Estimating the scale of illicit financial flows: the abnormality method*

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Abstract

This paper introduces the abnormality method to estimate illicit financial flows (IFFs) leveraging a bilateral gravity model complemented by a machine learning technique to analyse unexplained financial flows to offshore centres. The paper finds robust evidence linking abnormal flows to offshore financial centres to tax avoidance and evasion and offers new estimates on the scale and the costs associated with abnormal flows and their geographical distribution. In 2020, abnormal flows to tax havens and secrecy jurisdictions stood at US$3 trillion, at a cost of US$50 billion in foregone tax revenue. Total abnormal flows arise mostly from the European, American and Asian continents, flowing mostly to European tax haven jurisdictions. Finally, the analysis of the Automatic Exchange of Information regulation indicates a significant reduction of abnormal flows.

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1 Introduction

Illicit financial flows (IFFs) facilitated by offshore financial centers remain a complex problem in the global economy, posing a threat to sustainable economic development (Brandt, 2023; Kar & Cartwright-Smith, 2009). While prior literature has estimated the scale of specific types of IFFs—such as those related to corruption, tax evasion, and international crime—we lack a comprehensive picture of the total scale of illicit financial flows which arise due to regulatory arbitrage opportunities offered by these jurisdictions.

This paper develops a novel approach, called the abnormality method, to estimate global IFFs in foreign direct investment (FDI), banking claims, and portfolio investment. We also address questions regarding the scale and distribution of these IFFs. The abnormality method can be applied to all IFFs; in this paper, we focus on IFFs connected to tax evasion and tax avoidance. Specifically, the paper aims to answer three fundamental questions: firstly, what is the magnitude of illicit financial flows globally and how is it evolving? Secondly, what are the costs associated with illicit financial flows in offshore financial centres? Lastly, what was the impact of the implementation of the Automatic Exchange of Information (AEOI) on illicit financial flows to offshore financial centres?

The paper addresses the challenge of untangling licit and illicit financial flows with the novel abnormality method. Using a bilateral gravity model of cross-border financial flows, we predict "normal" cross-border flows based on economic and other characteristics of partner countries. We then compare the actual reported amounts with what the model predicts to obtain estimates of the magnitude of abnormal flows. We find that abnormal flows to secrecy and tax haven jurisdictions have been on an upward trend since 2010, amounting to US$3 trillion in 2020. This is equivalent to 3% of world GDP, indicating the economic significance of IFFs. We also find that abnormal flows originated mainly from Europe, America, and Asia; they were negligible for Africa and Oceania. The jurisdictions which rank high in the secrecy and tax haven indexes were responsible for the bulk of abnormal flows: the top two countries receiving abnormal flows of FDI are the Netherlands and Luxembourg, secrecy jurisdictions with significant amounts of abnormal banking claims and portfolio investment include the Cayman Islands, Netherlands, Hong Kong, and Switzerland.

Next, we demonstrate that highly secretive jurisdictions and aggressive tax havens are the primary recipients of abnormal flows and that these flows are driven to those jurisdictions because of the ability to conceal the origin of these assets. We first apply a linear regression technique using the Tax Justice Network's Financial Secrecy Index and Corporate Tax Haven Index as explanatory variables, showing that these country characteristics significantly predict the share of incoming abnormal flows. We additionally provide feature importance rankings from the Random Forest machine learning technique to further confirm the central role of secrecy and haven variables in influencing abnormal flows. Both methods robustly show that countries' secrecy and haven characteristics are important drivers of these abnormal flows. We further provide an exercise calculating the costs of abnormal flows to tax havens and secrecy jurisdictions, amounting to nearly US$50 billion in 2020.

The paper also analyses the impact of the Automatic Exchange of Information (AEOI) of bank account ownership data on abnormal bank deposits held in secrecy jurisdictions. Given the considerable revenue losses associated with IFFs and the finding that they are driven by secrecy and haven jurisdictions, governments worldwide adopted AEOI as an initiative to promote greater transparency and cooperation between countries in combating financial secrecy and tax evasion. In contrast to previous literature, our study examines the impact of AEOI on the flows closely connected to illicit practices. Using a difference-in-difference design, our results show that this policy intervention had a negative and statistically significant effect on abnormal flows to secrecy jurisdictions. Our results are in line with previous literature on the impact of AEOI. Johannesen and Zucman (2014) demonstrate that the implementation of information exchange upon request resulted in the repatriation of funds from cooperative to non-cooperative tax havens, while Beer, Coelho and Leduc (2019), Casi, Spengel and Stage (2020), and Bénétrix, Emter and Schmitz (2024) find that implementing AEOI significantly reduces the cross-border deposits in tax havens. Our results are larger because we do not consider all cross-border flows in our dependent variables, but rather we focus solely on abnormal flows.

This paper contributes to the large body of literature related to illicit financial flows and builds on the traditional economic literature on gravity models (Lane & Milesi-Ferretti, 2008; Portes & Rey, 2005; Rose & Spiegel, 2007), contributing to a growing strand of research that applies these models to anomalous financial flows

(Delatte, Guillin & Vicard, 2022; Gullo & Montalbano, 2022). Our paper studies illicit financial flows in a broader sense: it sheds light on the role of offshore financial centres in facilitating illicit practices (Coppola et al., 2021; Garcia-Bernardo et al., 2017) and their associated costs (Alstadsæter, Johannesen & Zucman, 2018; Cobham & Janský, 2018; Crivelli, de Mooij & Keen, 2016; Gravelle, 2009). Our research incorporates banking claims alongside FDI and portfolio investment. Using three publicly available datasets on bilateral international financial positions, which together capture the bulk of cross-border financial wealth, we estimate the scale of abnormal flows for all available countries from 2010 to 2020. Additionally, we separately assess the share of abnormal financial stocks in tax havens and secrecy jurisdictions. While tax havens are primarily linked to corporate tax avoidance, secrecy jurisdictions facilitate individual tax evasion. Our approach distinguishes between the three channels, allowing for a more precise evaluation of their distinct economic impacts.

