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## Abstract

Complex cross-border financial structures inflate measured international investment stocks in tax havens. Using a standard gravity framework, we estimate that about 40\% of global assets (FDI, portfolio equity and debt) are `abnormal' -- unexplained -- and operated through tax havens. Abnormal stocks are increasing over time and concentrated in a limited number of jurisdictions. Six jurisdictions including three European countries are the largest contributors: Cayman, Bermuda, Luxembourg, Hong Kong, Ireland and the Netherlands. Interestingly, the Luxleaks in 2014 do not appear to have diverted cross-border investments away.



JEL Classification: F23, G21, H22, H32

Keywords: Cross-border investments, Capital openness, tax havens, Gravity Equation



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Anne-Laure Delatte† Amelie Guillin‡ Vincent Vicard §

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# 1 Introduction

Tax havens generate international investment beyond standard factors such as country size and distance and affect the geography of cross-border investment substantially. Figure 1 plots the share of global stocks of foreign direct investment (FDI) and debt and equity investments operated through tax havens. We observe that between 4 and 5 out of 10 dollars of global assets were operated through a tax haven in 2017. Given their small economic size in general, it implies that these jurisdictions hold very large stocks of assets compared to their size: on average, FDI stocks and portfolio investments represent 2400% and 1000% of GDP in tax havens respectively versus 44% and 22% of GDP in non tax havens. Which proportion can be explained by standard factors?

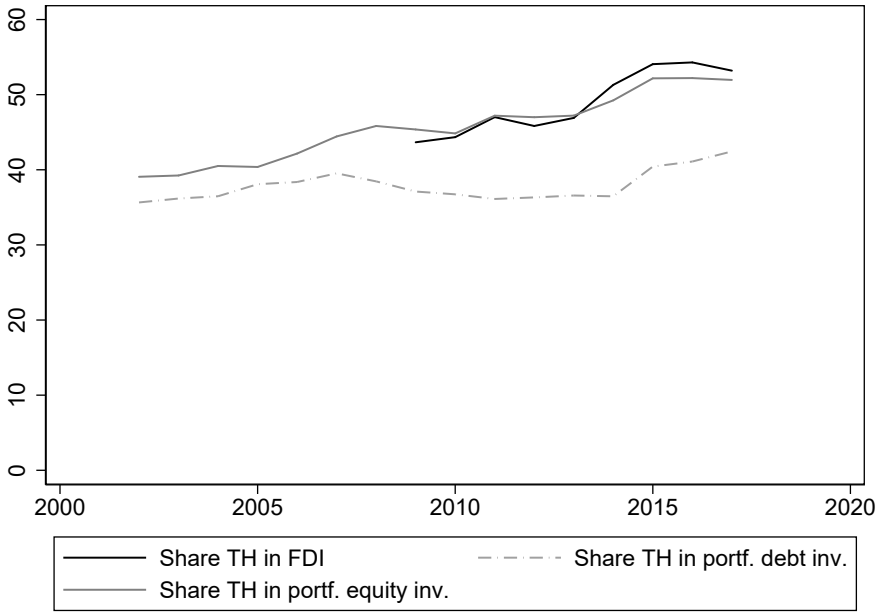
Fig. 2 plots the relative contribution of each jurisdiction to the total operated through tax havens. Interestingly, large tax havens are in general large in all stocks of FDI and portfolio assets. This is consistent with anecdotal evidence about the complex tax schemes involving different classes of investments.[1] While disproportions have been documented for FDI stocks on the one hand (Haberly and Wójcik; Damgaard et al., 2015; 2019), and portfolio investments on the other hand (Coppola et al., 2020), we lack of a comprehensive picture to assess the global financial distortions associated with tax havens.

One chief contribution in this paper is to uncover that tax havens distort global finance geography in all categories of assets, debt and equity as much as FDI stocks and to quantify this distortion. We estimate that about 40% of global asset are *abnormal* stocks, that they are concentrated in a few jurisdictions only, and that this proportion has been on the rise over the last decade.

It is important because tax issues and global finance might interact more than we expect. If tax havens generate disproportionate stocks of securities, then domestic

[1] "B.R.E.A.M. (Bonds Rule Everything Around Me)", Alexandra Scaggs, FT Alphaville, Feb 2018.

Figure 1: Share of tax haven in global stocks



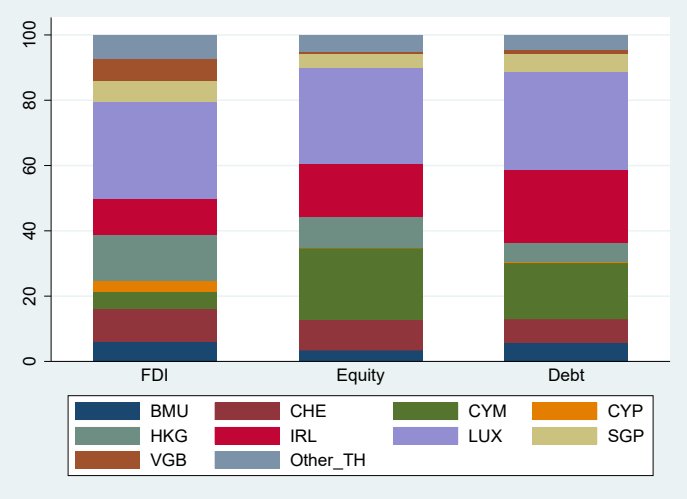

This Figure shows the share to global stocks of stocks for which a tax haven is an origin or a destination (respect. FDI, portfolio debt investment and portfolio equity investment). Authors' calculations with IMF CPIS and CDIS data. Tax havens are those listed in Hines and Rice (1994).

and international tax policy might have unintended consequences on global financial balances. For example, the Tax Cuts and Jobs Act (TCJA) passed in the US in December 2017 was followed by a substantial sell-off of offshore funds invested in liquid U.S. fixed-income securities and generated bond price volatility.[2] More generally, OECD has coordinated the discussion of 134 countries in order to try and reform international fiscal rules (OECD, 2019). In this context, it is key to quantify and locate *abnormal* stocks in order to anticipate the overall impact on global imbalances.

Our strategy relies on two patterns. First, tax schemes leave trace in international statistics of balance of payments. Examples of tax schemes involving FDI

[2]"U.S. Corporations' Repatriation of Offshore Profits: Evidence from 2018", Michael Smolyansky, Gustavo Suarez, Alexandra Tabova, Feds Notes, August 2019 and "The Global Con Hidden in Trumpâs Tax Reform Law, Revealed", Brad Sester, New York Times, Feb 6, 2019.

Figure 2: Largest tax havens by stocks of assets in 2017




The Figure shows countries' share in total stocks (respectively FDI, portfolio debt investment and portfolio equity investment) of tax havens (as origin or destination). Only countries with share in global stocks larger than 2% are represented separately. Authors' calculations with IMF-CPIS and CDIS data.

and portfolio investment stocks include the strategic location of intellectual property rights and intangibles assets, corporate inversion (when a subsidiary in a tax haven becomes the parent entity), the allocation of financial assets and liabilities to Special Purpose Entities (SPEs), or the re-investment by foreign subsidiaries of shifted profit in the capital market of large economies.

Second, international economics relies on gravity framework to assess the economic and geographic determinants of international investments. Our empirical strategy infers *abnormal* investment stocks, i.e. the level of investment stocks in tax havens unexplained by economic and geographic factors, from a standard gravity framework applied to cross-border investment stocks. The gravity model, initially developed to explain goods trade across countries (Bergstrand; Anderson, 1985; 1979), has been extended to assets trade: it is now well-documented that bilateral financial transactions rise proportionately with the economic size of both countries – "mass" – and are negatively correlated with resistance – the "distance", either

geographical or socio-cultural.[3]

We recover the country specific unexplained asset stock once controlled for standard gravity variables using a two-step procedure (Head and Ries, 2008). This methodology allows us to disentangle artificial activity driven by country-specific factors (e.g. lenient tax and transparency environment) from unobserved determinants of bilateral stocks related to historical, geographic or institutional proximity between any pair of investing and investor countries (e.g. historical relationships beyond former colonial links).[4] Our empirical strategy relies on bilateral data. They come from the Coordinated Direct Investment Survey and the Coordinated Portfolio Investments Survey of the IMF. The final sample consists of 235 reporting jurisdictions including 42 tax havens over the 2009-2017 period for FDI stocks and 91 jurisdictions including 22 tax havens reporting their assets to 237 countries over 2001-2017 for portfolio investment stocks.[5]

Our results show that a large share of assets are *abnormal*: on average over 2009-2017, we estimate that 37% of global (predicted) FDI, 42% and 45% of global (predicted) equity and debt stocks are *abnormal* and most of these *abnormal* stocks are operated through tax havens. Jurisdictions are however very heterogeneous in their *abnormality*: only a tiny share of the 42 tax havens listed in Hines and Rice (1994) stands out as abnormally big in each asset category, either as an origin or a destination of investments. Six jurisdictions including five tax havens concentrate the bulk of *abnormal* investments: Cayman, Bermuda, Luxembourg, Hong Kong, Ireland and the Netherlands. Paradoxically, we find that the Luxleaks revealed in 2014 have been followed by rising investments to and from Luxembourg.

**Related Literature** Our paper is most directly related to the literature on

[3]Portes et al. (2001); Portes and Rey (2005); Martin and Rey (2004); Lane and Milesi-Ferretti (2008); Blonigen and Piger (2014); Head and Ries (2008); Head and Mayer (2014); Chiţu et al. (2014); Brei and von Peter (2018)

[4]We dub *abnormal* stocks, these stocks in tax havens not predicted by standard size and bilateral frictions determinants within the gravity framework to emphasize that they are driven by factors without economic and geographic ground.

[5]Tax havens refer to the jurisdictions listed by Hines and Rice (1994) presented in Appendix (see Table 6). In section 5.1, we use alternative lists to test the robustness of our results.

international financial integration assessing the role of off-shore finance in the international financial system (Coppola et al.; Lane and Milesi-Ferretti; Zucman; Palan et al.; Lane and Milesi-Ferretti, 2020; 2018; 2013; 2013a; 2011). Relative to this literature, our contribution is to discipline cross-border investment data with the gravity framework to isolate the share driven by economic and geographic factors, rather than working with raw data and statistical ratios. In this sense, methodologically, our article is part of the gravity literature on financial stocks (Portes and Rey; Martin and Rey; Lane and Milesi-Ferretti; Blonigen and Piger; Head and Ries; Head and Mayer; Chiţu et al.; Brei and von Peter, 2005; 2004; 2008; 2014; 2008; 2014; 2014; 2018). We collect a complete set of gravity variables for a sample of 235 jurisdictions among which 42 are tax havens.[6] Our gravity-estimates produce a better-informed ranking of who are the largest contributors to *abnormal* finance: on the one hand, more than two-third of tax havens play a minor role; on the other hand, six jurisdictions including three European countries deserve policy attention.

A branch of this literature examines more particularly how offshore centers affect the allocation of Foreign Direct Investment (e.g. Haberly and Wójcik (2015), Damgaard et al. (2019) and Garcia-Bernardo et al. (2017)). A recent paper by Coppola et al. (2020) focuses on the flawed allocation of portfolio investments in offshore centers by identifying the ultimate parents of portfolio stocks. Two other branches of the literature use balance of payment and national account data on the one hand (Alstadsæter et al.; Tørsløv et al., 2017; 2018) and firm-level data on the other hand (Vicard; Bouvatier et al., 2019; 2017) to quantify missing corporate profits in high tax countries and pinpoint their location. We differ from them who look at foreign direct investment incomes and returns, by focusing on investment stocks. In total, the allocation of FDI and portfolio investments is rarely assessed

[6]The CEPII gravity dataset contains 224 entities while our dataset contains 235 entities (215 in common). At the end, we have 20 additional countries: American Samoa; Bonaire, Sint Eustatius and Saba; Bouvet Island; Curacao; Guernesey; Guam; Isle of Man; British Indian Ocean Territory; Jersey; Kosovo; Liechtenstein; Monaco; Montenegro; South Georgia and the South Sandwich Islands; Serbia; South Sudan; Sint Maarten; United States Minor Outlying Islands; Vatican; US Virgin Islands. The database is publicly accessible in a github repository here

together and our paper contributes in filling the gap. We show that the largest contributors to abnormal investments are large actors in both FDI and portfolio assets.[7] This result probably reflects the complexity of tax schemes that potentially involve all categories of international capital stocks. It suggests that regulation, such as transparency measures, should include all categories of investment stocks.

Section 2 presents our empirical strategy, Section 3 the estimation results, Section 4 quantification and map. Section 5 presents several robustness estimates and Section 6 concludes.

# 2 Empirical Strategy

We apply a standard gravity framework to discipline our data. We prefer gravity to open economy models of country portfolio which also explain portfolio allocation across countries assets (Stulz; Rowland; Calvo and Mendoza, 1981; 1999; 2000). The reason is that while inter-temporal choice portfolio models pointed to the role of information costs in the portfolio allocation, they have remained silent on the specific nature of these information costs and models trying to be more specific have not derived implications for portfolio allocation (Buch, 2005). The advantage of the gravity framework is to derive a quantitative link between geographic and cultural distance and the structure of the international component of asset portfolios.

