint and through this they affect monitoring incentives, thereby creating a link between entry and monitoring decisions.[19]

4.1.1 Consumers' Preferences

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

$$U = \alpha \ln Q + q_0 \text{ with } Q = \int_{\Omega} \left(q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}, \tag{3}$$

where $q(\omega)$ is the quantity consumed of variety ω. 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. α is a preference parameter with $0 < \alpha < 1$. The demand for one particular variety is:$q(\omega) = p(\omega)^{-\sigma} P^{\sigma} Q$, where $p(\omega)$ is the price of variety ω. 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

[19]Domestic banks could be included in the model as well. If domestic banks are subject to regulatory requirements, global intermediary will offer cheaper funds and firms will seek funds from them. Equally possible is to extend the contract to a multi-banking context. In either case the relevant channels remain unaltered.

of firms $F(r)$, whose support is $[0, r_h]$ and $Q = \frac{\alpha}{P}$. The structure is common to modern trade models featuring a firms' entry selection channel (see Melitz (2003)). The elasticity of substitution of each variety determines firms' mark-ups, hence their profits and entry decisions. Firms in our model are heterogeneous in their default probabilities, r, which is distributed according to $F(r) = (\frac{r}{r_h})^{\gamma}$.

4.1.2 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 θ_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 sets a price R_p and each unit of the firm transforms one unit of intermediate input into θ_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, it follows that:

$$\int_{R_p}^{\infty} g(\theta_p) d\theta_p = a(R_p)^{-\zeta} = x_p, \tag{4}$$

which implies: $R_p = R(x_p) = \left(\frac{x_p}{a}\right)^{-\frac{1}{\zeta}}$. 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 through the zero profit condition $R_b = R(x_p)$. The loan return is given by a risk premium, heterogenous across firms, and a safe rate. The latter is determined in the general equilibrium through the market clearing condition between global savings and investment.

4.2 Monopolistic 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 and fund production with risky debt. The probability of default, heterogenous across firms, implies that firms' revenues are stochastic:

$$\underset{\sim}{R} = \begin{cases} R & \text{with probability} \quad 1 - r + m \\ 0 & \text{with probability} \quad r - m \end{cases} \tag{5}$$

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 it entails a convex cost for the lender. Under monopolistic competition, firms optimally charge a constant mark-up over marginal cost:

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

Firms profits are given by expected revenues minus the cost of debt: $\pi(r) = (1 - r + m)p(r)q(r) - R_b(r)$. Post-tax profits are given by $\pi^E(r) = (1-t)\pi(r)$. The marginal tax rate depends upon firms' location.

4.2.1 Debt Rate and Firms' Risk—The Contractual Agreement

Firms are funded by an intermediary that raises funds globally from foreign investors. There is a large set of risk-neutral investors with infinitely elastic supply, that required an expected safe return equal to R_S. A risk-neutral global intermediary raise liabilities globally and supply debt to firms. Monitoring costs and convex and denoted by $c(m)$. Since the contract structure applies equally to all firms, for notational convenience the dependence of the loan rates on firms' default distribution is omitted since now on.

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. In the optimal contract, intermediaries choose the monitoring intensity, m,, (see Dewatripont and Maskin (1995) or Martinez-Miera and Repullo (2017)) as well as the rate offered to investors to maximize the expected profit, net of returns to investors, R_I, given intermediaries' incentive compatibility constraint, which disciplines monitoring incentives, and the participation constraints for intermediaries and investors. Offshore profits enter the incentive compatibility constraint, thereby creating a link between entry decisions and monitoring. The optimal contract reads as follows:

$$\max_{\{R_I,m\}} [(1-r+m)((1-t_F)R_b - R_I) - c(m)] \tag{7}$$

subject to the intermediaries' incentive compatibility constraint:

$$m^* = \arg\max_m \left\{[(1-r+m)((1-t_F)R_b - R_I^*) - c(m)]\right\}, \tag{8}$$

the intermediaries' participation constraint:

$$(1-r+m^*)((1-t_F)R_b - R_I^*) - c(m) \geq 0 \tag{9}$$

and the international investors' participation constraint:

$$(1-r+m^*)R_I^* \geq R^S \tag{10}$$

The incentive compatibility constraint (8) 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. Note that lower taxes or investors' rates, by boosting profits, make firms appear elusively safe and reduce intermediary's monitoring incentives. The participation constraints (9) and (10) 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.