The remainder of the paper is organised as follows. Section 2 reviews the literature on IFFs. Section 3 describes the data we use to estimate abnormal flows. Section 4 presents the empirical strategy of the proposed method in detail. Section 5 presents and discusses the main results. Section 6 presents the analysis of the effects of AEOI on IFFs. Section 7 concludes.

2 Literature on Illicit Financial Flows

Measuring illicit financial flows presents significant challenges due to their hidden nature, the involvement of multiple actors in complex financial networks, and ongoing definitional debates. In the past decade, measuring and combating IFFs has grown in importance in policy-makers agendas, both at the government and the international organisations level, led by African countries in particular. 2015 was a landmark year: the United Nations Economic Commission for Africa (UNECA) released a joint report with the African Commission, identifying IFFs as one of Africa's biggest development challenges. The report estimated that Africa was losing more than $50 billion annually in IFFs (UNECA, 2015). On that same year, the Addis Ababa Action Agenda adopted following the Third International Conference on Financing for Development also identified IFFs as a global priority (United Nations, 2015a); and later that year, governments throughout the world agreed on the United Nations Sustainable Development Goals (SDGs), with one of the SDG targets (16.4) specifically addressing IFFS: *By 2030, significantly reduce illicit financial and arms flows, strengthen the recovery and return of stolen assets and combat all forms or organized crime* (United Nations, 2015b)

To monitor the SDG target, the world needs reliable and comparable reliable on IFFs; thus was developed SDG indicator 16.4.1 to measure the "total value of inward and outward illicit financial flows" (United Nations, 2017). Since 2017, the United Nations Conference on Trade and Development (UNCTAD) and the United Nations Office on Drugs and Crimes (UNODC) started methodological work and broad consultations on the development of statistical definitions and methods to measure IFFs.

Debates over definitions of what constitutes an IFF preceded measurement and statistical challenges: UNCTAD defines IFFs as "financial flows that are illicit in origin, transfer or use, that reflect an exchange of value and that cross country borders" (UNCTAD, 2024). IFFs can be classified into four groups. The first group involves tax and commercial abuse; the second group stems from illegal markets; the third group includes corruption activities; and the fourth group is related to criminal activities, involving financing of crime and terrorism. While many of these IFFs are undebatably illegal, a key ongoing debate is whether tax optimisation strategies should be classified as IFFs. Indeed, note that SDG target 16.4 refers to

illicit instead of *illegal* financial flows. This poses a legal and definitional debate: is tax optimisation illicit?

The European Commission (2017) describes aggressive tax planning as "taking advantage of the technicalities of a tax system or of mismatches between two or more tax systems for the purpose of reducing tax liability." Recognising that the boundary between legal and illegal tax practices is fuzzy, the European Commission considered a continuum of activities from legal tax planning to illegal tax evasion. UNCTAD (2024) considers aggressive tax avoidance an IFF alongside illegal tax and commercial practices. Such IFFs take place through "the manipulation of transfer pricing, strategic location of debt and intellectual property, tax treaty shopping and the use of hybrid instruments and entities. However, an important aspect to bear in mind is that in the case of aggresive tax planning, the flows arise from legal business transactions, and only the cross-border flow can be categorised as an IFF. Moreover, the academic literature has also compellingly argued why the proceeds of aggressive tax avoidance should be considered IFFs (Brandt, 2023; Cobham & Janský, 2020; Johannesen, Pirttilä & UNU-WIDER, 2016; UNCTAD, 2024).

Hence, the literature on tax avoidance is also literature on IFFs. The tax avoidance literature can be grouped into two categories. The first category studies corporate tax avoidance. Grubert and Mutti (1991) and Hines and Rice (1994) pioneered studies on profit shifting, with a growing interest in recent years (Clausing, 2020; Garcia-Bernardo, Janský & Tørsløv, 2022; Guvenen et al., 2022; Laffitte & Toubal, 2022; Tørsløv, Wier & Zucman, 2023; Vicard, 2023). The recent availability of Country-by-Country Reporting datasets has given new tools to the literature on corporate tax evasion and profit shifting (Bratta, Santomartino & Acciari, 2021; Cobham, Faccio & FitzGerald, 2019; De Mooij, Liu & Prihardini, 2019; Fuest, Hugger & Neumeier, 2022; Fuest et al., 2022; Garcia-Bernardo & Janský, 2024; Garcia-Bernardo, Janský & Tørsløv, 2021; Garcia-Bernardo, Janský & Zucman, 2022; Nessa et al., 2022; Tax Justice Network, 2023, 2024). The research is also deeply intertwined with the growing body of research on tax havens (Alstadsæter, Johannesen & Zucman, 2019; Johannesen & Zucman, 2014; Zucman, 2013).