The gravity model relates the level of bilateral investment stocks to i/ bilateral factors, ii/ characteristics of the origin country (asset holder), iii/ characteristics of the destination country (asset issuer), and iv/ global factors (Lane and Milesi-Ferretti, 2008). Bilateral factors include any geographic, informational or cultural linkages likely to affect frictions in bilateral transactions (Martin and Rey; Head and

[7] We provide additional evidence on international banking assets on a shorter sample of 31 reporting countries in the robustness section: we find that the distortions documented on FDI and portfolio assets also concern international banking claims and the same jurisdictions identified on FDI and portfolio abnormal stocks are also large contributors of abnormal banking claims (see Section 5.2).

Ries, 2004; 2008). Origin country characteristics measure cross-country differences in the propensity and ability of resident investors to invest abroad globally. At the other end, destination country characteristics account for cross-countries differences affecting their relative attractiveness for all investors. Finally the constant, or year fixed effects in a panel setting, capture any factors affecting the stock of cross border investment worldwide (e.g. a global financial crisis).

## 2.1 Specification

Our measure of *abnormal* investment is the residual of a two-step gravity equation on foreign direct investments (FDI) and portfolio holdings. In the first step, we regress bilateral investment stocks on time-varying origin and destination fixed effects and a vector of geographic and cultural distance measures:

$$\ln Asset^{k}_{odt} = \theta_{ot} + \theta_{dt} + \beta X_{odt} + \varepsilon_{odt}. \tag{1}$$

The dependent variable, $\ln Asset^{k}_{odt}$, is the logarithm of bilateral stocks of asset $k$, $k$ being alternatively FDI, portfolio debt investment and portfolio equity investment.[8] $\theta_{ot}$ and $\theta_{dt}$ are country-and-time fixed effects at origin and destination levels.[9] $X_{odt}$ include a set of geographic and cultural distance factors as suggested in Blonigen and Piger (2014): (log) bilateral distance and binary variables for a common language, a common border, former colonial linkages, a common regional trade agreement, joint EU membership, a common currency and a same territory (the sources of the data are described in Appendix B). Such formulation of the gravity equation has been consistently used with different categories of investment stocks: FDI (Head and Ries, 2008) and portfolio investment equity and debt (Portes et al.; Portes and Rey; Lane and Milesi-Ferretti, 2001; 2005; 2008).

[8] Bilateral FDI stocks are investments in destination country $d$ by origin country $o$ in year $t$; for portfolio debt and equity investments, the bilateral stock is measured between destination country $d$ (holder of the asset) and origin country $o$ (issuer).

[9] We use the *reghdfe* package (Correia, 2014).

In order to measure abnormal investment stocks at the country-year level, we follow Baker and Fortin (2001) and Head and Mayer (2014) and estimate a second step equation regressing the outward and inward fixed effects derived from the first stage, $\theta_{ot}$ and $\theta_{dt}$, on country-specific variables. We prefer a two-step approach because it allows us to derive country-specific residuals ($\mu_{ot}$ and $\mu_{dt}$ below) while a one single estimate would leave us with pair-specific residuals ($\mu_{odt}$). With pair-specific residuals, we would not be able to disentangle abnormal activity related to country characteristics from that due to pair-specific characteristics (e.g. historical links beyond what former colonial links measures).

In turn, with the two-step approach, we identify outliers at the country-level, either as an origin or as a destination country. The second step remains full part of the gravity framework:

$$\theta_{ot} = \alpha_1 Z_{ot} + \alpha_2 \bar{X}_{ot} + \mu_{ot} \tag{2a}$$

$$\theta_{dt} = \alpha_1 Z_{dt} + \alpha_2 \bar{X}_{dt} + \mu_{dt} \tag{2b}$$

where $Z_{ot}$ and $Z_{dt}$ are country-and-time observable variables, $\bar{X}_o$ and $\bar{X}_d$ includes the average characteristics of countries $o$ and $d$ defined as $\bar{X}_{ot} = \sum_d X_{odt}/N_d$ for each bilateral variable included in $X_{odt}$ in Equation 1. $Z_{ot}$ and $Z_{dt}$ include current GDP and population, the rule of law, insularity and landlocked characteristics. In addition, a discrete market capitalization measure is included in the portfolio estimate, ranked from 1 to 3 in tercile of market capitalization-to-GDP, in order to account for the differences of agglomeration economies among financial centers.

We follow Okawa and van Wincoop (2012) and we exclude asset returns and tax rates from the vector of country-specific variables. In fact, Okawa and van Wincoop (2012) show that gravity applies properly to information friction only and that introducing a financial friction such as a tax invalidates the gravity specification.[10]

[10]They show that bilateral asset holdings are not anymore proportional to the size of the destination country as would be the case in any gravity specification. The reason is that gravity in trade models holds under a CES demand system, where demand for goods depends on relative prices. This kind of demand system does not generally hold in portfolio choice, where portfolio demand

Yet, tax affects returns and therefore should consistently influence the allocation of asset. Is it a problem for our research objective that gravity does not account for it? On the contrary, we think that it precisely fits our goal. As a matter of fact, the common criteria defining tax haven jurisdictions include low or null tax rate, and aggressive tax competition and opacity (Palan et al.; Hines and Rice, 2013b; 1994). Including zero or closed to zero statutory tax rates of several jurisdictions, would deny the presence of unfair tax competition.[11] Put differently, while tax qualifies for an economic factor of stock allocation in a context without unfair tax competition, we argue that including null or extremely low statutory tax rates would blur our analysis. Section 5 presents sensitivity analysis when including corporate tax rates as a determinant of investment stocks. Our conclusions remain unchanged.

The residuals $\mu_{ot}$ and $\mu_{dt}$ are the unexplained stock of asset, i.e. our country-specific measure of *abnormal* assets. We estimate Equations 2a and 2b on the sample of non tax havens because it has been shown that profit shifting by multinationals inflates GDP per capita in tax havens (Tørsløv et al., 2018), potentially biasing estimated coefficients on $Z_{ot}$ and $\bar{X}_{ot}$. $\mu_{ot}$ and $\mu_{dt}$ are hence computed from out of sample predictions for tax havens listed in Hines and Rice (1994). Section 5 presents sensitivity analysis when estimating on the full sample and using four alternative lists of tax havens and our conclusions remain unchanged.

## 2.2 Bilateral Investment stocks

We use the statistics on bilateral FDI coming from the Coordinated Direct Investment Survey of IMF (CDIS) (the reference edition of the survey is the IMF CDIS 2019 covering 2009-2017) and we complete and improve some data. To do so, we use two measures of FDI, the Inward Direct Investment Positions, i.e. the stock

depends on the inverse of a variance-covariance matrix of returns times a vector of expected excess returns.

[11] In 2018, 12 jurisdictions have a zero statutory corporate tax rate and 17 have a tax rate below 12% (`https://taxfoundation.org/corporate-tax-rates-around-the-world-2019/`).

declared by the destination country of investment, and the mirror Outward Direct Investment Positions, i.e. the stock declared by the origin or investor country. We find noticeable differences between both stocks arising from missing values and from the quality of the data. Similarly, Angulo and Hierro (2017) highlight large bilateral asymmetries between inward and mirror stocks. In total, 126 countries do not report FDI with their partners but their partners do so: approximately 30% of missing inward values have a mirror outward stock reported (56,855 observations). Therefore, we use the mirror data to complete the FDI database.

In addition, the same mirror data allow us to assess the reporting quality at the country level. We first isolate the largest bilateral asymmetries between reported and mirror inward stocks and then we compare the reporting quality of each country in the pair. We replace the reported data of "bad" reporters with the mirror data reported by "good" reporters (our procedure is detailed in Appendix A and the resulting top and bottom quality ranking of reporting countries is reported in Table 5). Doing so, we complete and improve the FDI data for 93 countries including 27 tax havens. The resulting sample consists of 235 reporting jurisdictions including 42 tax havens.

Statistics on bilateral portfolio investments come from the Coordinated Portfolio Investment Survey of the IMF (CPIS) (the reference edition of the survey is the IMF CPIS 2019 covering 2001-2017). The database provides a breakdown between debt and equity assets. The resulting sample consists of 91 jurisdictions including 22 tax havens reporting their assets to 236 countries. Contrary to previously, we can not exploit mirror data similarly as for FDI because CPIS includes a smaller number of mirror data than CDIS.

# 3 Results

## 3.1 Gravity estimates

Table 1 reports the estimated coefficients on geographic and cultural distance determinants of bilateral FDI and portfolio investments from Equation 1. Estimated coefficient signs are consistent with expectation: bilateral investment stocks decrease with distance and increase with contiguity, historical colony linkages and common language; the European Union is associated with larger cross-members investment assets; similarly, tax treaties between origin and destination are associated with larger stock of bilateral assets. Bilateral investment treaty (BIT) and RTAs are associated with larger FDI only; on the contrary, only debt assets are significantly larger between two partner countries sharing a common currency.

Table 1: First-step gravity: bilateral determinants

| | (1) FDI | (2) Debt | (3) Equity |
|---|---|---|---|
| Log distance | -1.258*** | -0.838*** | -0.902*** |
| | (0.038) | (0.030) | (0.039) |
| EU membership dummy | 0.882*** | 0.966*** | 0.453*** |
| | (0.128) | (0.096) | (0.118) |
| Tax treaty dummy | 0.534*** | 0.097* | 0.197*** |
| | (0.067) | (0.054) | (0.070) |
| Bilateral investment treaty dummy | 0.484*** | -0.107** | -0.026 |
| | (0.056) | (0.047) | (0.063) |
| Common language dummy | 1.012*** | 0.380*** | 0.748*** |
| | (0.081) | (0.067) | (0.089) |
| Common border dummy | 0.619*** | 0.352*** | 0.791*** |
| | (0.120) | (0.127) | (0.160) |
| Common currency dummy | 0.132 | 0.645*** | 0.111 |
| | (0.117) | (0.111) | (0.130) |
| Former colonial relationship dummy | 0.998*** | 0.276*** | 0.602*** |
| | (0.126) | (0.106) | (0.145) |
| Same country dummy | -0.085 | 0.451 | -0.002 |
| | (0.365) | (0.327) | (0.375) |
| RTA dummy | 0.635*** | | |
| | (0.066) | | |
| Observations | 70,022 | 70,489 | 65,159 |
| R-squared | 0.642 | 0.723 | 0.725 |

This table reports the estimates of the first step of the gravity equation on FDI, portfolio debt and portfolio equity specified in Eq.1. We use an OLS estimator on a full sample. The period of estimation is 2009-2017 for FDI stocks and 2002-2017 for portfolio debt and equity. *** indicates a correlation significant at the 0.01 level.

We use the country-and-time fixed effects estimated in this first stage to estimate the second step equations 2a and 2b.[12] We now use a sample excluding jurisdictions listed in Hines and Rice (1994) to prevent artificially inflated national account statistics in tax havens to contaminate our estimates. There are two caveats. First, excluding tax havens only reduces but does not eliminate the bias because a part of the activity among non tax havens is influenced/diverted by the presence of tax havens. In Section 5 we assess the sensitivity of our results to the inclusion of tax havens jurisdictions in the sample when estimating Equations 2a and 2a. Our final results remain unchanged. Second, we may be introducing a bias due to the list chosen. In Section 5, we limit the incidence of this bias by testing four alternative lists from: the OECD, the IMF, Oxfam and one including the 15 top jurisdictions listed by all three lists. Our final results remain unchanged.[13]

Results are reported in Table 2. A larger GDP is associated with larger stocks at both origin and destination level while larger population is mostly associated with lower stocks of assets (the only exception is equity at origin). Countries ruled by the principle of the rule of law display larger stocks of assets as expected; on the contrary landlocked countries display lower stock of FDI and equity (the estimated coefficient is not significant for debt securities). The larger the market capitalization, the larger the stocks of asset (except for debt at origin).

[12] We assess how important correcting for bilateral frictions is by regressing fixed effects estimated in a specification controlling for bilateral factors with fixed effects estimated without controls. The slopes of the regression lines are in between 0.908 and 0.979 and the R2s go from 0.86 to 0.97. Additional descriptive statistics on quartiles reveal that corrections matter for the average country and affect particularly the estimated country fixed effects for a significant share of countries. We are grateful to an anonymous referee for this suggestion.

[13] We are grateful to an anonymous referee for this suggestion.

Table 2: Second-step gravity equation

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | FDI | | Portfolio debt | | Portfolio equity | |
| | Origin | Destination | Origin | Destination | Origin | Destination |
| Log GDP | 0.720*** | 0.779*** | 0.903*** | 1.167*** | 0.619*** | 1.267*** |
| | (0.033) | (0.039) | (0.036) | (0.084) | (0.042) | (0.088) |
| Log population | -0.132*** | -0.212*** | -0.196*** | -0.672*** | 0.098** | -0.798*** |
| | (0.035) | (0.041) | (0.036) | (0.093) | (0.042) | (0.097) |
| Rule of law | 0.178*** | 0.799*** | 0.531*** | 0.358*** | 0.832*** | 0.973*** |
| | (0.049) | (0.060) | (0.051) | (0.102) | (0.060) | (0.107) |
| Landlocked country | -0.351*** | -0.587*** | -0.114 | -0.179 | -0.277*** | 0.657*** |
| | (0.073) | (0.088) | (0.075) | (0.165) | (0.089) | (0.171) |
| Tertile of capitalization | | | 0.001 | 0.647*** | 0.382*** | 0.958*** |
| | | | (0.051) | (0.108) | (0.060) | (0.110) |
| Constant | -2.885*** | -18.193*** | -13.160*** | -16.511*** | -9.884*** | -19.024*** |
| | (0.959) | (1.164) | (0.957) | (2.245) | (1.190) | (2.335) |
| Observations | 1,495 | 1,508 | 1,989 | 890 | 2,098 | 877 |
| R-squared | 0.722 | 0.745 | 0.759 | 0.688 | 0.708 | 0.771 |

This table reports the estimates of the second step of the gravity equation on FDI, portfolio debt and portfolio equity specified in Eq.2a and Eq.2b. Variables $\bar{X}_o$ and $\bar{X}_d$ in Equations 2a and 2b are included but coefficients are not reported. The period of estimation is 2009-2017 for FDI stocks and 2002-2017 for portfolio debt and equity. We use an OLS estimator on a sample excluding tax havens. ***, ** indicates a correlation significant at the 0.01 and 0.05 level resp.