4.2.2 Monitoring —Extensive and Intensive Margin of Risk

The debt contract is 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 are not. The monitoring threshold determines the *extensive margin* of risk. The extent to which each firm is monitored, the *intensive* margin, depends upon the investors' return and the cost of monitoring. Finally, the optimal debt rate is a function of firms' default probability. The first order condition to equation (8) for monitoring intensity links the latter to the bank margins:

$$((1 - t_F)R_b - R_I^*) - c^{'}(m^*) = 0 \tag{11}$$

Given the return on outside funds that satisfies investors' participation constraint: $R_I^* = \frac{R^S}{(1-r+m^*)}$ (11) can be written as follows:

$$R_b = \frac{R^S}{(1 - t_F)(1 - r + m^*)} + c^{'}(m*) \tag{12}$$

The last equation allows us to determine the loan rate for monitored firms, which varies according to their type, r. Determining the loan rate also require contestability. Based on it 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 (12). The convexity of the monitoring cost function implies that a corner solution with zero monitoring materializes when $c^{''}(0) - \frac{R_S}{(1-t_F)(1-r)^2} \geq 0$. This condition also determines the following monitoring cut-off:

$$\hat{r} = 1 - \sqrt{\frac{R_S}{(1 - t_F)c^{''}(0)}} \tag{13}$$

below which the safer firms are not monitored. The threshold $\hat{r}$ determines risk ***extensive*** margin. The intensive margin of risk is either zero or positive, whenever $r > \hat{r}$. The optimal monitoring intensity, m^*, is obtained by taking first order condition of 12, and given the cost function, $c(m) = k(m)^2$:

$$m^* = \begin{cases} 0 & \text{when} \quad r < \hat{r} \\ r - (1 - \sqrt{\frac{R_S}{(1-t_F)2k}}) & \text{when} \quad r < \hat{r} \end{cases} \tag{14}$$

4.2.3 Endogenous Internationalization and Risk Distribution of Entrants

Firms opening an affiliate enjoy a tax advantage and can seek funds from the global intermediary, but pay an entry cost an entry cost, $\varkappa$. The default probability threshold, $\tilde{r}$, for which a firms are indifferent between opening an affiliate in the THFC or not is given by:

$$(1-t_i^F)\left[(1-r+m^*)p(r)q(\tilde{r}) - R_b(\tilde{r})q(\tilde{r})\right] = (1-t_i^H)\left[(1-r+m^*)p(\tilde{r})q(\tilde{r}) - R_b(\tilde{r})q(\tilde{r})\right] + \varkappa \tag{15}$$

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

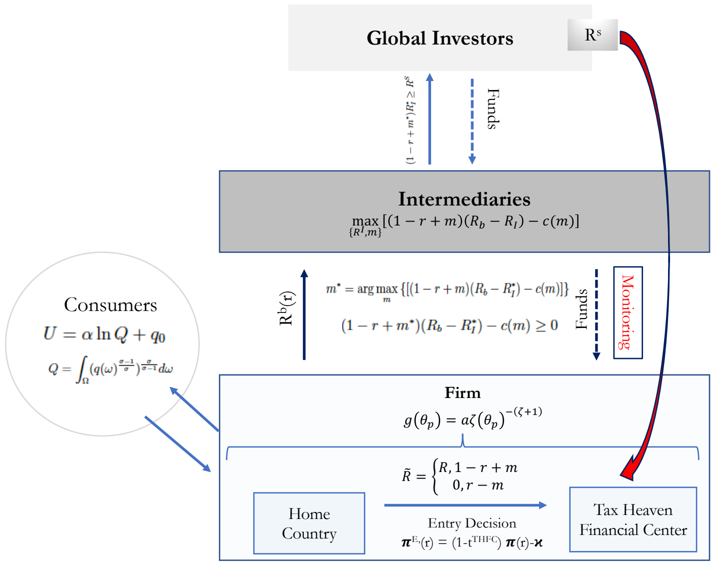
$$(1-t_i^F)\left[(1-r+m^*)\left(\frac{\sigma}{\sigma-1} - 1\right)R_b(\tilde{r})\right] - \varkappa = (1-t_i^H)\left[(1-r+m^*)\left(\frac{\sigma}{\sigma-1} - 1\right)R_b(\tilde{r})\right] \tag{16}$$