Besides studies on tax avoidance, there is a larger literature on studying commercial IFFs. The issue of trade misinvoicing, prominent in developing economies, has received significant attention. Trade misinvoicing involves the deliberate misreporting of the value of goods in international transactions to evade taxes or move

illicit funds. Under-invoicing exports to low-tax jurisdictions reducing taxable income in higher-tax countries, while over-invoicing imports inflates costs to facilitate money laundering. These practices enable the cross-border transfer of illicit proceeds while evading detection by authorities. Cobham, Jansky and Mares (2021) showed that the trade reporting gap is large. Methodologies to study trade misinvoicing range from methodologies that use country and commodity datasets, such as partner country trade statistics method (Global Financial Integrity, 2019; Ndikumana & Boyce, 2011; Nicolaou-Manias, 2016; Spanjers & Frede Foss, 2015; Spanjers & Salomon, 2017) and the price filter method (Chalendard, Raballand & Rakotoarisoa, 2019), to more frontier analysis using direct transaction data (Davies et al., 2018) and gravity analysis (Paz, 2022). Other studies on IFFs include research on money laundering (Ferwerda, 2012; Ferwerda et al., 2020; Walker, 1995; Walker & Unger, 2009) and corruption (Brun et al., 2011).

3 Data Sources

Our main database is built from publicly available sources, including the Bank for International Settlements' (BIS) Locational Banking Statistics, the International Monetary Fund's (IMF) Coordinated Direct Investment Survey (CDIS) and Coordinated Portfolio Investment Survey (CPIS), as well as the Tax Justice Network's secrecy and haven scores. The transparency of these datasets ensures full replicability of our estimates. Moreover, since the data are updated annually, our methodology allows for continuous updates, incorporating the latest available figures. While our results provide a snapshot up to 2022, the data framework enables the creation of a dynamic tracker for illicit financial flows, which can be revised each year as new data become available.

We extract banking deposits from the Locational Banking Statistics, Foreign Direct Investment (FDI) and Portfolio Investment statistics from the CDIS and the CPIS, respectively. We use the Tax Justice Network's secrecy and haven scores to estimate the abnormal flows of these three channels in secrecy and tax haven jurisdictions. The gravity model used to estimate abnormal flows requires an array of control variables, which are discussed in the next section with the methodology.

3.1 The Locational Banking Dataset

"The BIS publishes aggregated data on 47 jurisdictions whose national central banks report the claims and liabilities of their banks in the BIS locational banking statistics (LBS) (see BIS, 2013). The release includes reports from both tax havens and non-havens, thus allowing us to analyse deposits of non-banks both in and from tax havens using the same data source. These LBS 'by residence of counterparty' are compiled according to balance of payments conventions via the immediate counterparty, not the ultimate guarantor or beneficiary of deposits (IMF, 2013; BIS, 2013; BIS, 2014). A complete disaggregation of deposits with respect to the depositor is not available, but we can distinguish non-banks from banks holding deposits. This data is ideal for the exercise at hand because we do not need to know the type of depositor in the non-haven: the broad non-bank category fits our purposes perfectly, as funds can be deposited both by a shell company and by an individual. We do not need to know which structure is most prevalent. The reaction of the aggreg-

ate to information exchange agreements captures all of the financing arrangements discussed so far."

The locational banking statistics offer public data on cross-border banking claims and liabilities. The statistics "measure international banking activity from a residence perspective, focusing on the location of the banking office and capture the outstanding claims (financial assets) and liabilities of internationally active banks located in reporting countries on counterparties residing in more than 200 countries." The data captures around 95% of all cross-border banking activity, extensively covering the international banking system, and giving valuable insights into global banking deposit patterns.

We use two key BIS variables: non-banking sector liabilities and non-banking sector claims. These variables are reported quarterly; however, to ensure consistency with the annual frequency of other datasets, we convert them to annual values by adopting the fourth-quarter figure for each year. If the fourth-quarter value is unavailable, we use the most recent available figure from earlier quarters, prioritising the third quarter, then the second, and finally the first.

Only 31 countries report both claims and liabilities to the BIS. To estimate claims for non-reporting countries, we mirror the liabilities reported by declaring countries. For example, consider France, a reporting country, and Bolivia, a non-reporting country. France reports both its claims on and liabilities to Bolivia, while Bolivia does not report any claims or liabilities. Thus, we can observe France's claims in Bolivia but not Bolivia's claims in France. To approximate the latter, we assume they correspond to France's reported liabilities in Bolivia.

While this approach provides the best available proxy for estimating claims in non-reporting countries, it has limitations. Discrepancies exist even between claims and liabilities reported by BIS-declaring countries, so similar inconsistencies are expected between reporting and non-reporting countries. Additionally, although this method expands BIS data coverage, it remains geographically imbalanced. Since most reporting countries are from the Global North, banking statistics often lack coverage of financial flows between Global South countries, particularly intra-continental claims and liabilities within South America and Africa.

We complement the locational banking statistics by including data from Panama's banking authority, the *Superintendencia de Bancos de Panamá*, which reports Panama's claims and liabilities with respect to the rest of the world. Panama

does not report to the BIS, but it reports its data publicly and with the same categorisation as the BIS.

3.2 The Coordinated Direct Investment Survey (CDIS) and the Coordinated Portfolio Investment Survey (CPIS) datasets

The IMF's CDIS contains data on foreign direct investment positions between partner countries. We use the outward direct investment stock data available for more than 114 countries from 2010 to 2022. The CDIS offers investment trends and cross-border financial activities. Although more than a hundred economies participate, coverage remains uneven. Many developing economies, particularly in Africa and parts of Asia, do not report this data, which limits the global representativeness of the dataset.

Similarly, the CPIS offers a comprehensive view of cross-border holdings of portfolio investment securities. As of 2020, it includes data from 85 reporting countries and over 200 partner economies. Like the CDIS, the CPIS suffers from selective coverage, with notable gaps in the data from African nations. Additionally, in some jurisdictions, the survey may not fully account for all relevant financial institutions, potentially leading to underreporting of actual portfolio holdings. Despite these limitations, the CPIS remains a critical tool for analysing international portfolio investment patterns.