## 3.2 Time-varying country-specific abnormal stocks

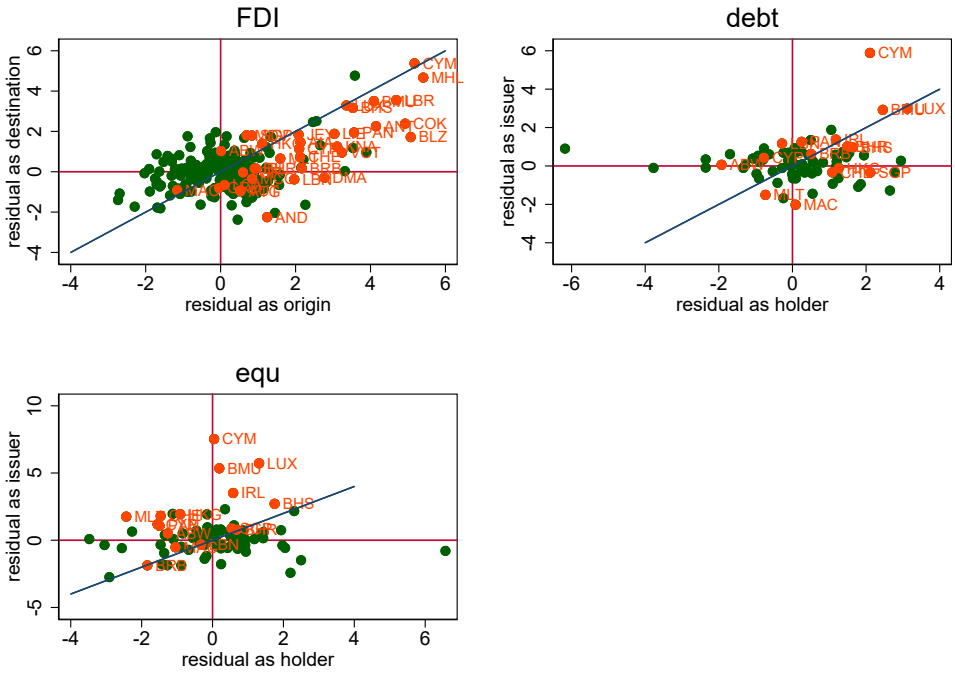
Now, we use estimates from Table 2 to predict the stocks for our full sample of countries. Our measures of time-varying country-specific *abnormal* stock are the residuals of this out-of-sample prediction.

Figure 3 plots the period average *abnormal* stocks at origin and destination levels by country. We observe that *abnormal* stocks operated though a tax havens (orange dots) are differently located than the ones operated through non tax havens (green dots). First, more orange dots lay in the northeast quarter of the figure than green dots meaning that *abnormal stocks* in tax havens are larger on average. Second, on the FDI figure, several orange dots tend to be located around the first bisector suggesting that the associated jurisdictions stand out as origin and destination levels, i.e. as "platform" jurisdictions. Such pattern corresponds to conduit countries that act as intermediaries of the international financial system and channel investments from an ultimate investor to the final investment destination. Many jurisdictions are however better characterised as sinks that retain FDI (Garcia-Bernardo et al., 2017) or as a source of intra-group financing, involving abnormal stocks in one dimension only. In turn, outliers in equity stocks tend to be located along the y-line, suggesting that these jurisdictions stand out as large equity issuers. Third, a few tax haven jurisdictions are top outliers in the three asset categories.

## 3.3 To which extent are abnormal stocks related with typical characteristics of tax havens?

As we mentioned earlier, the common criteria defining tax haven jurisdictions include low or null tax rate, aggressive tax competition and opacity (Palan et al.; Hines and Rice, 2013b; 1994). In line with this definition, we test the contribution to individual country abnormal stocks of three factors: the statutory tax rate, a financial secrecy index (based on 20 secrecy indicators computed by Tax Justice Network) and a tax

Figure 3: Individual abnormal stocks: breakdown by origin and destination




This Figure shows the *abnormal* stocks of FDI, debt and equity by country at origin and destination levels operated through tax havens (orange dots) and non tax haven jurisdictions (green dots). They are the residuals of Eq. 2a and Eq. 2b estimated out-of-sample. Residuals are averaged over the respective periods of estimation.

haven dummy (from Hines and Rice (1994)).

Table 8 in Appendix reports the results of a cross-section estimate on individual abnormal stocks in 2017. Statutory tax rates and the secrecy index have the expected signs (negative and positive respectively), but are not systematically significant at the 10% level, while the tax haven dummy is associated with larger abnormal stocks in all categories and all dimensions (except equity at origin), which is consistent with what we observe Fig.3. When combining all three variables together, only the tax haven dummy remains significantly associated with higher abnormal stocks, while tax rates and financial secrecy turn insignificant. It suggests that larger abnormal stocks in tax havens are associated with their defining characteristics – low corporate

tax rates and financial secrecy. Such exercise is limited by data availability and its cross-sectional nature, so these results should be considered with caution.[14] They are however suggestive that abnormal stocks are related with factors associated with tax planning and tax evasion. It is consistent with recent results showing that portfolio holdings in tax havens react to anti tax evasion measures (Heckemeyer and Hemmerich, 2020).[15]

In the next Section, we examine what these *abnormal* stocks represent to the global financial stocks.

# 4 Global and individual quantification

## 4.1 Share of *abnormal* finance operated through tax havens in global finance

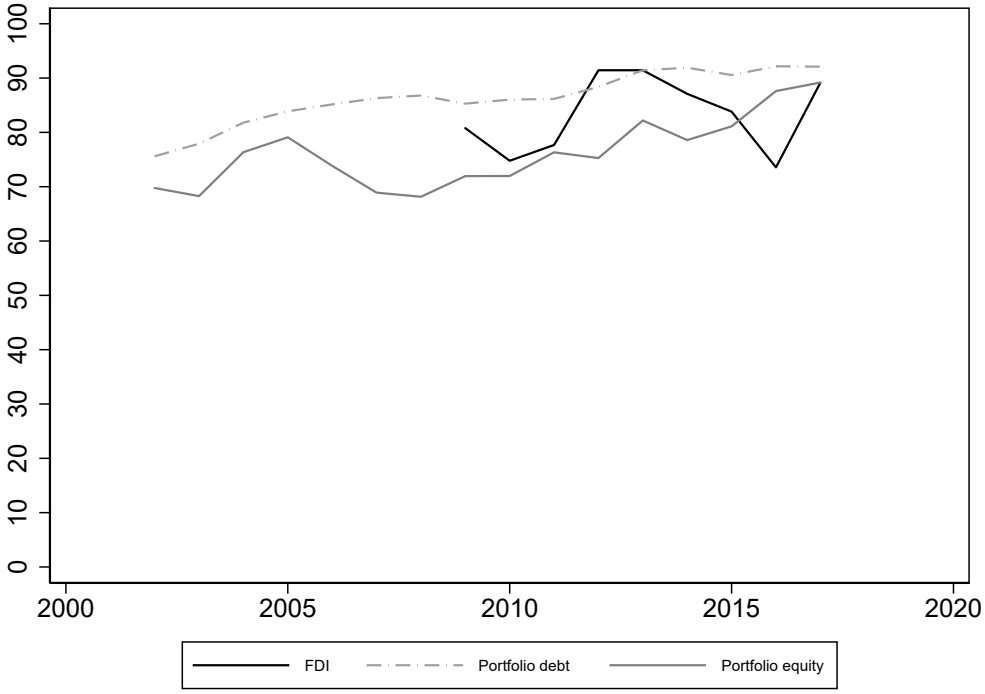
Fig.1 in introduction shows that between 4 and 5 out of 10 dollars of global assets were operated through a tax haven in 2017. How much of this can be explained by economic and geography factors? Our methodology precisely answers this question.

We compute the share of *abnormal* stocks operated through a tax haven in the total stocks of tax havens. Since our measure of abnormal stocks is at the country×year level and enters multiplicatively in bilateral gravity (equation 1 in level), we need to predict global bilateral stocks to assess how much of the stock of assets operated through tax havens it explains. To do so, we compute separately the predicted bilateral stocks for each class of assets from the specifications reported in Table 1 and the predicted bilateral stocks minus country-and-time specific residuals

[14] First, we work with a sub-sample of maximum 79 countries compared to a maximum of 235 in our main analysis because of data availability on the secrecy index. Second, we exploit the cross-section data because the factors have a quasi null time-variance.

[15] Heckemeyer and Hemmerich (2020) show that bilateral agreements on exchange of information in tax havens affect portfolio outbound from tax havens because tax evaders who hide their funds in tax havens usually re-invest those funds in the capital market of large economies. Therefore measures of tax transparency curb portfolio outbound because it provides timely information on non-compliance of tax on investment return or capital.

Figure 4: Abnormal stocks operated as a share of the total stocks operated through tax havens




This Figure shows the share of *abnormal* investment stocks in total predicted stocks operated through a tax haven for FDI (dark plain line), debt (dotted line) and equity (grey plain line) respectively.

estimated from equations 2a and 2b for tax havens. The difference of these two predicted bilateral stocks yields the abnormal stock at the country pairs level by year. Our measure of abnormal stock is then the sum of abnormal stocks divided by total predicted stocks operated though tax havens, i.e. when either country $o$ or $d$ is a tax haven, as follows:

$$Share\ abnormal\ \mathrm{TH}_t = 100 \times \frac{\sum_{od,(o,d\ \in\ TH)} \left[\exp(\ln \tilde{Assets}_{odt}) - \exp(\ln \tilde{Assets}_{odt} - \mu^{TH}_{d,n,t} - \mu^{TH}_{o,n,t})\right]}{\sum_{od,(o,d\ \in\ TH)} \tilde{Assets}_{odt}} \tag{3}$$

where $\ln \tilde{Assets}_{odt}$ are bilateral stocks predicted from the first step gravity equation

(Equation 1) and $\mu_{d,n,t}$ and $\mu_{o,n,t}$ come from the estimation of equations 2a and 2b.[16]

Figure 4 plots the share of *abnormal* investment stocks in total predicted stocks operated through a tax haven for FDI (dark plain line), debt (dotted line) and equity (grey plain line) respectively. We observe that the shares vary between 70 and 90% along assets and time, meaning that at least 70% of international capital stocks operated through tax havens during the period can not be explained by standard gravity factors. The three shares are rising over the period and end up close to 90%. The unexplained share is slightly larger on average for portfolio debt stocks, at 92% in 2017 (from 76% in 2002), against 89% for FDI and portfolio equity stocks. FDI stocks are observed on a shorter time span and the share unexplained by gravity factors for tax havens countries is more volatile. It is however of similar magnitude as for other assets and increases from close to 81% in 2009 to 89% in 2017.

In total, if we look at global finance, our results imply that on average between 2009 and 2017, *abnormal* FDI in tax havens have represented 36% of global predicted FDI. Proportions are similar for equity and debt assets: on average between 2002 and 2017, *abnormal* equity (debt) have represented 43% (45%) of global predicted equity (debt) in tax havens. In the following we discuss their geography.

## 4.2 Unpleasant Geography

How are *abnormal* stocks geographically distributed? So far, the literature has treated all tax havens equal by providing lists of jurisdictions without weighting scheme.[17] Given that our sample includes all existing jurisdictions in at least one dimension of the bilateral stocks (origin or destination), we are able to draw an overall geographic comparison across jurisdictions. To do so and convey the heterogeneity of country-specific *abnormal* stocks, we distort the geometry of a global

[16] We report abnormal stocks to predicted stocks instead of actual stocks so as not to attribute prediction errors to abnormal stocks.

[17] Palan et al. (2013a) refer to 11 lists among which Hines and Rice (1994) that we use in this paper.

map by substituting countries' land area by their level of abnormality (see Fig. 5), i.e. each country is represented along their GPS coordinates by a square which size is proportional to the average country-specific measure of abnormal stocks:

$$AbnormalTot_i = [\mu_{FDI,i,o,t} + \mu_{FDIi,d,t} + \mu_{Eq,i,d,t} + \mu_{Debt,i,d,t}]/4$$

where $\mu_{i,t,o}$ and $\mu_{i,t,d}$ are obtained from the estimate of Eq. 2a and Eq.2b. on FDI, equity and debt stocks.[18] In other terms, the larger a country in Fig. 5, the less their stocks are explained by gravity, the more their international financial exchanges are driven by non economic and geographic factors.