Substituting the expression for $R_b = \frac{R^S}{(1-r+m^*)} + c^{'}(m^*)$ allows us to recover the entry default threshold, $\tilde{r}$:

$$\pi(r) = \begin{cases} (1-t_i^F)\left[(1-r+m^*)\left(\frac{\sigma}{\sigma-1} - 1\right)R_b(\tilde{r})\right] - \varkappa & \text{when} \quad r < \tilde{r} \\ (1-t_i^H)\left[(1-r+m^*)\left(\frac{\sigma}{\sigma-1} - 1\right)R_b(\tilde{r})\right] & \text{when} \quad r > \tilde{r} \end{cases} \tag{17}$$

After substituting the loan rate from equation 12, the default threshold for entrants reads as follows:$(t_i^H - t_i^F)\left[\left(\frac{\sigma}{\sigma-1} - 1\right)(R^S + (1-\tilde{r}+m^*))c^{'}(m^*))\right] = \varkappa$. A decline in the entry threshold implies that a riskier pool of firms enters the THFC.

Figure 12. Structure of the general equilibrium model



4.2.4 Global Market Clearing of Debt and Equilibrium

The safe rate in the model is determined through the funds clearing condition for debt:

$$F(R_S^*) = \int_0^1 R^{-1}(R_p^*)dr = w, \tag{18}$$

where w is the exogenous amount of worldwide wealth and where $x_p = R^{-1}(R_p^*)$ is the inverse of $R(x_p) = R_p^*$. An increase in global funds reduces the rate required by investors and in turn the firms' cost of debt.

Definition 1. Competitive Equilibrium. A competitive Equilibrium is an optimal variety, $q(\omega) = p(\omega)^{-\sigma} P^\sigma Q$, an optimal price, $p(r)$, that satisfies 6, an investment schedule, x_p, and the 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 is summarized in figure 12 below. Next, we examine the impact on the model's equilibrium of changes in the tax rate in the haven and in the global safe rate. This will lead to the double coincidence of higher entry in the THFC and higher risk.

4.2.5 Changes in THFC Taxes or in the Cost of Global Funds

Lemma 1. *A fall in taxes reduces the monitoring threshold and intensity, hence raises risk.*

Proof. A decline in the foreign tax, t_F raise the monitoring threshold from equation $\hat{r} = 1 - \sqrt{\frac{R_S}{(1-t_F)c''(m^*)}}$, hence less firms are monitored. Also it reduces the monitoring intensity, from equation 17.

Intuitively, a fall in taxes raises firms' profits, hence it makes them appear elusively safe to the intermediary. Firms can more easily meet the contract incentive compatibility constraint, hence the optimal monitoring intensity declines.

An advantage of entering the THFC is that firms can obtain funds from a global intermediary, which in turn has access to global savings and enjoys a light regulation (hence it is not subject to costly capital requirements). In recent decades the raise in global savings induced a decline in safe rates. This in turn have contributed to the growth of U.S. liabilities (Bernanke (2005)) and can affect financial risk (Summers (2014)). Motivated by this we examine the impact on the model equilibrium conditions, particularly risk and entry, of a decline in the safe rate.

Proposition 1. *An increase in global savings induces a fall in R^S, raises the fraction of entrants, shifts its distribution toward riskier firms and increases risk at the intensive and extensive margin.*

Proof. Since $R'(x_p) < 0$ and since R_p^* is decreasing in R_S^*, it follows: $\frac{dR_S}{dw} = \frac{1}{F'(R_S^*)} < 0$. From equation 20 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. 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 from $R_b = \frac{R^S}{(1-t_F)(1-r+m^*)} + c'(m^*)$. 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 the optimal loan rate leads to:

$$\frac{dm^*}{dR^S} = -(\frac{1}{(1-t_F)(1-p+m^*)})[c^{"}(m^*) - \frac{R^S}{(1-t_F)(1-p+m^*)^2}]^{-1} \tag{19}$$

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.