3.3 Control Variables

We use a set of control variables to account for economic, geographic, cultural and governance factors. Economic variables include the *GDPs* of reporting and partner countries, sourced from the World Bank Data. We draw cultural and geographical variables from the *Centre d'Études Prospectives et d'Informations Internationales*'s (CEPII) database.[1] Geographic distance is measured as the distance between the capitals of the reporting and partner countries. *Contiguous* indicates whether two

[1] The CEPII, or *Centre d'Études Prospectives et d'Informations Internationales* is a French centre for research on the world economy, which produces relevant macroeconomic databases.

countries share a land border or not, to capture particular dynamics at play between neighbouring countries.

Cultural control variables include *Common Language*, which indicates the presence or absence of a shared official language and controls for the impact of linguistic commonalities, and *Colony*, which captures the presence or absence of a shared historical coloniser and controls for the potential influence of colonial legacies.

The governance variables are obtained from the World Bank's World Governance Indicators. These include *Corruption*, a score that captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. We include corruption as a control since it can potentially have two effects on cross-border financial flows: for instance, corrupt individuals sending the proceeds of their corruption abroad, but also law-abiding citizens shielding their wealth from corrupt practices. The second governance control variable is *Political Stability*, a score that captures perceptions of the likelihood of political instability and/or politically motivated violence. *Government effectiveness* captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Governance variables control for the possibility that in politically unstable or violent countries or in countries with high corruption or low government effectiveness, financial outflows might be higher as capital flows search for safer and/or more stable jurisdictions.

3.4 Tax Justice Network's Secrecy Score and Tax Havens Score

To analyse the partner countries' standings as secrecy jurisdictions or corporate tax havens, and more generally, to measure the opportunities offered by offshore financial centres, we use two indicators computed by the Tax Justice Network: the secrecy and the haven scores.

Secrecy jurisdictions are the world's countries most complicit in helping individuals to hide their finances from the rule of law. Indeed, financial secrecy facilitates tax abuse and enables money laundering. The Tax Justice Network studies the meas-

ures and laws put in place by these secrecy jurisdictions to offer the opportunities of opacity, which include banking secrecy, secretive companies, trusts, and golden visas, available to non-residents to hide their identity and activities and thereby escape or undermine domestic laws and regulations. It then assigns a secrecy score to these countries, where a 100 implies maximum financial secrecy and 0 indicates full financial transparency. The closer a country is to a score of a 100, the higher the risk of illicit financial flows to that country.

Corporate tax havens are the world's countries most complicit in helping multinational corporations underpay corporate income tax in the countries where they actually do business. A jurisdiction's haven score is a measure of how much scope for corporate tax abuse the jurisdiction's tax and financial systems allow and is assessed against 20 indicators. The opportunities offered by these jurisdictions may involve artificially low tax rates, narrow tax bases, patent boxes, tax holidays, or aggressive tax treaties. Like for the secrecy score, a haven score of a 100 suggests a jurisdiction is an aggressive corporate tax haven, and poses a higher risk for illicit financial flows. The more a country moves away from 100 and towards 0, the less risk of illicit financial flows. Table 1 presents summary statistics for all variables of interest and control variables.

Table 1. Descriptive statistics

	Observations	Mean	Standard deviation	Minimum	Maximum
FDI	124,153	8.510e+09	1.089e+11	0	6.581e+12
Banking claims	93,463	1.478e+09	1.529e+10	0	8.864e+11
Portfolio investment	91,971	7.549e+09	5.803e+10	0	2.804e+12
Haven score (2021), partner	235,140	67.128	17.754	29.281	100
Secrecy score (2020), partner	445,423	63.835	10.117	37.550	79.825
Distance	680,436	8,352.690	4,653.220	2	19,815
GDP, reporting	707,440	3.900e+11	1.687e+12	1.266e+07	2.544e+13
GDP, partner	704,707	3.900e+11	1.687e+12	1.266e+07	2.544e+13
Common language	639,560	0.168	0.373	0	1
Common coloniser	639,560	0.115	0.319	0	1
Contiguous border	698,404	0.012	0.110	0	1
Govt effectiveness, reporting	578,574	49.261	28.902	0	100
Political stability, reporting	581,144	49.132	28.901	0	100
Corruption index, reporting	578,831	49.236	29.068	0	100

4 Empirical methodology: estimating the scale and costs of abnormal flows

To estimate the magnitude of abnormal flows, we employ a standard bilateral gravity model approach. Gravity models have been widely used in international trade research to analyse trade patterns between countries. The method, pioneered by Tinbergen (1962), has been adapted to model a variety of cross-border flows, such as migration (Poot et al., 2016), retail sales forecasting (Ghosh, 2001), transportation research (Giuliano, 2001; Kitamura, 2005), or money laundering (Ferwerda et al., 2013, 2020). The basic form of the gravity model can be expressed as:

$$X_{ij} = c \cdot \frac{GDP_i \cdot GDP_j}{D_{ij}} \tag{1}$$

where X_{ij} indicates trade flows between countries i and j; GDP of both countries i and j represent economic mass; D is the geographical distance between the capital cities of the two trading partners; and c is a regression constant. The intuition behind this model is that there is a positive relationship between the flow of goods and the mass (routinely measured by GDP or population) of the two economies that attract each other. The model also predicts an inverse relationship between distance (geographical or cultural) and trade flows; that is, high trade costs or large distances reduce the trade volume or interaction between two trade partners.