In order to visualize heterogeneity, we further emphasize top outliers and top FDI *abnormal* plateforms. Jurisdictions qualify as top outliers if all their abnormal stocks are larger than the sample average by one standard deviation at least over half of the estimation period $T$:

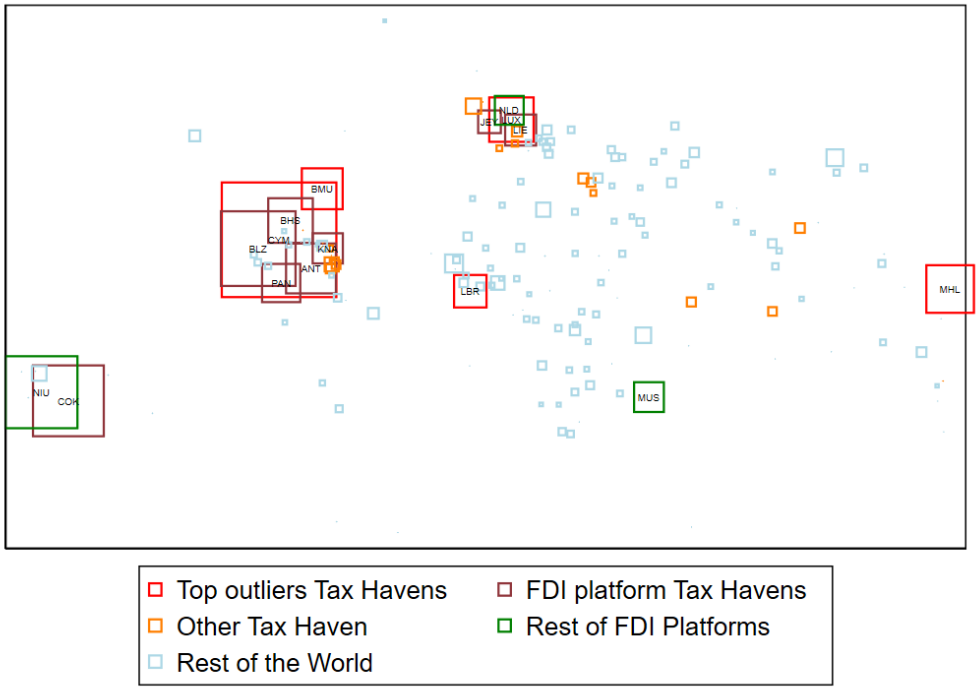
$$\mu_{i,d,t} > (\overline{\mu_{d,t}} + \sigma_{d,t}) \text{ in } t > \frac{T}{2}$$
$$\mu_{i,o,t} > (\overline{\mu_{o,t}} + \sigma_{o,t}) \text{ in } t > \frac{T}{2}$$

with $\mu_{i,o,t}$ and $\mu_{i,d,t}$ the abnormal stocks of FDI, equity and debt of country $i$, in time $t$, at origin and destination levels. In plain English, these jurisdictions are simultaneously large *abnormal* FDI platforms, with large inward and outward FDI, and large holder of equity and debt. Similarly, top *abnormal* FDI platforms are defined as jurisdictions with large measured inward and outward *abnormal* FDI stocks (larger than the sample average by one standard deviation at least over half of the estimation period). This is to visualize jurisdictions that have developed a functional specialization in *conduit* economies defined as "attractive intermediate destinations in the routing of international investments" (e.g. Weyzig (2013)). For these jurisdictions, we substitute the land area by the average country-specific measure of abnormal stocks of FDI[19]

[18] We disregard $\mu_{Eq,i,o,t}$ and $\mu_{Debt,i,o,t}$ here because the sample of reporting countries in CPIS is limited to 91 jurisdictions.

[19] $AbnormalFDI_i = (\mu_{FDI,i,o,t} + \mu_{FDIi,d,t})/2$ where $\mu_{i,t,o}$ and $\mu_{i,t,d}$ are obtained from the estimate of Eq. 2a and Eq.2b.

Figure 5: The geographic distribution of *abnormal* international finance




This Figure shows a map where *abnormal* stocks substitute for land area. Top outliers are simultaneously large *abnormal* FDI platforms, with large inward and outward *abnormal* FDI, and large holder of *abnormal* equity and debt. Red squares represent top outliers listed as a tax haven : Cayman, Marshal Island, Bermuda, Luxembourg and Liberia). Top FDI platforms are jurisdictions with large inward and outward *abnormal* FDI. Brown squares represent jurisdictions identified as top FDI platforms and listed as a tax haven: Beleze, Cook Island, Panama, Bahamas, Netherland Antilles, Lichtenstein, Saint Kitts and Nevis and Jersey; green squares represent top FDI platforms not listed as tax haven: Niue, Netherlands and Mauritius. *Abnormal* stocks are estimated as specified in Eq. 2a and Eq. 2b using out-of-sample OLS estimates.

In Fig. 5 we observe that : 1) there is no top outlier in non tax haven jurisdictions, a fact that suggests the relevance of our methodological approach to identify *abnormality* related to tax and regulation avoidance; 2) abnormal stocks are strongly heterogeneous among tax havens: some tax havens are plotted with very large squares (the red and brown ones) while some other tax havens have squares similar to non tax havens (the orange ones); 3) five tax havens are top outliers: Cayman Islands, Marshall Island, Bermuda, Luxembourg and Liberia (ranked by their value

of $AbnormalTot_i$); 4) there is at least one top outlier in each continent, except for Asia: Cayman and Bermuda in America, Luxembourg in Europe, Liberia in Africa, Marshall Island in Oceania; 5) 11 jurisdictions are top FDI platforms: Beleze, Cook Island, Panama, Bahamas, Netherland Antilles, Niue, Netherland, Mauritius, Lichtenstein, Saint Kitts and Nevis and Jersey (ranked by the value of $AbnormalFDI_i$); 6) there is a cluster of top *abnormal* FDI platforms in the Caribbean where more than half of the jurisdictions listed as tax havens qualify as conduit; 7) there is a cluster in Oceania with Marshall Islands, Cook Islands and Niue; 8) there is at least one top *abnormal* FDI platform per continent. 9) Netherland, Niue and Mauritius are 3 out of 10 top FDI platforms not listed in Hines and Rice (1994). However, this is consistent with existing evidence pointing their role of pass-through country: Dharmapala and Hines (2009) describes the Netherlands as sharing with tax havens "the pattern of hosting a disproportionately high share of net book income"; in the same vein, Weyzig (2013) points to the role tax treaties as a key determinant of FDI routed through the Netherlands. The work by Beer and Loeprick (2018) on investment hubs and tax treaties points the specialization of Mauritius as an FDI conduit. Last, Niue is located in the archipelago consisting of Cook island listed as tax haven.

Last, Table 11 in Appendix C summarizes the composition of the different bins that we have explored; in addition to top outliers and top FDI platforms, we identify top debt and equity holders. We find that Antiga is a top debt holder while Ireland, Hong Kong and Bahamas stand out as top *abnormal* equity holders.

Now that we have identified top *abnormal* jurisdictions, we would like to assess their respective weight in tax haven finance.

## 4.3 Which jurisdictions are the largest contributors to *abnormal* finance?

After identifying the jurisdictions with the largest distortions, we put them in perspective with their market share in tax haven finance. In fact, the political agenda may want to focus on the big tax havens, where most of their activity cannot be explained. Fig. 2 in introduction displays the relative market share of each jurisdiction in total tax haven finance.

A first observation is that Switzerland, Jersey and Singapore, which are large tax havens, do not stand out as top outliers in the bins presented above. In sum, our estimates suggest that their being large offshore centers is driven by economic and geographic factors.

In turn, Luxembourg, Caymans Island and Bermuda are not only large offshore centers in all categories of stocks but our empirical results suggest that international investments to and from these places are mostly not driven by economic and geographic factors. They are therefore key jurisdictions in grey finance and should be given special attention.

Beyond these three large actors, Hong Kong and Ireland deserve attention too given their individual share in equity activity and their position in top *abnormal* equity.

Last, while the share of Netherlands is not displayed in Fig. 2 because it is not listed as a tax havens in Hines and Rice (1994), it is worth reminding that they rank in the top *abnormal* FDI platform in our estimates (in line with Weyzig (2013) and Dharmapala and Hines (2009)) and that their share in global FDI is 23.5%, much higher than any tax havens. Given the existing evidence, there is no doubt that the Netherlands needs to be closely monitored. It is all the more interesting that the rest of *abnormal* FDI platforms identified above have a low market share (i.e. they are included in "other tax havens").

In total, we find large heterogeneity among tax havens and we emphasize six

large jurisdictions on which the policy agenda against profit and wealth shifting may want to focus. We are also able to pinpoint jurisdictions by their functional specialization, a fact that may be helpful to design proper policies at the regional level.

## 4.4 Time evolution

Fig.4 suggests that aggregate *abnormal* stocks have increased over the period. Now that we have identified the largest contributors of abnormal stocks, we split the time period in three sub-periods, 2009-2011, 2012-2014 and 2015-2017 and we proceed to the same bins exercise as above. The results are stable: Luxembourg, Cayman, Bermuda, Ireland and the Netherlands stand out over the three sub-periods and Hong Kong stand out from 2012 to 2017.

In particular, it is striking that Luxembourg stands out over the entire period marked by the leaks which revealed confidential information about their tax rulings in November 2014.[20] To make sure, we test the significance of a time trend in the residuals of Luxembourg after 2014.[21] We find that it is positively significant for FDI, suggesting that FDI have increased after the leak; and we find that the time-trend is not significant for portfolio stocks, suggesting that these stocks have remained stable after the leak. We also test a time trend in the residuals of their main partners and in largest FDI platforms and we reject the null. In sum, we conclude that the Luxleaks in 2014 not only did not appear to have diverted cross-border investments away from the Luxembourg nor other jurisdictions but appear to have been followed by rising FDI to and from Luxembourg.

[20] Luxembourg Leaks Database by the ICIJ

[21] The main channel is the reputational costs for firms, for which evidence are mixed (Hanlon and Slemrod; Wilde and Wilson (2009; 2018). Two studies investigate the Luxembourg Leaks and find positive reactions by investors, i.e. more investments (Nesbitt et al.; Huesecken et al., 2017; 2018)

# 5 Robustness

In this section, we first provide sensitivity analyses along alternative methodological choices, sample and the vector of determinants (section 5.1). Second, we report evidence of large abnormal banking stocks in tax havens based on a similar empirical strategy applied to international banking claims (Section 5.2) on a sample of 31 reporting countries.

## 5.1 Sensitivity analysis

Our six alternative are: (i) a two-step OLS using the full sample in the second step estimate; (ii) a one-step gravity equation; (iii) a two-step estimation using a Poisson PML estimator; (iv) a two-step estimation using a Poisson PML estimator on positive stocks only; (v) controlling for corporate tax rate in the second step gravity equation (Equations 2a and 2b); and (vi) testing alternative lists of tax havens.

All results are reported in Appendix C. Table 9 reports the correlation between second-step residuals estimated in the baseline and in the alternatives with the associated $R^2$. Figures 8, 9 and 10 plot the correlation lines along the different alternatives. In general, we observe that abnormal stocks estimated in our baseline and the different alternatives are significantly correlated with high levels of $R^2$ except in one of the ten specification including portfolio debt (column 8 of Table 9). It suggests that overall our findings are not sensitive to different estimation methods, samples and to the inclusion of the corporate tax rate. Table 10 reports the results of the second step gravity equation (Equations 2a and 2b) along the five first alternatives mentioned above.

- Some coefficients estimated on the full sample are different (columns (1), (5), (9), (13), (17) and (21) of Table 10), a fact that confirms that including tax havens biases the coefficients. Indeed, it is interesting to observe that the

estimated coefficients on GDP and population are both higher (in absolute terms) in the full sample estimates, a result that reflects the (artificially) high GDP per capita of tax havens economies.

- In the one-step OLS estimate, we compute the average of bilateral residuals at origin and destination levels. The estimated residuals slightly differ because we do not control for unobserved bilateral proximity variables.

- Both PPML estimates with and without zeros yield lower $R^2$ than the other alternatives.[22] Coefficients differ because PPML imposes more structure to the fixed effects.[23] $R^2$ remains close to 0.6 except for debt and equity stocks at destination. Note that the inclusion of zero stocks significantly affects the results only for the latter two specifications.

- Including the corporate tax rate as a determinant of investment stocks hardly change our baseline results.[24] The corporate tax stands out as significant only for debt stocks at origin (column (10) of Table 10). This result is consistent with the existing works finding weak economic significance of corporate tax rates on FDI stocks in OECD countries (Blonigen and Piger, 2014).

- Tables, 12 and 13 in Appendix report the results of introducing four alternative lists from the OECD, the IMF, Oxfam and one including the 15 top jurisdictions listed by Oxfam (alternative lists and sources are reported in Table C). New estimates confirm that our results do not depend on the list: first, the estimate results along the four alternatives and our baseline are similar; second we find that mostly the same jurisdictions are top outliers along all lists as well as most FDI platforms (see Table 14).

[22] We use the Correia et al. (2019) package.

[23] The Poisson PML has been advocated to estimate gravity equation on trade in goods (Santos Silva and Tenreyro, 2006); Fally (2015) further shows that the PPML estimator imposes fixed effects estimates consistent with restrictions of structural gravity and multilateral resistance terms derived from general equilibrium.

[24] Corporate tax rate are statutory rates from `https://taxfoundation.org/corporate-tax-rates-around-the-world-2019/`.