To sum up, a decline in taxes in the haven raises firms' risk at both the extensive and the intensive margin. Furthermore a fall in the safe rate, by reducing the cost of firms' debt, induces a raise in the fraction of entrants and also shift their distribution toward a riskier pool. If both taxes and the cost of debt decline profits raise, more firms have an incentive to enter the THFC. Firms also appear elusively safer and intermediaries optimally reduce monitoring.

4.2.6 Simulations of the Model

Model's simulations also allows us to graphically visualize the above results. Figure 13 below shows that the impact of a change in taxes on the monitoring and the entry threshold on the left panel and the default probability on the right panel. The left panel shows the responses of the entry threshold, $\tilde{r}$, and of the monitoring threshold, $\hat{r}$, to change in in safe rates, R_S. The right panel shows 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 parallel with our empirics a tax haven is identified with a country lowering taxes below 15%. A fall in taxes from 15% to zero raises the monitoring threshold (right panel), hence reduces the fraction of monitored firms, due to the mechanism discussed so far. It also reduces the entry threshold. The latter results from a combination of partial and general

Figure 13. **Simulation for Changes in Foreign Taxes.** Left panel shows the responses of the entry threshold and the monitoring threshold to change in foreign taxes. Right panel shows changes in the relation between monitoring intensity and default probability with respect to two different values of the foreign tax rate.

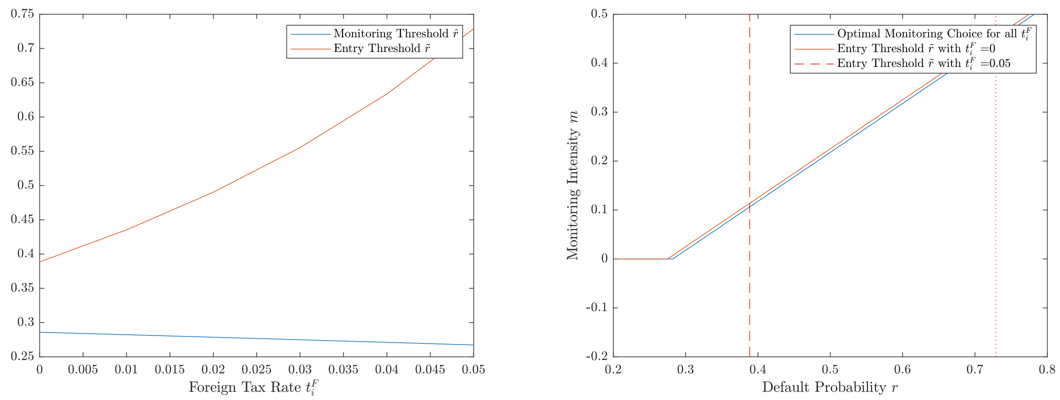
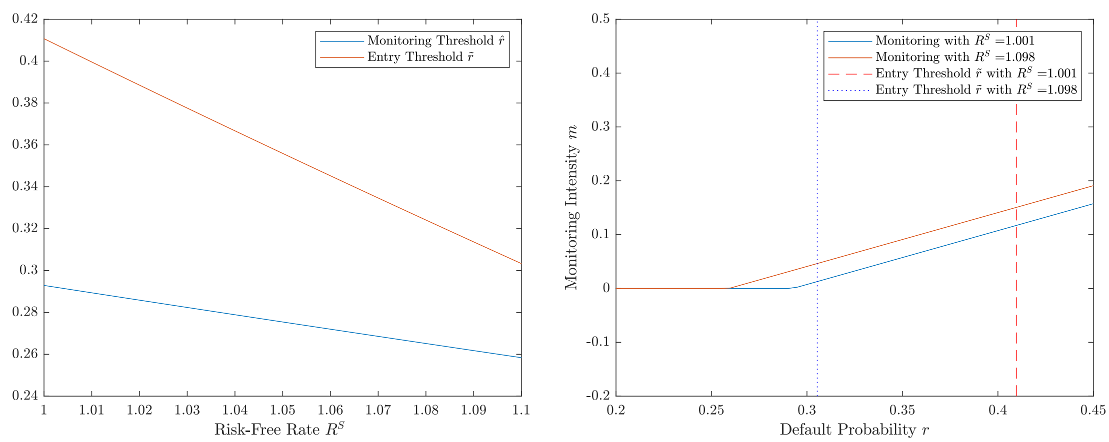