Our approach contributes to the strand of literature that uses gravity models to estimate cross-border flows beyond trade; in this case, cross-border financial flows. Delatte, Guillin and Vicard (2022) analyse abnormal flows associated with FDI, portfolio investment, and debt, estimating that 40% of total stocks in tax havens fall into this category. Gullo and Montalbano (2022) focus on portfolio investment, highlighting the role of secrecy in attracting illicit capital to highly secretive jurisdictions. Our standard bilateral gravity model to estimate financial flows is specified as follows:

$$FF_{ijt} = \beta_0 + \beta_1 ln(Y_{it}) + \beta_2 ln(Y_{jt}) + \beta_3 ln(D_{ijt}) + \beta_4 (X_{ijt}) + \lambda_{ij} + \theta_{it} + \theta_{jt} + \epsilon_{ijt} \tag{2}$$

where FF_{ij} is the financial flow between countries i and j at time t, estimated separately for banking claims, FDI, and portfolio investment; Y_{it} and Y_{jt} are the

GDP for reporting and partner countries, respectively; D_{ijt} is the distance variable representing the geographical proximity between the country pairs; X_{ijt} is a vector of traditional gravity control variables; λ_{ij}, θ_{it}, and θ_{jt} are high-dimensional fixed effects, respectively country-pair fixed effects, origin-time and destination-time, following Gullo and Montalbano (2022) and Okawa and van Wincoop (2012). ϵ_{ijt} is a country pair-specific yearly residual. The model is estimated using Poisson Pseudo-Maximum Likelihood, which is consistent in the presence of heteroskedasticity and zero financial flows (Fally, 2015; Silva & Tenreyro, 2006). The inclusion of high-dimensional fixed effects effectively controls for a wide range of potential confounding variables or unobserved heterogeneity. Together, this will reduce bias and yield more precise residuals.

Our strategy incorporates a novel element to the traditional gravity analyses: once financial flows are estimated with the gravity model, we estimate the abnormal flows to secrecy jurisdictions and tax havens. We define abnormal flows as the portion of financial flows to secrecy jurisdictions and tax havens that cannot be explained by the standard gravity model and is presumed to arise from the opportunities presented by secrecy jurisdictions and tax havens. The rationale is the following: if our gravity model predicts financial flows across countries accurately, then one can assume that the difference between the predicted and the observed values in secrecy jurisdictions and tax havens are abnormal flows.

Definition of tax havens and secrecy jurisdictions. We define tax havens and secrecy jurisdictions based on the Tax Justice Network's Haven Score and Secrecy Score. These indices indicate that most, if not all, jurisdictions engage in some degree of secrecy and tax haven practices, but with substantial variation in intensity. We focus on jurisdictions most likely to function as extreme secrecy jurisdictions and aggressive tax havens, so we set thresholds high enough to exclude jurisdictions with moderate secrecy or tax haven characteristics, thereby ensuring that only those exhibiting the most significant secrecy and tax haven features are captured. We use common cutoffs for this definition: countries are considered tax havens if their Haven Score is at least 70, and they are considered secrecy jurisdiction if their Secrecy score exceeds 65. Table A1 in the Appendix lists countries that fulfil either or both of these conditions. In our sample, 28 countries are tax havens and 63 countries are secrecy jurisdictions, out of these 17 are both.

We then define abnormal flows as follows:

$$AbnormalFlow_{ijt} = \begin{cases} \max\{\hat{\epsilon}_{ijt}, 0\} & \text{if } Score_j \geq \Omega \\ 0 & \text{otherwise,} \end{cases} \tag{3}$$

where $\hat{\epsilon}_{ijt} = FF_{ijt} - \widehat{FF}_{ijt}$ is the difference between the observed and estimated flow (i.e. FDI, bank deposits, or portfolio investment); and since we calculate abnormal flows separately for tax havens and secrecy jurisdictions, $Score_j$ relates to the Haven Score in the case of FDI, with Ω taking the value 70, or in the case of banking deposits and portfolio investment, $Score_j$ relates to the Secrecy Score and Ω equals 65. When $\hat{\epsilon}_{ijt} = FF_{ijt} - \widehat{FF}_{ijt}$ is non-negative (i.e., when the observed flow is higher than the predicted flow) to a partner country that is either a highly secretive jurisdiction or an aggressive tax haven, the disparity between the observed and predicted values is categorised as abnormal flow.

IFFs arise from various activities, including corruption, money laundering, and organized crime. This paper examines whether the abnormal flows estimated through Equations 3 and 2 are linked to a specific subset of IFFs: tax evasion, corporate tax avoidance, and corruption. Secrecy jurisdictions and tax havens are likely to attract such illicit flows due to the financial benefits and legal protections they offer. Tax havens facilitate corporate tax avoidance and tax evasion by enabling multinational corporations to minimize their tax liabilities. Similarly, the opacity provided by secrecy jurisdictions conceals the origins of illicit funds, creating a safe haven for criminals and tax evaders. Corrupt individuals, both in the private and in the public sectors, need a secretive and safe place to store their illegal proceeds.

Our central hypothesis is that if abnormal flows to secrecy jurisdictions and tax havens are strongly and positively correlated with tax evasion, corporate tax avoidance, and corruption, then these jurisdictions play a significant role in facilitating such financial flows. We test the hypothesis by estimating the model below.

$$IFF_{ijt} = \alpha + \beta X_j + u_{ijt} \tag{4}$$

where IFF_{ij} is the share of abnormal flows, calculated as the estimated abnormal flows divided by the total observable flows values; and X_j encompasses the variables we want to test, namely the haven score and the secrecy score.[2]

[2] Here, we define IFFs as the subset of positive abnormal flows: $IFF_{ijt} = \max\{\hat{\epsilon}_{ijt}, 0\}$, to avoid creating artificial variation in IFFs dependent on haven or secrecy scores.