## 5.2 Additional evidence on international banking claims

We proceed to estimates on international banking data to complete our perspective on international capital stocks.[25] Our results confirm two important findings of our baseline estimates: i) we find similar magnitudes and dynamics as for FDI and portfolio; ii) we find that Cayman, Bermuda, Marshall Islands, Luxembourg, Bermuda and Liberia are also top outliers for abnormal banking claims similarly to abnormal FDI and portfolio stocks.

We collect "locational banking statistics" from the BIS which meet a bank residency criterion (country where the branch/office operates) and include intra-group data (i.e. they are not consolidated). Bilateral data for all individual counterparties vis-a-vis all sectors and non-banks are published for 31 reporting countries (i.e. 60% of all bilateral positions).

We follow Brei and von Peter (2018) to clean, transform and adjust the database: in the publicly available database, we observe claims and liabilities of banks of 31 reporting countries to and from bank and non bank sectors. We transform the "banks-to-country" data to a "country-to-country" network, by overlaying the asset and liability data for all country pairs on which data are reported. The resulting network leaves out only direct exposures between non-banks.[26] We end up with 84,600 observations, 31 reporting countries including 7 tax havens and 200 partner countries including 36 tax havens. The list of reporting tax havens is Guernsey, Ireland, Isle of Man, Jersey, Luxembourg, Macao, Switzerland.

We apply the same empirical strategy as in our baseline estimates. First, Table 3 reports the results of a two-steps gravity estimate. In the first step, our estimates show that banking claims increase with bilateral agreements (BIT, EU membership and tax treaty). As expected, the impact of distance is negative while linguistic or colonial ties foster bilateral banking claims. The second-step estimates, displayed in

[25] We thank an anonymous referee for their suggestion.

[26] We refer the readers to Brei and von Peter (2018) for more details on the cleaning and adjustments procedure.

Table 3 column (2)-(3), suggest that a higher GDP is associated with larger claims at both origin and destination, as the rule of law and the market capitalization.

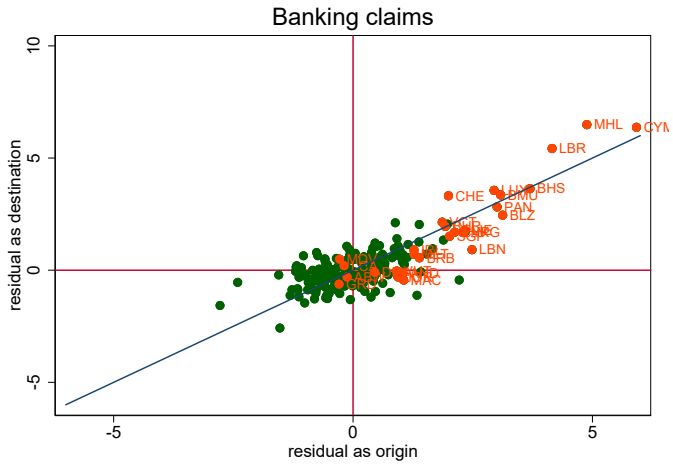
Table 3: First and Second-step gravity equation

| | (1) | (2) | (3) |
|---|---|---|---|
| | First step | Second step | |
| | Banking | Banking | |
| | | partner | country |
| Log distance | -1.059*** | | |
| | (0.035) | | |
| Tax treaty | 0.322*** | | |
| | (0.051) | | |
| EU membership | 1.119*** | | |
| | (0.103) | | |
| Bilateral investment treaty | 0.653*** | | |
| | (0.047) | | |
| Common language | 0.484*** | | |
| | (0.062) | | |
| Common border | -0.008 | | |
| | (0.194) | | |
| Common currency | 0.141 | | |
| | (0.115) | | |
| Former colonial relationship | 1.103*** | | |
| | (0.099) | | |
| Same country | 1.023*** | | |
| | (0.316) | | |
| Log GDP | | 0.770*** | 0.804*** |
| | | (0.025) | (0.024) |
| Log population | | -0.022 | -0.059** |
| | | (0.025) | (0.024) |
| Rule of law | | 0.746*** | 0.637*** |
| | | (0.035) | (0.034) |
| Landlocked country | | -0.485*** | -0.240*** |
| | | (0.051) | (0.048) |
| Tertile of capitalization | | 0.125*** | 0.133*** |
| | | (0.039) | (0.037) |
| Observations | 84,152 | 2,595 | 2,646 |
| R-squared | 0.786 | 0.859 | 0.839 |

This table reports the results of the first and second steps estimation of the gravity equation on banking claims. The period of estimation is 2001-2017. In the first step, the dependent variable is banking claims and we use an OLS estimator on the full sample. In the second step, the dependent variables are the fixed effects at the origin and destination levels extracted from the first step. We use an OLS estimator on a sample excluding tax havens. Variables $\bar{X}_o$ and $\bar{X}_d$ in Equations 2a and 2b are included but coefficients are not reported. ***, ** indicates a correlation significant at the 0.01 and 0.05 level resp.

Second, Fig. 6 reports the estimated abnormal banking claims at origin and destination based on the gravity estimates. We observe that: i) abnormal stocks of non tax haven (green dots) scatter around zero; ii) the group of countries which abnormal banking claims are significantly away from zero is composed of tax haven jurisdictions only (orange dots); iii) all tax havens do not display large abnormal banking claims. In sum, for a group of tax havens, gravity factors can not explain international banking claims operated.

Figure 6: Share of abnormal stocks held in the banking sector in all TH banking investments

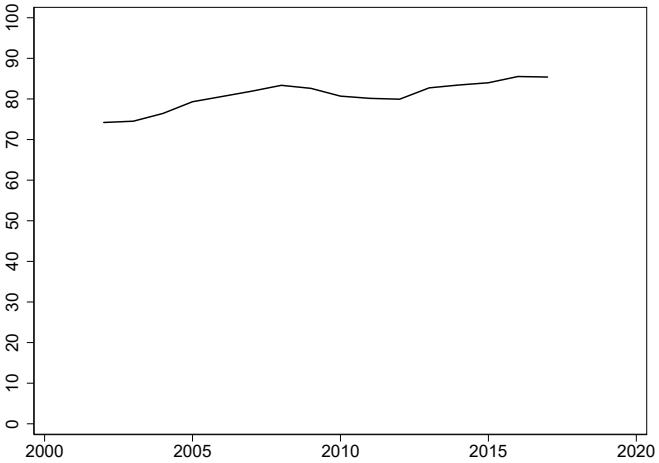



This Figure shows the abnormal stocks of banking claims by country at origin and destination levels operated through tax havens (orange dots) and non tax haven jurisdictions (green dots). They are the residuals of Eq. 2a and Eq. 2b estimated out-of-sample. Residuals are averaged over 2001-2017.

Third, Fig. 7 charts the share of abnormal stocks over total predicted stocks for tax havens (equivalent to Fig. 3). We find similar magnitudes and dynamics as for FDI and portfolio stocks: i) Around 80% of stocks in TH are not explained by standard gravity factors, a value very similar to what we find on FDI and portfolio abnormal stocks; ii) the share is rising over the period as for the other stocks.

Fourth, we isolate the jurisdictions which amount of abnormal banking claim are

Figure 7: Share of abnormal banking investment stocks in total banking investment operated in a tax haven




This graph displays the share of abnormal banking claims in total stock reported by TH (at origin and destination) by category of stock. Abnormal stocks are derived from Eq. 2-a and 2-b in the paper and estimated by OLS on a sample excluding tax havens.

at least one standard deviation above the sample mean (as in Table 8). We find 16 outliers among which 14 are tax havens; and even more interesting, the top outliers include Cayman, Bermuda, Marshall Islands, Luxembourg, Bermuda, Liberia which were found as the top 5 outliers on the other stocks.

In total, we find that the distortions documented on FDI and portfolio assets also concern international banking claims, a result that suggests that all categories of cross-border capital stocks are affected.

# 6 Conclusion

In this paper, we employed a standard gravity framework to quantify abnormal stocks of FDI and portfolio securities over 2009-2017 for up to 236 jurisdictions. We provide evidence that (a) the bulk of international assets in tax havens are 'abnormal', i.e unexplained by standard gravity factors; (b) there is a strong het-

erogeneity among jurisdictions, the bulk of unexplained international investments is concentrated on six jurisdictions, among which five large tax havens; (c) while Luxembourg is among them, we find that the Luxleaks were paradoxically followed by a rise of unexplained FDI in and from Luxembourg.

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# A Appendix: FDI stock data

We proceed in two steps to improve on the raw CDIS data. First, we replace missing inward stock values by the mirror outward stocks declared by the partner country when it is available. Second, we exploit inconsistencies between inward stocks reported by the declaring country (*Inward Direct Investment Positions*) and the mirror outward stocks reported by their partner countries (*Inward Direct Investment Positions, derived*) and identify the largest asymmetries at the country level (top 10 percentile in the sample) when both stocks exist.[27] To do so, we compute the following ratios on bilateral stocks reported by the country and its partner:

$$Ratio_{ot}^{Inward} = \frac{|\sum_o (Inward_{ot} - Inward_{ot}^{derived})|}{\sum_o Inward_{ot}} \tag{4}$$

$$Ratio_{ot}^{Outward} = \frac{|\sum_o (Outward_{ot} - Outward_{ot}^{derived})|}{\sum_o Outward_{ot}} \tag{5}$$

and we take the mean over the period. When $Ratio_o^{inward}$ is high, it means that the amount of FDI reported by the reporting country and all its partners differ substantially. We flag as 'bad' reporters those countries that fall into the top 10% in terms of $Ratio_o^{Inward}$. For those countries, we identify the 'best' reporting country within a country pair by comparing $Ratio_o^{Inward}$ with $Ratio_d^{Outward}$: when $Ratio_o^{Inward} > Ratio_d^{Outward}$, we replace the bilateral inward stock by the mirror outward stock.

Bilateral asymmetries can be substantial. The largest one in our sample is between the United States and Luxembourg in 2015 (about $700,000 millions). The ratio $Ratio_o^{Inward}$ allows comparison across countries controlling for the stock of FDI received by the country. Based on 120 countries, the average ratio is around 5.41 ranged from 0.04 to 495.2. Although most of asymmetries are moderate ($Ratio_o^{Inward}$ ¡ 1 for 75% of the sample), some countries report incorrectly inward stocks regardless of the partner. For those countries, considering raw data would be misleading.

Doing so, we improve FDI data for 93 jurisdictions and we complete the data for 27 tax haven jurisdictions as reported in Table 4 which compares the raw data available in the CDIS databasis (*Raw CDIS FDI*) with our measure of inward stocks (*Completed FDI*).

[27] We also test two other thresholds: top 5% and top 25%.

Table 4: Descriptive statistics on Inward data

| Variable | Number of countries | Number of observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| Raw CDIS FDI | 120 | 133,047 | 1.86e+09 | 2.03e+10 | -5.98e+10 | 1.24e+12 |
| Completed FDI | 237 | 195,574 | 1.57e+09 | 1.95e+10 | -5.98e+10 | 1.61e+12 |
| Raw CDIS FDI TH | 16 | 14,000 | 4.26e+09 | 3.28e+10 | -5.98e+10 | 8.57e+11 |
| Completed FDI TH | 43 | 27,410 | 3.14e+09 | 2.71e+10 | -5.98e+10 | 8.57e+11 |

Table 5: Ranking

| | $Ratio^{Inward}$ | $Ratio^{Outward}$ |
|---|---|---|
| Top | Spain | Sweden |
| | Singapore | Finland |
| | Sweden | Germany |
| | Luxembourg | Japan |
| | Malaysia | Sint Maarten |
| | France | United States |
| | Lithuania | France |
| | Germany | Norway |
| | Czech Republic | Denmark |
| | Greece | Spain |
| Bottom | Cyprus | Philippines |
| | Uruguay | Bangladesh |
| | Senegal | Barbados |
| | Lebanon | Macao |
| | Kuwait | Mauritius |
| | Mauritius | Malta |
| | Malta | Kyrgyz Republic |
| | Cambodia | El Salvador |
| | Barbados | Curacao |
| | Curacao | Mozambique |

This table reports the best/worst reporting countries (countries with the lowest/largest differences between FDI stock and mirror flows) amongst countries that report both inward and outward stocks. See Appendix A for more details on computing $Ratio^{Inward}$ and $Ratio^{Outward}$.

# B Appendix: Data and sources

Table 6: The list of tax havens (from Hines and Rice (1994))

| | | | |
|---|---|---|---|
| Andorra | Channel Islands (Jersey, Guernsey) | Lebanon* | Montserrat |
| Anguilla | Cook Islands | Liberia* | Netherlands Antilles (Aruba, CuraÃ§ao, Sint Maarten) |
| Antigua and Barbuda | Cyprus | Liechtenstein | Panama* |
| Bahamas | Dominica | Luxembourg | Saint Kitts and Nevis |
| Bahrain | Gibraltar | Macao | Saint Lucia |
| Barbados | Grenada | Maldives | Saint Martin |
| Belize | Hong Kong* | Malta | Saint Vincent and the Grenadines |
| Bermuda | Ireland* | Marshall Islands | Singapore* |
| British Virgin Islands | Isle of Man | Switzerland* | Turks and Caicos Islands |
| Cayman Islands | Jordan* | Monaco | Vanuatu |

Note: * Population > 2 million.