Figure 14. **Simulation: Changes in Global Safe Rates.** Left panel shows the responses of the entry threshold and the monitoring threshold to change in safe rates. Right panel shows changes in the relation between monitoring intensity and default probability with respect to two different values of the safe rate.



equilibrium effects. A decline in the tax at first entices more firms to enter. As riskier firms enter, and given the cost of global funds, intermediary optimally raise the extent of monitoring. This translates into higher loan rates, which in turn by reducing profits induces some firms to exit. Overall if the second effect prevails the overall entry threshold declines.

Figure 14 shows simulations of the main model variables with respect to changes in the safe rate. 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, hence less firms are monitored increasing the extensive margin of risk. At last, it reduces the monitoring intensity (right panel) for each project above the monitoring threshold. Note that the largest effects come the extensive margin of risk. Overall a joint decline in taxes and in safe rates can explain the double occurrence of a raise in the flows toward THFC and a raise in risk.

The Role of Intangibles. Our empirical analysis showed that debt from high intangible firms is more likely gravitating toward THFC and is correlated with risk. While our model does not explicitly formalize a theory of firms with intangible capital,[20] its role can assessed through elements of the model, which most plausibly relate to this type of firms. First, firms operating in those sectors have lower entry costs, as the transfer of royalties and patents is less costly than plants' establishment. Second, firms in sectors with high share of intangibles typically feature riskier collateral which is harder to monitor. This raises monitoring costs, something which we formalize with a raise in k.

Proposition 2. *A fall in entry costs reduces the entry threshold inducing more firms to enter. A raise in the monitoring costs reduces monitoring at the extensive and the intensive margin.*

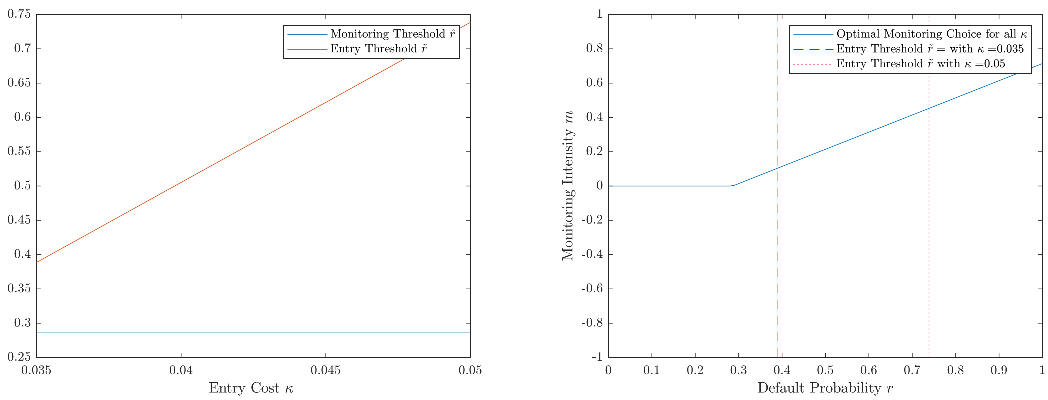
Proof. Substituting the optimal monitoring intensity for firms in the THFC, namely 17, one obtains:

$$(t_i^H - t_i^F)\left[\left(\frac{\sigma}{\sigma-1}-1\right)\left[R^S+\sqrt{\frac{R_S}{(1-t_F)2k}}\right]2k\left(r-1+\sqrt{\frac{R_S}{(1-t_F)2k}}\right)\right]=\varkappa \qquad (20)$$

From the above a decline in the cost of entry reduces the entry threshold, hence raises the

[20]See Haskel and Westlake (2018) for features of intangible capital intensive sectors.