However, abnormal flows may also arise from other factors unrelated to offshore financial centers, necessitating a more robust analytical approach. To strengthen our analysis, we employ an ensemble learning technique—the Random Forest algorithm—which enhances the accuracy of our findings by capturing non-linear relationships between dependent and independent variables. This algorithm combines multiple decision trees, each trained on random subsets of data and variables, to produce a more reliable model by reducing overfitting. By leveraging feature importance measures, we identify and rank the variables that most significantly explain the share of abnormal flows.[3] Together, estimating equation 4 and the Random Forest algorithm provide a robust framework for testing the relationship between abnormal flows and tax evasion, corporate tax avoidance, and corruption.

To quantify the financial costs associated with offshore financial centres, we estimate the revenue losses attributable to abnormal flows by applying a 5% return on investment (RoI) and a fixed tax rate of 30% to the abnormal flow values derived from Equation 3:

$$CostStock = AbnormalStock * 0.05 * 0.3 \tag{5}$$

The choice of a 5% return reflects an approximate average return expected by individuals or corporations utilizing tax havens. The estimated tax revenue loss is calculated by applying the fixed tax rate to this return, under the assumption that, in the absence of offshore financial centres, these funds would have been subject to taxation in the reporting country. However, this approach has limitations. Not all abnormal flows stem from tax evasion or corporate tax avoidance; some originate from illicit activities that would not have been taxed in their countries of origin. As a result, using total abnormal flows to estimate revenue losses likely produces an upper-bound estimate. Additionally, the effective tax rates paid by multinational corporations are often significantly lower than statutory rates, meaning that applying a fixed tax rate may further overestimate revenue losses. Despite these limitations, Equation 5 provides valuable insights into the potential fiscal impact of IFFs by estimating the tax revenue that could have been collected in the absence of secrecy jurisdictions and tax havens.

[3] Additional variables, including the exchange rate, interest rate, and financial institution index used in the Random Forest model, are sourced from the IMF. For a detailed discussion of Random Forest regression, see Louppe et al. (2013) and Strobl et al. (2008).

5 Results

We first confirm the validity of the gravity model by estimating equation 2 without high-dimensional fixed effects (only including year fixed effects) to check whether coefficients relating to our explanatory variables have the expected signs and significance. Columns 1, 3, and 5 of Table 2 present these results for the three dependent variables: FDI, banking claims, and portfolio investment.

Table 2. Gravity model – validity

	Observed FDI		Observed banking claims		Observed portfolio inv	
	(1)	(2)	(3)	(4)	(5)	(6)
Log(distance)	-0.672***		-0.549***		-0.514***	
	(0.079)		(0.126)		(0.066)	
Log(GDP), reporting	0.458***		0.502***		0.613***	
	(0.066)		(0.129)		(0.072)	
Log(GDP), partner	0.565***		0.529***		0.689***	
	(0.044)		(0.128)		(0.074)	
Common coloniser	0.200		0.174		0.339	
	(0.243)		(0.377)		(0.509)	
Contiguous border	-0.375	0.808**	-0.607		-0.330	
	(0.308)	(0.353)	(0.519)		(0.289)	
Common language	0.949***		1.578***		1.182***	
	(0.150)		(0.328)		(0.207)	
Govt effective, reporting	0.050***		0.032***		0.044***	
	(0.007)		(0.008)		(0.007)	
Political stab, reporting	0.002		0.001		0.008*	
	(0.004)		(0.007)		(0.004)	
Constant	-3.863**	25.196***	-4.891	24.442***	-12.619***	25.848***
	(1.899)	(0.061)	(3.677)	(0.000)	(2.591)	(0.000)
High-dimensional FE	No	Yes	No	Yes	No	Yes
Year FE	Yes	No	Yes	No	Yes	No
Observations	86,453	85,266	57,895	57,535	63,529	62,278
Pseudo R^2	0.529	0.989	0.445	0.985	0.583	0.995

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: this table presents estimates from regressions of equation 2, using three different outcomes and two model specifications. As outcome variables, we use the observed FDI (columns 1–2), observed banking claims (columns (3–4), and observed portfolio investment (columns (5–6). High-dimensional fixed effects, used in columns 2, 4, and 6, include country-pair fixed effects, reporting country-year fixed effects, and partner country-year fixed effects. Standard errors are clustered at the country-pair level.)

The results show the expected signs and significance, consistent with the results of other gravity models. Holding other things equal, distance significantly reduces bilateral financial flows between countries while the GDP of both trading partners significantly increases bilateral financial flows. In short, positive and statistically significant coefficients on both the GDP of partner and reporting countries indicate that larger countries send and receive larger volumes of bilateral financial flows; a negative and statistically significant coefficient on the distance variable suggests that greater distance between the two countries reduces bilateral financial flows. Regarding the covariates, several observations stand out. To start with, countries with a common language have higher bilateral financial flows in all three channels, as indicated by the positive and statistically significant coefficients. On the other hand, sharing a common coloniser, while yielding a positive coefficient in all three financial flows, is not statistically distinguishable from zero. Next, the estimate for sharing a contiguous border is negative but statistically insignificant for all three financial flows as well.[4] Finally, when looking at the governance controls, only government effectiveness is positively and significantly related to outward financial flows, while the estimates for political stability are very small and statistically insignificant.

Columns 2, 4, and 6 present the results for estimations of the same equation 2, now including high-dimensional fixed effects. The high-dimensional fixed effects include country-pair, reporting country-year, and partner country-year fixed effects. As such, they are co-linear with the explanatory variables; hence, when they are included, they absorb the explanatory variables, erasing the relevant coefficients.[5] Large pseudo-R^2 statistics confirm that our models with high-dimensional fixed effects have high explanatory power of the variation in bilateral financial flows.