Table 7: Data source

| Bilateral determinants | FDI | Portfolio | Sources |
|---|---|---|---|
| Distance | X | X | Gravity dataset (CEPII) + authors' calculations |
| RTA | X | | Regional Trade Agreements database (WTO) |
| EU member | X | X | Regional Trade Agreements database (WTO) |
| Tax Treaty | X | X | Tax Treaties database (IBFD) |
| Bil Invt Treaty | X | X | International Investment Agreements (UNCTAD) |
| Common Langage | X | X | Gravity dataset (CEPII) + CIA factbooks |
| Common Border | X | X | Gravity dataset (CEPII) + CIA factbooks |
| Common Currency | X | X | Gravity dataset (CEPII) + CIA factbooks |
| Former Colony | X | X | Gravity dataset (CEPII) + Colonial Contiguity Data (Correlates of War Project) |
| Territory | X | X | Gravity dataset (CEPII) |
| Country-specific determinants | | | |
| GDP | X | X | World Development Indicators data (WORLD BANK) + UNCTAD + National sources |
| Population | X | X | World Development Indicators data (WORLD BANK) + UNCTAD + National sources |
| Rule of Law | X | X | Worldwide Governance Indicators data (WORLD BANK) |
| Land-lock | X | X | CIA factbooks |
| Market Cap Tercile | | X | International Financial Statisitcs (IMF) + authors' calculation |

Table 8: Drivers of abnormal stocks

| | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|
| | | | | FDI | | | | |
| | | Origin | | | | Destination | | |
| Statutory tax rate | | -2.584 | | 0.520 | | -2.644* | | -0.931 |
| | | (1.611) | | (1.545) | | (1.485) | | (1.593) |
| Secrecy index | | | 0.058*** | 0.032** | | | 0.032** | 0.014 |
| | | | (0.013) | (0.015) | | | (0.013) | (0.016) |
| Tax haven dummy | 1.528*** | | | 1.152*** | 0.948*** | | | 0.682* |
| | (0.300) | | | (0.387) | (0.302) | | | (0.399) |
| Constant | 0.500*** | 1.636*** | -2.693*** | -1.524 | 0.097 | 1.041*** | -1.595* | -0.467 |
| | (0.178) | (0.404) | (0.851) | (0.985) | (0.180) | (0.373) | (0.852) | (1.016) |
| Observations | 79 | 79 | 79 | 79 | 79 | 79 | 79 | 79 |
| R-squared | 0.252 | 0.032 | 0.205 | 0.296 | 0.113 | 0.040 | 0.071 | 0.126 |

| | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) |
|---|---|---|---|---|---|---|---|---|
| | | | | Portfolio debt | | | | |
| | | Origin | | | | Destination | | |
| Statutory tax rate | | -4.269** | | -2.356 | | -0.857 | | 0.174 |
| | | (2.091) | | (2.381) | | (1.639) | | (1.780) |
| Secrecy index | | | 0.039** | 0.019 | | | 0.008 | -0.005 |
| | | | (0.019) | (0.023) | | | (0.014) | (0.017) |
| Tax haven dummy | 0.887** | | | 0.444 | 0.497 | | | 0.578 |
| | (0.394) | | | (0.512) | (0.320) | | | (0.418) |
| Constant | -0.110 | 1.109** | -2.243* | -0.590 | 0.047 | 0.412 | -0.311 | 0.306 |
| | (0.200) | (0.515) | (1.137) | (1.550) | (0.182) | (0.417) | (0.886) | (1.069) |
| Observations | 58 | 58 | 58 | 58 | 74 | 74 | 74 | 74 |
| R-squared | 0.083 | 0.069 | 0.073 | 0.115 | 0.032 | 0.004 | 0.005 | 0.034 |

| | (18) | (19) | (20) | (21) | (22) | (23) | (24) | (25) |
|---|---|---|---|---|---|---|---|---|
| | | | | Portfolio equity | | | | |
| | | Origin | | | | Destination | | |
| Statutory tax rate | | -2.681 | | -4.064 | | -4.931** | | -1.611 |
| | | (2.223) | | (2.567) | | (2.153) | | (2.229) |
| Secrecy index | | | -0.005 | -0.008 | | | 0.026 | -0.012 |
| | | | (0.020) | (0.025) | | | (0.019) | (0.020) |
| Tax haven dummy | -0.159 | | | -0.424 | 1.690*** | | | 1.699*** |
| | (0.427) | | | (0.552) | (0.405) | | | (0.516) |
| Constant | -0.108 | 0.473 | 0.174 | 1.373 | 0.051 | 1.724*** | -1.103 | 1.198 |
| | (0.217) | (0.548) | (1.227) | (1.671) | (0.222) | (0.546) | (1.196) | (1.309) |
| Observations | 58 | 58 | 58 | 58 | 73 | 73 | 73 | 73 |
| R-squared | 0.002 | 0.025 | 0.001 | 0.047 | 0.197 | 0.069 | 0.027 | 0.208 |

This tables report cross-section estimates of individual abnormal stocks. The year of estimation is 2017 for every stocks. The secrecy index is from 2018 vintage. ***, ** indicates a correlation significant at the 0.01 and 0.05 level resp.

# C Appendix: Additional tables, Figures and Robustness

# Table 9: Robustness

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Stock | FDI stocks | | | | | | | | | |
| Country i as | Origin | | | | | Destination | | | | |
| Specification | OLS 2-step full sample | OLS 1-step | PPML 2-step | PPML 2-step (excl. 0) | Incl. Tax as determinant | OLS 2-step full sample | OLS 1-step | PPML 2-step | PPML 2-step (excl. 0) | Incl. Tax as determinant |
| $\mu_{it}^{spe}$ | 1.013*** | 0.882*** | 0.697*** | 0.841*** | 0.988*** | 1.023*** | 0.841*** | 0.681*** | 0.797*** | 0.954*** |
| | (0.034) | (0.022) | (0.032) | (0.038) | (0.012) | (0.025) | (0.029) | (0.038) | (0.045) | (0.017) |
| Observations | 207 | 207 | 207 | 207 | 197 | 208 | 208 | 208 | 208 | 197 |
| R-squared | 0.815 | 0.889 | 0.698 | 0.701 | 0.970 | 0.889 | 0.807 | 0.608 | 0.607 | 0.944 |
| Stock | Portfolio debt stocks | | | | | | | | | |
| Country i as | Origin | | | | | Destination | | | | |
| Specification | OLS 2-step full sample | OLS 1-step | PPML 2-step | PPML 2-step (excl. 0) | Incl. Tax as determinant | OLS 2-step full sample | OLS 1-step | PPML 2-step | PPML 2-step (excl. 0) | Incl. Tax as determinant |
| $\mu_{it}^{spe}$ | 0.983*** | 0.770*** | 0.945*** | 1.031*** | 1.011*** | 0.996*** | 0.690*** | 0.360*** | 0.873*** | 0.914*** |
| | (0.037) | (0.044) | (0.075) | (0.076) | (0.010) | (0.023) | (0.035) | (0.042) | (0.042) | (0.019) |
| Observations | 83 | 83 | 83 | 83 | 82 | 190 | 190 | 190 | 190 | 176 |
| R-squared | 0.897 | 0.788 | 0.660 | 0.693 | 0.992 | 0.910 | 0.674 | 0.281 | 0.699 | 0.929 |
| Stock | Portfolio equity stocks | | | | | | | | | |
| Country i as | Origin | | | | | Destination | | | | |
| Specification | OLS 2-step full sample | OLS 1-step | PPML 2-step | PPML 2-step (excl. 0) | Incl. Tax as determinant | OLS 2-step full sample | OLS 1-step | PPML 2-step | PPML 2-step (excl. 0) | Incl. Tax as determinant |
| $\mu_{it}^{spe}$ | 1.000*** | 0.591*** | 0.822*** | 0.877*** | 1.006*** | 0.994*** | 0.680*** | 0.532*** | 0.816*** | 0.957*** |
| | (0.021) | (0.061) | (0.078) | (0.084) | (0.012) | (0.030) | (0.031) | (0.042) | (0.039) | (0.021) |
| Observations | 83 | 83 | 83 | 83 | 82 | 197 | 197 | 197 | 197 | 183 |
| R-squared | 0.966 | 0.532 | 0.578 | 0.572 | 0.989 | 0.851 | 0.716 | 0.447 | 0.690 | 0.922 |

Table 10: Robustness: second step estimations

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | FDI | | | | | | | |
| | Origin | | | | Destination | | | |
| | OLS full sample | OLS incl. corporate tax | PPML | PPML excl 0 | OLS full sample | OLS incl. corporate tax | PPML | PPML excl 0 |
| Log GDP | 0.801*** | 0.634*** | 1.022*** | 0.864*** | 0.882*** | 0.860*** | 1.241*** | 0.953*** |
| | (0.035) | (0.032) | (0.031) | (0.026) | (0.042) | (0.040) | (0.045) | (0.038) |
| Log population | -0.313*** | -0.085** | -0.121*** | -0.129*** | -0.513*** | -0.296*** | -0.327*** | -0.260*** |
| | (0.036) | (0.035) | (0.033) | (0.028) | (0.042) | (0.043) | (0.047) | (0.040) |
| Rule of law | 0.049 | 0.258*** | 0.247*** | 0.158*** | 0.627*** | 0.827*** | 0.755*** | 0.716*** |
| | (0.055) | (0.047) | (0.048) | (0.040) | (0.065) | (0.059) | (0.068) | (0.058) |
| Landlocked country | -0.330*** | -0.509*** | -0.036 | -0.113* | -0.515*** | -0.412*** | -0.559*** | -0.588*** |
| | (0.082) | (0.072) | (0.071) | (0.060) | (0.096) | (0.090) | (0.101) | (0.085) |
| Statutory corporate tax rate | | -0.053 | | | | 0.480 | | |
| | | (0.402) | | | | (0.504) | | |
| Constant | -3.380*** | -3.041*** | -16.721*** | -16.152*** | -18.996*** | -19.200*** | -22.499*** | -18.743*** |
| | (1.029) | (0.945) | (0.920) | (0.776) | (1.210) | (1.174) | (1.315) | (1.125) |
| Observations | 1,790 | 1,345 | 1,549 | 1,534 | 1,804 | 1,346 | 1,549 | 1,536 |
| R-squared | 0.635 | 0.726 | 0.851 | 0.844 | 0.668 | 0.774 | 0.806 | 0.780 |

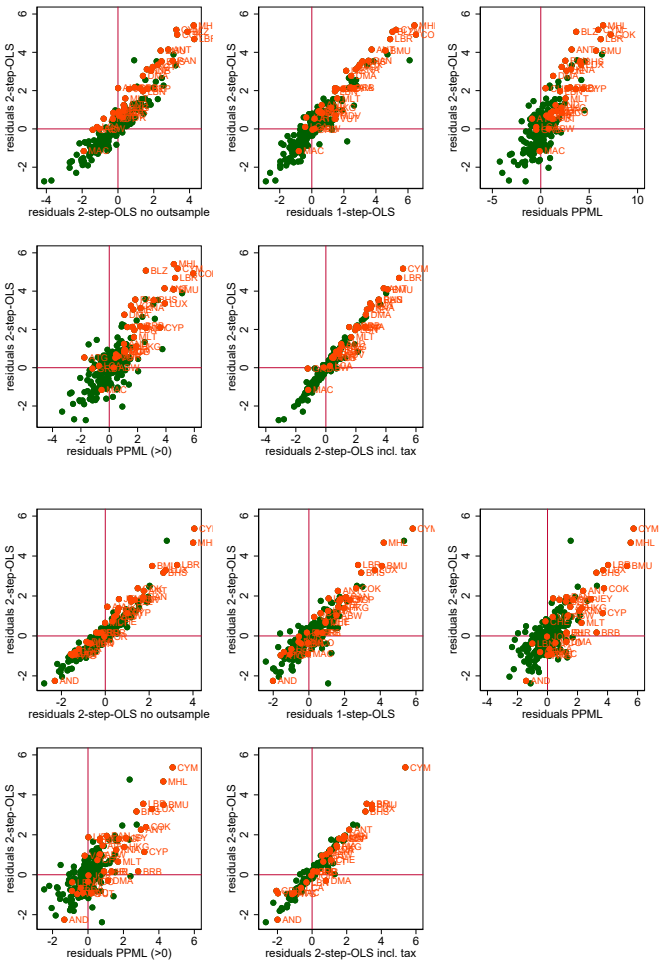
| | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
|---|---|---|---|---|---|---|---|---|
| | Portfolio debt investment | | | | | | | |
| | Origin | | | | Destination | | | |
| | OLS full sample | OLS incl. corporate tax | PPML | PPML excl 0 | OLS full sample | OLS incl. corporate tax | PPML | PPML excl 0 |
| Log GDP | 0.893*** | 1.040*** | 1.142*** | 0.742*** | 1.426*** | 1.214*** | 1.546*** | 1.545*** |
| | (0.036) | (0.036) | (0.038) | (0.025) | (0.073) | (0.090) | (0.058) | (0.055) |
| Log population | -0.349*** | -0.289*** | -0.107*** | -0.005 | -1.053*** | -0.699*** | -1.076*** | -1.059*** |
| | (0.035) | (0.035) | (0.038) | (0.026) | (0.072) | (0.094) | (0.063) | (0.060) |
| Rule of law | 0.345*** | 0.444*** | 0.991*** | 0.639*** | 0.181** | 0.340*** | -0.049 | -0.087 |
| | (0.053) | (0.049) | (0.056) | (0.038) | (0.085) | (0.104) | (0.070) | (0.067) |
| Landlocked country | -0.097 | -0.106 | -0.101 | -0.178*** | 0.161 | -0.241 | 0.025 | 0.085 |
| | (0.078) | (0.073) | (0.079) | (0.053) | (0.136) | (0.168) | (0.113) | (0.108) |
| Tertile of capitalization | 0.290*** | -0.087* | 0.237*** | 0.188*** | 0.778*** | 0.650*** | 0.568*** | 0.510*** |
| | (0.048) | (0.048) | (0.059) | (0.038) | (0.081) | (0.108) | (0.074) | (0.071) |
| Statutory corporate tax rate | | 0.912** | | | | -0.937 | | |
| | | (0.380) | | | | (0.957) | | |
| Constant | -13.700*** | -13.216*** | -24.604*** | -20.832*** | -20.259*** | -17.571*** | -29.426*** | -30.278*** |
| | (0.997) | (0.945) | (1.071) | (0.705) | (1.960) | (2.294) | (1.495) | (1.453) |
| Observations | 2,423 | 1,847 | 2,721 | 2,312 | 1,138 | 886 | 900 | 899 |
| R-squared | 0.695 | 0.789 | 0.838 | 0.850 | 0.698 | 0.689 | 0.827 | 0.832 |