Figure 15. **Simulation for Changes in Cost of Entry.** Left panel shows the responses of the entry threshold and the monitoring threshold to change in the cost of entry. Right panel shows changes in the relation between monitoring intensity and default probability with respect to two different values of the cost of entry.



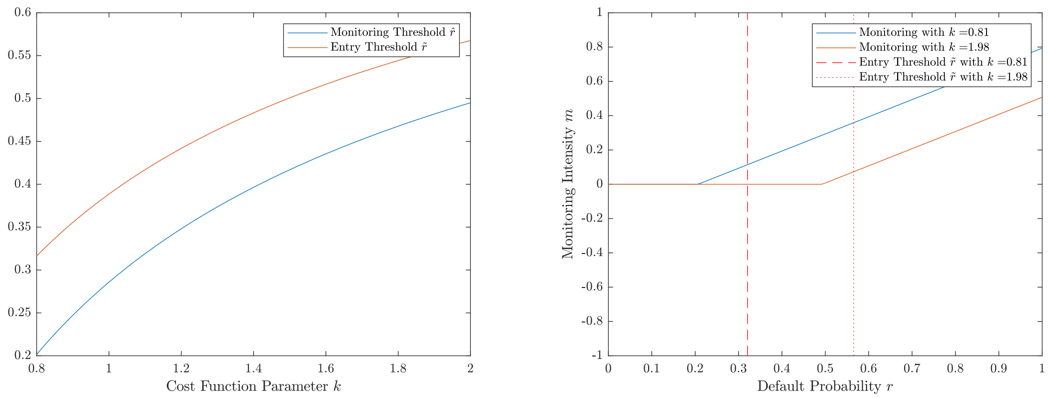
fraction of entrants. Second, a raise in the cost of monitoring, through a raise in k, leads to a decrease in the monitoring intensity as per total differentiation of the optimal loan rate:

$$\frac{dm^*}{dk} = -m^*[c^{"}(m^*) - \frac{R^S}{(1-t_F)(1-p+m^*)^2}]^{-1} \tag{21}$$

The latter is negative for all firms for which monitoring is positive. Next, equation 13 shows that an increase in k raises the monitoring threshold, implying that less firms are monitored. To further show our arguments the model is simulated under changes in the entry cost and in the cost of monitoring. Figure 15 shows that lower entry costs affect the entry margin, but risk remains unchanged. This is so since entry costs do not affect the debt contract conditions.

Intuitively, when more firms enter new entrants are riskier. Everything else equal, this induces global intermediaries to increase their monitoring incentives to satisfy the incentive compatibility constraint. Next, the effect of a change in the cost of monitoring is simulated. Figure 16 shows results. Intuitively, if monitoring opaque collateral is more costly, global intermediaries optimally monitor less (right panel) and a lower fraction of firms (left panel). That explains the link between intangible firms' debt and risk in our data.

Figure 16. **Simulation for Changes in the Cost of Monitoring.** Left panel shows the responses of the entry threshold and the monitoring threshold to change in the cost of entry. Right panel shows changes in the relation between monitoring intensity and default probability with respect to two different values of the cost of entry.



5 Conclusions

The U.S. global imbalances continue to grow steadily. 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 their micro origins. Using a confidential and granular data on U.S. claims and liabilities, a set of new facts is uncovered. Private holdings are mainly intermediated through THFC, have increased in the post financial regulation era and are largely intermediated by unregulated mutual funds. Assets intermediated through THFC are riskier, pay higher Sharpe ratios and are mainly linked to firms operating in intangible-intensive sectors. Safe assets, such as Treasuries, are mainly held within the official sector. Gravity specifications, which controls for standard economic motives, confirm the role of tax avoidance and regulatory arbitrage. This evidence is rationalized through a model with firms, heterogenous in their default probability, which endogenously choose try in the THFC to seek funds from global intermediaries that exert monitoring endogenously. A fall in corporate tax in the THFC and a fall in the cost of global funds raise entrants' profits, encouraging more firms to enter, making them appear elusively safer and reducing intermediaries monitoring incentives.