5.1 Abnormal flows

The purpose of Table 2 is to confirm the validity of the gravity model, with the chosen control variables, to estimate financial flows. We then use the models with

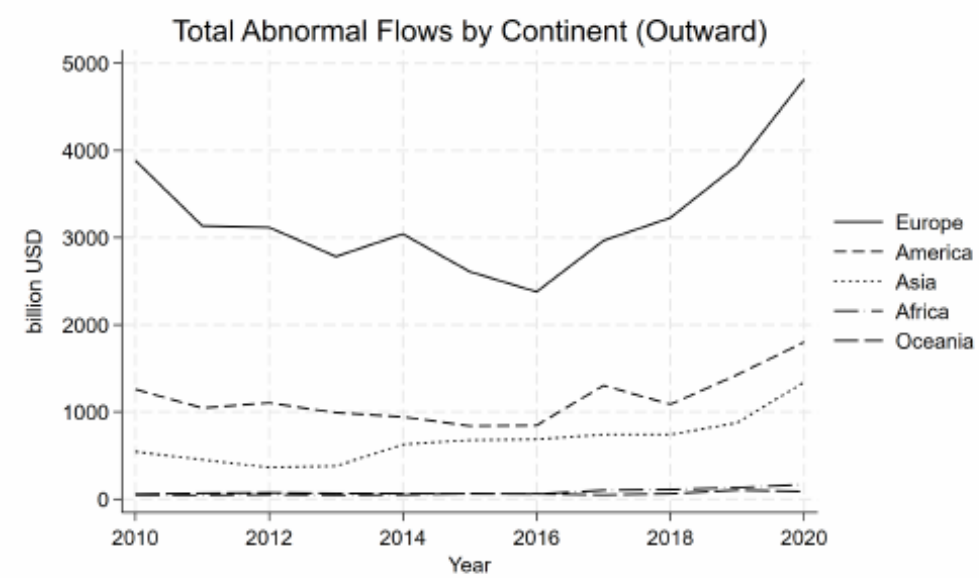
[4] This is due to the inclusion of the distance variable with which it is correlated; in untabulated tests excluding the distance variable, the estimate for *Contiguous border* is positive, large, and statistically significant.

[5] In column 2, we do estimate a contiguous border effect. There is variation on the country-pair-year level, hence not absorbed by our fixed effects, due to the independence of South Sudan in 2011. In our data, this is represented by a binary switch in 2011 of the contiguous border variable for the country pairs Sudan-Kenya, Sudan-Uganda, and Sudan-Democratic Republic of the Congo.

the high-dimensional fixed effects to predict each financial flow independently, since these models have the most explanatory power. Once we obtain the predicted estimates, we define abnormal flows to be the difference between observed and predicted flows.

Figure 1 illustrates the volume of abnormal financial flows (the sum of FDI, banking claims, and portfolio investment) by continent from 2010 to 2020. In this last year, abnormal flows from European countries to secrecy and haven jurisdictions amounted to approximately US$4.8 trillion, following a persistent upward trend since 2016, when they stood at US$2.6 trillion. Abnormal flows out of American countries exhibited similar patterns, declining slightly until 2016, after which they steadily rise to US$1.8 trillion in 2020. Abnormal flows leaving Asian countries are on the rise throughout most of our sample period, totalling US$1.3 trillion in 2020. The abnormal flows from African and Oceanian countries are negligible compared to other regions. Besides lower participation in global trade and investment, data limitations likely contribute to this under-representation, as financial transactions from these regions are often poorly recorded.

Figure 1. Abnormal flows – time trends

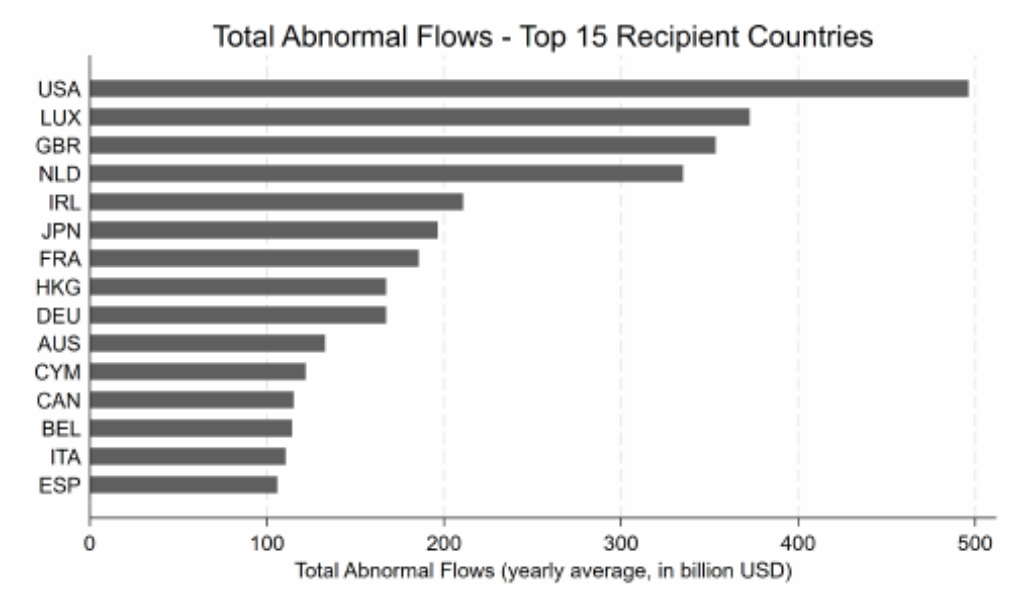


Note: total outward abnormal flows is measured as the sum of abnormal FDI, abnormal banking claims, and abnormal portfolio investment.