| | (17) | (18) | (19) | (20) | (21) | (22) | (23) | (24) |
|---|---|---|---|---|---|---|---|---|
| | Portfolio equity investment | | | | | | | |
| | Origin | | | | Destination | | | |
| | OLS full sample | OLS incl. corporate tax | PPML | PPML excl 0 | OLS full sample | OLS incl. corporate tax | PPML | PPML excl 0 |
| Log GDP | 0.692*** | 0.712*** | 0.717*** | 0.583*** | 1.453*** | 1.272*** | 1.198*** | 1.183*** |
| | (0.045) | (0.043) | (0.034) | (0.030) | (0.076) | (0.092) | (0.070) | (0.068) |
| Log population | -0.175*** | 0.066 | 0.294*** | 0.161*** | -0.895*** | -0.829*** | -0.873*** | -0.857*** |
| | (0.043) | (0.042) | (0.035) | (0.030) | (0.075) | (0.096) | (0.077) | (0.075) |
| Rule of law | 0.633*** | 0.792*** | 1.258*** | 0.754*** | 0.916*** | 0.989*** | 0.849*** | 0.762*** |
| | (0.065) | (0.059) | (0.052) | (0.044) | (0.089) | (0.107) | (0.085) | (0.083) |
| Landlocked country | -0.127 | -0.237*** | -0.698*** | -0.544*** | 0.738*** | 0.562*** | 0.163 | 0.283** |
| | (0.095) | (0.089) | (0.072) | (0.063) | (0.142) | (0.170) | (0.138) | (0.134) |
| Tertile of capitalization | 0.693*** | 0.302*** | 0.938*** | 0.407*** | 0.704*** | 1.001*** | 0.836*** | 0.822*** |
| | (0.060) | (0.058) | (0.054) | (0.045) | (0.084) | (0.110) | (0.090) | (0.087) |
| Statutory corporate tax rate | | -0.434 | | | | 1.091 | | |
| | | (0.475) | | | | (0.961) | | |
| Constant | -11.371*** | -9.859*** | -20.458*** | -17.848*** | -22.347*** | -19.901*** | -28.456*** | -26.477*** |
| | (1.278) | (1.185) | (0.992) | (0.856) | (2.049) | (2.313) | (1.865) | (1.812) |
| Observations | 2,540 | 1,951 | 2,737 | 2,419 | 1,125 | 874 | 895 | 895 |
| R-squared | 0.631 | 0.737 | 0.868 | 0.804 | 0.767 | 0.779 | 0.799 | 0.796 |



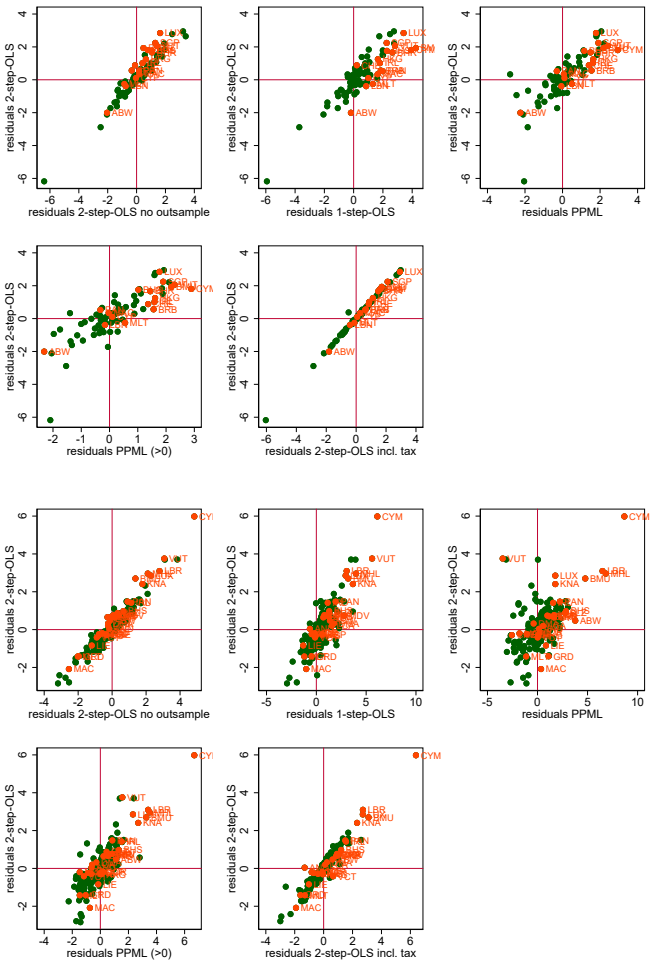
This table reports the estimates of the second step of the gravity equation along alternative estimation methods on FDI, portfolio debt and portfolio equity specified in Eq.2a and Eq.2b.Variables $\bar{X}_o$ and $\bar{X}_d$ in Equations 2a and 2b are included but coefficients are not reported. The period of estimation is 2009-2017 for FDI stocks and 2002-2017 for portfolio debt and equity. ***, ** indicates a correlation significant at the 0.01 and 0.05 level resp.

Figure 8: Robustness: FDI



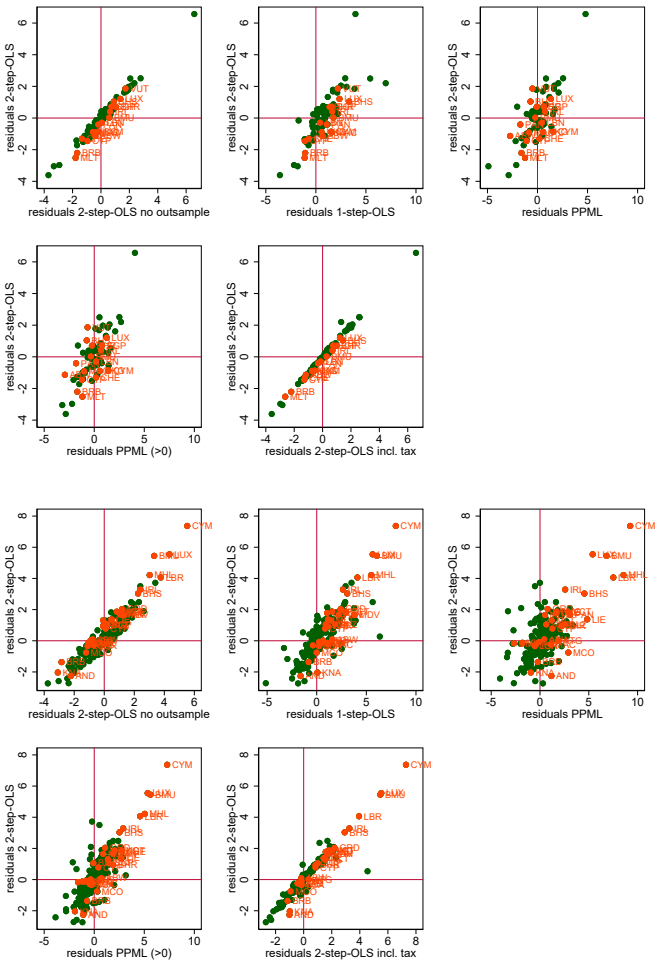

This Figure plots the residuals of a gravity estimate on FDI along alternative methodologies: (i) a two-step OLS using the full sample in the second step estimate; (ii) a one-step gravity equation; (iii) a two-step estimation using a Poisson PML estimator; (iv) a two-step estimation using a Poisson PML estimator on positive stocks only; and (v) controlling for corporate tax rate in the second step gravity equation. *Abnormal* stocks are estimated as specified in Eq. 2a and Eq. 2b. Orange dots represent tax haven jurisdictions whereas green dots represent orange dots.Most dots are located on the first bisector line, suggesting that alternative methods yield similar values of residuals.

Figure 9: Robustness: Portfolio debt




This Figure plots the residuals of a gravity estimate on portfolio debt along alternative methodologies: (i) a two-step OLS using the full sample in the second step estimate; (ii) a one-step gravity equation; (iii) a two-step estimation using a Poisson PML estimator; (iv) a two-step estimation using a Poisson PML estimator on positive stocks only; and (v) controlling for corporate tax rate in the second step gravity equation. *Abnormal* stocks are estimated as specified in Eq. 2a and Eq. 2b. Orange dots represent tax haven jurisdictions whereas green dots represent orange dots.Most dots are located on the first bisector line, suggesting that alternative methods yield similar values of residuals.

Figure 10: Robustness: Portfolio equity




This Figure plots the residuals of a gravity estimate on portfolio equities along alternative methodologies: (i) a two-step OLS using the full sample in the second step estimate; (ii) a one-step gravity equation; (iii) a two-step estimation using a Poisson PML estimator; (iv) a two-step estimation using a Poisson PML estimator on positive stocks only; and (v) controlling for corporate tax rate in the second step gravity equation. *Abnormal* stocks are estimated as specified in Eq. 2a and Eq. 2b. Orange dots represent tax haven jurisdictions whereas green dots represent orange dots.Most dots are located on the first bisector line, suggesting that alternative methods yield similar values of residuals.

Table 11: Which jurisdictions have the largest abnormal stocks by category of stocks?

| Top outliers | Top FDI platforms | Top debt holders | Top equity holders |
|---|---|---|---|
| Caymans | Belize | North Korea | Gambia |
| Marshall Islands | Cook Island | Kiribati | Ireland |
| Luxembourg | Panama | Djibouti | American Samoa |
| Bermuda | Bahamas | Burundi | Libya |
| Liberia | Netherland Antilles | USA | Grenada |
| | Niue | Afghanistan | Mauritius |
| | Netherlands | Swaziland | Hong Kong |
| | Mauritius | Antigua | Albania |
| | Lichtenstein | | Bahamas |
| | Saint Kitts and Nevis | | USA |
| | Jersey | | |

This table reports the list of jurisdictions with average abnormal stocks larger than the sample average by one standard deviation. They are ranked by their value of abnormal stocks. Top outliers are large in FDI, debt and equity, top FDI platforms are large in FDI stocks both at origin and destination levels. Tax haven jurisdictions are emphasized in red.