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A Appendix

The Treasury International Capital (TIC) Reporting System The TIC (Treasury International Capital) system collects data on cross-border banking and securities positions and transactions. 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 and the IMF's Coordinated Portfolio Investment Survey (CPIS). Reporting is legally mandated.

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.

While the reporting system features several surveys, the dataset used in this paper are mainly drawn from the annual surveys. The latter collects 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. 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.

TIC: 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).

Constructing Average and Total Realized Volatility This section describes 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. The country-year averages are computed through the following steps.

First, industry averages are calculated as follows: $x_i^{av} = \text{mean}(x_{i,t}) = \frac{1}{4}\sum_{t=2010}^{2013}(x_{i,t})$ for $x \in \{\text{Realized Volatility}, \text{Sharpe ratio}, \text{GSZ Uncertainty}, \text{Intangibility}\}$. Next, country-year averages are calculated as follows: $x_{jt}^{av} = \sum_{i \in I}\left[x_i^{av} \frac{MV_{i,j,t}}{\sum_{i \in I} MV_{i,j,t}}\right]$ with $MV_{i,j,t}$ the market value of positions in industry i, for country j, in year t. Next, the country-year totals are computed with the following steps. Due to changes in the industry classification, main results are reported after 2007. First, the average position over sample across countries are calculated as follows: $MV^{av} = \text{mean}(MV_{i,j,t}) = \frac{1}{I*13}\sum_{i \in I}\sum_{t=2007}^{2019} MV_{i,j,t}$, with I the set of countries included. Next, normalized country-year totals are calculated as follows:

$$x_{jt}^{tot} = \sum_{i \in I}\left[x_i^{av} \frac{MV_{i,j,t}}{MV^{av}}\right]. \tag{22}$$

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 broad NAICS codes after winsorizing at the 1% and 99% level.

Uncertainty measure from Gilchrist et al. (2014) 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).

Other Data Sources 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.

List of Tax Havens American Samoa, Andorra, Anguilla, Antigua and Barbuda, Aruba, Bahamas, Bahrain, Barbados, Belize, Belgium, Bermuda, Botswana, British Virgin Islands, Cambodia, Cayman Islands, Channel Islands, Cook Islands, Costa Rica, Cyprus, Djibouti, Dominica, Fiji, Ghana, Gibraltar, Grenada, Guam, Guernsey, Hong Kong, Iceland, Iran, Ireland, Isle of Man, Jersey, Jordan, Lebanon, Liberia, Liechtenstein, Luxembourg, Macao, Maldives, Malta, Marshall Islands, Mauritius, Micronesia, Monaco, Mongolia, Montserrat, Nauru, Netherlands, Netherlands Antilles, Niue, North Korea, Oman, Pakistan, Panama, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, San Marino, Seychelles, Singapore, St. Martin, Switzerland, Syria, Tonga, Trinidad and Tobago, Turks and Caicos Islands, US Virgin Islands, Vanuatu, Yemen, Zimbabwe.

A.1 Model Calibration

Parameter choice follows past studies and experiment with different values. Monitoring costs values are taken from Martinez-Miera and Repullo (2017). Risk free rates are in lone with annual T-bill rates. The elasticity of substitution for variety is set to 5 and it generates a mark-up of 1.2. 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 A.1

Parameter	Description	Value
γ	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%
σ	Varieties Elasticity	6

A.2 Additional Figures

Figure A.1 shows the growth of U.S. liabilities, breaking down between THFC and not. The first have experienced a much larger growth. Figure A.2 shows the growth in U.S. claims and liabilities. For the second the bulk is represented by private debt and equities and for the former the bulk is debt. Figure A.4 shows that asset holdings in THFC are nearly all in U.S. dollars). Figure A.3 shows that most of the debt in the Cayman Islands is in the form of asset-backed securities (ABS).