Table 12: Sensitivity analysis: Second-step gravity- List of TH

| | IMF list | | | | | |
|---|---|---|---|---|---|---|
| | (1) country FDI | (2) partner FDI | (3) country Debt | (4) partner Debt | (5) country Equity | (6) partner Equity |
| Log GDP | 0.762*** | 0.828*** | 1.420*** | 0.920*** | 1.273*** | 0.668*** |
| | (0.032) | (0.038) | (0.092) | (0.037) | (0.089) | (0.044) |
| Log population | -0.168*** | -0.265*** | -0.863*** | -0.222*** | -0.758*** | 0.090** |
| | (0.034) | (0.041) | (0.096) | (0.037) | (0.094) | (0.044) |
| Rule of law | 0.141*** | 0.757*** | 0.222** | 0.543*** | 0.983*** | 0.862*** |
| | (0.050) | (0.060) | (0.105) | (0.054) | (0.103) | (0.063) |
| Landlocked country | -0.391*** | -0.571*** | -0.262 | -0.148* | 0.390** | -0.308*** |
| | (0.071) | (0.085) | (0.168) | (0.078) | (0.162) | (0.092) |
| Tertile of capitalization | | | 0.429*** | -0.003 | 0.506*** | 0.233*** |
| | | | (0.124) | (0.055) | (0.119) | (0.065) |
| Constant | -2.643*** | -18.513*** | -9.779*** | -12.623*** | -17.372*** | -8.421*** |
| | (0.966) | (1.168) | (2.418) | (1.021) | (2.349) | (1.273) |
| Observations | 1,406 | 1,415 | 759 | 1,870 | 746 | 1,974 |
| R-squared | 0.715 | 0.744 | 0.697 | 0.743 | 0.786 | 0.684 |

| | OECD list | | | | | |
|---|---|---|---|---|---|---|
| | (7) country FDI | (8) partner FDI | (9) country Debt | (10) partner Debt | (11) country Equity | (12) partner Equity |
| Log GDP | 0.807*** | 0.892*** | 1.353*** | 0.969*** | 1.387*** | 0.752*** |
| | (0.034) | (0.039) | (0.076) | (0.038) | (0.080) | (0.045) |
| Log population | -0.260*** | -0.318*** | -1.004*** | -0.390*** | -0.852*** | -0.218*** |
| | (0.036) | (0.041) | (0.073) | (0.037) | (0.076) | (0.044) |
| Rule of law | 0.127** | 0.690*** | 0.239*** | 0.378*** | 0.972*** | 0.663*** |
| | (0.052) | (0.060) | (0.087) | (0.054) | (0.092) | (0.065) |
| Landlocked country | -0.194** | -0.348*** | 0.149 | 0.016 | 0.754*** | 0.014 |
| | (0.076) | (0.086) | (0.138) | (0.078) | (0.144) | (0.095) |
| Tertile of capitalization | | | 0.824*** | 0.240*** | 0.822*** | 0.695*** |
| | | | (0.088) | (0.050) | (0.091) | (0.061) |
| Constant | -2.602** | -16.427*** | -20.912*** | -12.583*** | -22.355*** | -9.274*** |
| | (1.030) | (1.182) | (2.023) | (1.023) | (2.127) | (1.293) |
| Observations | 1,566 | 1,577 | 1,066 | 2,149 | 1,053 | 2,251 |
| R-squared | 0.700 | 0.759 | 0.706 | 0.715 | 0.773 | 0.670 |

Table 13: Sensitivity analysis: Second-step gravity- List of TH

| | Oxfam list | | | | | |
|---|---|---|---|---|---|---|
| | (13) country FDI | (14) partner FDI | (15) country Debt | (16) partner Debt | (17) country Equity | (18) partner Equity |
| Log GDP | 0.715*** | 0.785*** | 1.268*** | 0.911*** | 1.303*** | 0.628*** |
| | (0.032) | (0.036) | (0.089) | (0.037) | (0.086) | (0.042) |
| Log population | -0.065* | -0.115*** | -0.652*** | -0.224*** | -0.710*** | 0.184*** |
| | (0.035) | (0.039) | (0.097) | (0.038) | (0.094) | (0.043) |
| Rule of law | 0.197*** | 0.763*** | 0.309*** | 0.476*** | 1.104*** | 0.861*** |
| | (0.048) | (0.055) | (0.107) | (0.053) | (0.104) | (0.060) |
| Landlocked country | -0.346*** | -0.566*** | -0.346* | -0.098 | 0.804*** | -0.204** |
| | (0.071) | (0.080) | (0.186) | (0.079) | (0.179) | (0.091) |
| Tertile of capitalization | | | 0.437*** | -0.008 | 0.756*** | 0.338*** |
| | | | (0.118) | (0.053) | (0.112) | (0.061) |
| Constant | -3.476*** | -18.298*** | -16.874*** | -13.273*** | -16.155*** | -8.643*** |
| | (0.940) | (1.076) | (2.317) | (0.989) | (2.216) | (1.198) |
| Observations | 1,392 | 1,411 | 810 | 1,866 | 797 | 1,980 |
| R-squared | 0.748 | 0.789 | 0.684 | 0.750 | 0.792 | 0.717 |

| | Top 15 list | | | | | |
|---|---|---|---|---|---|---|
| | (19) country FDI | (20) partner FDI | (21) country Debt | (22) partner Debt | (23) country Equity | (24) partner Equity |
| Log GDP | 0.755*** | 0.838*** | 1.306*** | 0.839*** | 1.392*** | 0.548*** |
| | (0.035) | (0.042) | (0.081) | (0.038) | (0.082) | (0.044) |
| Log population | -0.243*** | -0.444*** | -0.843*** | -0.280*** | -0.751*** | -0.012 |
| | (0.035) | (0.043) | (0.082) | (0.037) | (0.083) | (0.043) |
| Rule of law | 0.027 | 0.604*** | 0.196** | 0.391*** | 0.983*** | 0.676*** |
| | (0.053) | (0.065) | (0.092) | (0.055) | (0.094) | (0.064) |
| Landlocked country | -0.462*** | -0.642*** | -0.195 | -0.236*** | 0.684*** | -0.461*** |
| | (0.082) | (0.099) | (0.162) | (0.082) | (0.163) | (0.096) |
| Tertile of capitalization | | | 0.688*** | 0.235*** | 0.690*** | 0.620*** |
| | | | (0.096) | (0.052) | (0.096) | (0.061) |
| Constant | -3.251*** | -19.252*** | -17.300*** | -13.065*** | -18.947*** | -9.529*** |
| | (1.018) | (1.231) | (2.152) | (1.019) | (2.190) | (1.250) |
| Observations | 1,683 | 1,697 | 968 | 2,247 | 955 | 2,364 |
| R-squared | 0.632 | 0.637 | 0.671 | 0.687 | 0.765 | 0.628 |

This table reports the estimates of the second step of the gravity equation on FDI, portfolio debt and portfolio equity considering the following alternatives: baseline list is from Hines and Rice (1994) and the alternatives are Oxfam, Top 15, OECD and IMF (the list and sources are presented at the end of the Appendix). ***, ** indicates a correlation significant at the 0.01 and 0.05 level resp.

Table 14: Which jurisdictions have the largest abnormal stocks? Alternative lists

(a) Top outliers

| Hines and Rice | Oxfam | Top 15 | OECD | IMF |
|---|---|---|---|---|
| Bermuda | Bermuda | Bermuda | Bermuda | Bermuda |
| Caymans | Caymans | Caymans | Caymans | Caymans |
| Liberia | Liberia | Liberia | Liberia | Liberia |
| Luxembourg | Luxembourg | Luxembourg | Luxembourg | Luxembourg |
| Marshall Islands | Marshall Islands | Marshall Islands | Marshall Islands | Marshall Islands |

(b) Top FDI platforms

| Hines and Rice | Oxfam | Top 15 | OECD | IMF |
|---|---|---|---|---|
| Netherland Antilles | Anguilla | Netherland Antilles | Netherland Antilles | Anguilla |
| Bahamas | Netherland Antilles | Bahamas | Bahamas | Netherland Antilles |
| Bermuda | Bahamas | Bermuda | Bermuda | Bahamas |
| Cook Island | Bermuda | Cook Island | Cook Island | Bermuda |
| Caymans | Cook Island | Caymans | Caymans | Cook Island |
| Jersey | Caymans | Liberia | Liberia | Caymans |
| Liberia | Jersey | Luxembourg | Libya | Jersey |
| Luxembourg | Liberia | Marshall Islands | Luxembourg | Liberia |
| Marshall Islands | Luxembourg | Niue | Marshall Islands | Luxembourg |
| Mauritius | Marshall Islands | Belize | Niue | Marshall Islands |
| Niue | Mauritius | Liechtenstein | Belize | Mauritius |
| Belize | Niue | Mauritius | Mauritius | Niue |
| Saint Kitts and Nevis | Belize | Netherlands | Netherlands | Belize |
| Liechtenstein | Saint Kitts and Nevis | Panama | Panama | Liechtenstein |
| Netherlands | Liechtenstein | | Togo | Netherlands |
| Panama | textcolor[rgb] 1, 0, 0Netherlands | | | Panama |
| | Panama | | | |
| | Seychelles | | | |

(c) Top debt

| Hines and Rice | Oxfam | Top 15 | OECD | IMF |
|---|---|---|---|---|
| Bermuda | Bermuda | Bermuda | Bermuda | Bermuda |
| Caymans | Caymans | Caymans | Caymans | Caymans |
| Djibouti | Djibouti | Djibouti | Djibouti | Djibouti |
| Liberia | Liberia | Liberia | Liberia | Liberia |
| Luxembourg | Luxembourg | Luxembourg | Luxembourg | Luxembourg |
| Marshall Islands | Marshall Islands | Marshall Islands | Marshall Islands | Marshall Islands |
| USA | USA | Syria | North Korea | USA |
| Afghanistan | Afghanistan | USA | Sierra Leone | Afghanistan |
| Antigua and Barbuda | Antigua and Barbuda | Afghanistan | Syria | Antigua and Barbuda |
| Burundi | Burundi | Antigua and Barbuda | USA | Burundi |
| Kiribati | Kiribati | Burundi | Afghanistan | Kiribati |
| North Korea | Netherlands | Cote d'Ivoire | Antigua and Barbuda | Montenegro |
| Eswatini | North Korea | Kiribati | Burundi | Netherlands |
| | Eswatini | Netherlands | Cote d'Ivoire | North Korea |
| | | North Korea | Kiribati | Eswatini |
| | | Eswatini | Netherlands | |
| | | | Eswatini | |

This table reports the results of a sensitivity analysis of the baseline ranking reported in Table 14a along alternative lists of of tax havens: our baseline list is from Hines and Rice (1994) and the alternatives are Oxfam, Top 15, OECD and IMF (alternative lists and sources are reported in Table C). Countries in red are included in the respective lists while countries in black are not.

Table 15: Alternative lists of tax havens

| Countries | Hines and Rice (1994) | OECD | IMF | Oxfam | Top 15 |
|---|---|---|---|---|---|
| Andorra | | 1 | 1 | 1 | |
| Anguilla | 1 | 1 | 1 | 1 | |
| Antigua and Barbuda | 1 | 1 | 1 | | |
| Aruba | | 1 | 1 | 1 | |
| Austria | | | | 1 | |
| Bahamas | 1 | 1 | | 1 | 1 |
| Bahrain | 1 | 1 | 1 | 1 | |
| Bangladesh | | | | | |
| Barbados | 1 | 1 | 1 | 1 | 1 |
| Belgium | | | | 1 | |
| Belize | 1 | 1 | 1 | 1 | |
| Bermuda | 1 | | 1 | 1 | 1 |
| British Virgin Islands | | 1 | | 1 | 1 |
| Cayman Islands (the) | 1 | | 1 | 1 | 1 |
| Cook Islands (the) | | 1 | | 1 | |
| Costa Rica | | | | 1 | |
| Curacao | | | | 1 | 1 |
| Cyprus | 1 | | 1 | 1 | 1 |
| Dominica | 1 | 1 | 1 | 1 | |
| Micronesia | | | 1 | | |
| Fiji | | | | 1 | |
| Gibraltar | | 1 | 1 | 1 | |
| Grenada | 1 | 1 | 1 | 1 | |
| Guam | | | 1 | 1 | |
| Guernesey | | 1 | 1 | 1 | |
| Hong Kong | 1 | | 1 | 1 | 1 |
| Ireland | 1 | | 1 | | 1 |
| Isle of Man | | 1 | 1 | | |
| Israel | | | 1 | | |
| Jersey | | 1 | 1 | 1 | 1 |
| Jordan | 1 | | 1 | 1 | |
| Japan | | | 1 | | |
| Sainte-Lucie | | | 1 | | |
| Lebanon | 1 | | 1 | 1 | |
| Liberia | 1 | 1 | 1 | 1 | |
| Liechtenstein | 1 | 1 | 1 | 1 | |
| Luxembourg | 1 | | 1 | 1 | 1 |
| Macao | 1 | | 1 | 1 | |
| Maldives | 1 | 1 | | 1 | |
| Malta | 1 | | 1 | 1 | |
| Northern Marianas Islands | | | 1 | | |

( To be continued)

| Countries | Hines and Rice (1994) | OECD | IMF | Oxfam | Top 15 |
|---|---|---|---|---|---|
| Malaysia | | | 1 | | |
| Marshall Islands | | 1 | 1 | 1 | |
| Mauritius | | | 1 | 1 | 1 |
| Monaco | 1 | 1 | 1 | 1 | |
| Montserrat | | 1 | 1 | 1 | |
| Nauru | | 1 | | 1 | |
| Niue | | 1 | | 1 | |
| Netherlands (the) | | | 1 | 1 | 1 |
| Netherlands Antilles | 1 | 1 | 1 | 1 | |
| Palau | | | | 1 | |
| Panama | 1 | 1 | 1 | 1 | |
| Philippines | | | 1 | | |
| US Virgin Islands | | 1 | | 1 | |
| Saint Kitts and Nevis | 1 | 1 | | 1 | |
| Saint Lucia | 1 | 1 | | | |
| Saint Martin | | | | 1 | |
| Saint Vincent and the Grenadines | 1 | 1 | | | |
| San Marino | | | | 1 | |
| Samoa | | 1 | 1 | 1 | |
| Seychelles | | 1 | 1 | 1 | |
| Singapore | 1 | | 1 | 1 | 1 |
| Switzerland | 1 | | 1 | 1 | 1 |
| Tonga | | 1 | | 1 | |
| Turks and Caicos Islands (the) | | 1 | 1 | 1 | |
| Vanuatu | 1 | 1 | 1 | 1 | |
| Thailand | | | 1 | | |
| Uruguay | | | 1 | | |

This table reports the different lists of tax havens used in the paper. Our baseline list is from Hines and Rice (1994) and the alternatives are: Oxfam (`https://oi-files-d8-prod.s3.eu-west-2.amazonaws.com/s3fs-public/bp-opening-vaults-eu-banks-tax-havens-270317-methodology-en.pdf`, OECD (Gumpert et al., 2011), IMF (`https://www.imf.org/external/np/mae/oshore/2000/eng/back.htm`) and Top 15 including the 15 top jurisdictions listed by Oxfam (`https://www.oxfamamerica.org/press/oxfam-ranks-worlds-worst-corporate-tax-havens/`.