Figure A.1. U.S. Debt Liabilities, break-down in non-THFC (blue line) and THFC (red line). Sample period is 2002-2019. Source: Aggregate Treasury International Capital.

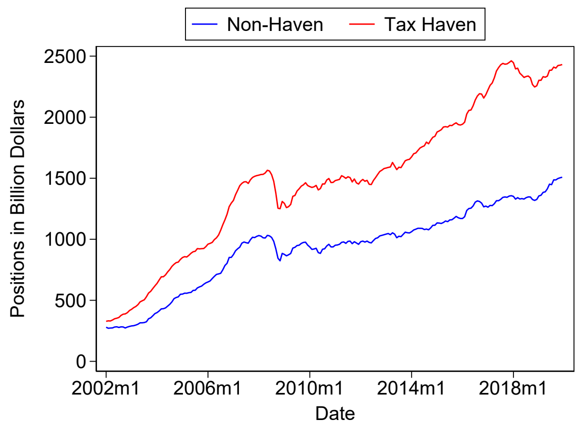
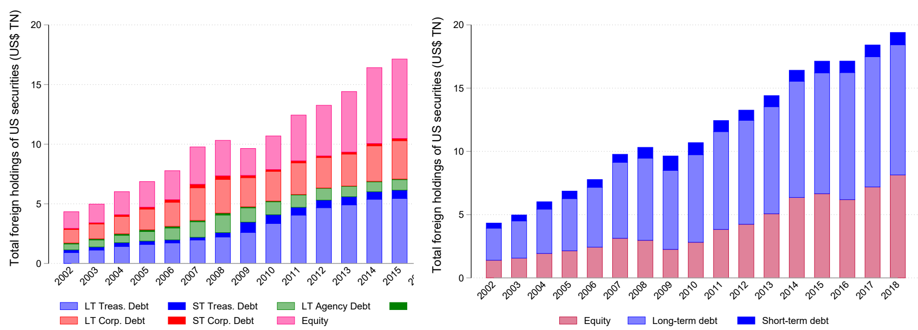


Figure A.2. U.S. Liabilities and Claims per type of security. Long and short term Treasuries, long and short private debt, long and short term agencies and equities (left panel), equity, long and short term debt (right panel). Sample period 2002-2018. Source: Treasury International Capital, surveys SHL and SHC.



(a) Liabilities

(b) Claims

Figure A.3. U.S. liabilities. Asset Backed Securities Debt and Non Asset Backed Securities Debt. Sample period is 2006-2018. Source is Treasury International Capital, surveys SHL and SHC.

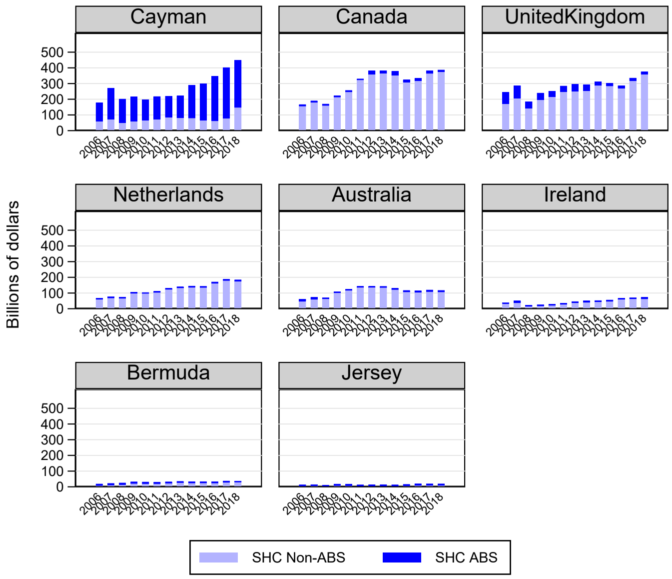


Figure A.4. U.S. holdings of foreign debt (Claims) toward top 12 countries in the order of their share. Each panel also shows the break-down in currency denomination. Sample period is 2011-2018. Source is: Treasury International Capital, surveys SHC/SHLA.