Figure 2 presents the top 15 destinations of abnormal flows as a yearly average. The results highlight a clear top four with the USA as the largest recipient, as the

economic world leader, receiving yearly average abnormal flows of US$500 billion. However, next to the UK as another large economy, the top four also includes Luxembourg (haven score 74) and Netherlands (haven score 80, secrecy score 67), likely due to their status as tax haven or secrecy jurisdiction. Both receive on average around US$350 billion in abnormal flows per year. Other recipient jurisdictions in the top 15 with haven scores exceeding 70 or secrecy scores exceeding 65 are Ireland (position 5, haven score 77), Hong Kong (position 8, haven score 78 and secrecy score 66), the Cayman Islands (position 11, haven score 100 and secrecy score 76), and Belgium (position 13, haven score 73).

Figure 2. Abnormal flows, total – top 15 recipient countries



Note: total inward abnormal flows is measured as the sum of abnormal FDI, abnormal banking claims, and abnormal portfolio investment by recipient country, averaged over 2010–2022.

Figure A1 in the Appendix shows the disaggregated annual average abnormal flows to the top 15 ranked jurisdictions for FDI, banking claims, and portfolio investment respectively. In terms of abnormal FDI, Netherlands and Luxembourg are the largest recipient countries. With Hong Kong, Ireland, Singapore, Belgium, Switzerland, and Bermuda, eight out of the top 15 are countries can be considered tax havens. Considering abnormal banking claims, the UK tops the list which includes four secrecy jurisdictions with Cayman Islands, Netherlands, Hong Kong, Switzerland. The top 15 countries in terms of attracting abnormal portfolio invest-

ment is led by the US by a large margin, two countries in this list (Cayman Islands and Netherlands) can be considered secrecy jurisdictions.

Geographically, the rankings are dominated by European jurisdictions (nine out of the top 15s in abnormal FDI and portfolio investment, ten out of 15 in abnormal banking claims). Additionally UK Overseas Territories and Crown Dependencies, such as the Cayman Islands and Bermuda appear among the top recipients of abnormal flows, alongside former British territories such as Hong Kong. These patterns align with arguments that the UK plays a central role in global tax avoidance through its so-called "second empire," its network of Crown Dependencies and Overseas Territories, at significant cost to other countries.

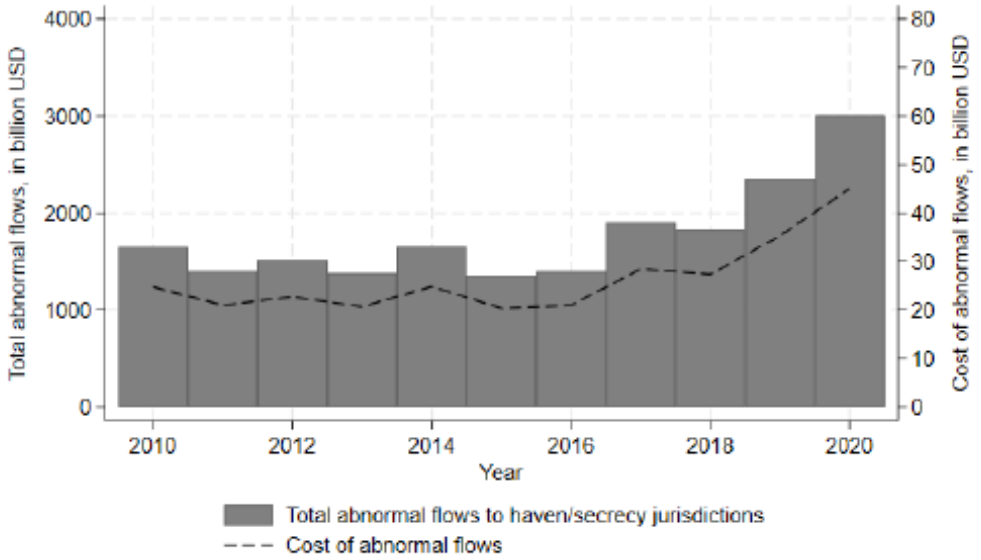
In Figure 3, we present the global sum of abnormal flows into tax havens and secrecy jurisdictions. Abnormal FDI is only included in this sum if the recipient country has a tax haven score of at least 70, and abnormal banking claims and portfolio investment are only included if their secrecy score exceeds 65. While total abnormal flows have been relatively steady around US$1.5 trillion until 2016, it has since seen an increase to US$3 trillion in 2022. Associated annual costs have risen from around US$25 billion to nearly US$50 billion.

5.2 Secrecy and haven scores

We proceed by testing our hypothesis that abnormal flows to tax havens and secrecy jurisdictions are indeed driven by tax evasion, corporate tax avoidance and corruption by estimating equation 4. In this section, we use predictions of financial flows obtained by our models without high-dimensional fixed effects, since including these fixed effects would produce to residuals that are already orthogonalised with respect to our explanatory variables. Hence, throughout this section, we use predicted flows obtained from the specifications in columns 1, 3, and 5 of Table 2. We then calculate the differences with observed financial flows, and regress the shares of these relative to observed flows on haven scores (in the case of abnormal FDI) and secrecy scores (for abnormal banking claims and portfolio investment). The results are presented in Table 3.

Table 3 reveals a strong and statistically significant relationship between the share of abnormal flows in the three financial channels and our explanatory variables. The higher the haven score of a particular jurisdiction, the larger the share

Figure 3. Abnormal flows to haven/secrecy jurisdictions and their costs



Note: global total abnormal flows is measured as the sum of abnormal FDI, abnormal banking claims, and abnormal portfolio investment, where FDI is only included if the recipient country has a tax haven score of at least 70, and banking claims and portfolio investment are only included if the secrecy score is at least 65. Global total abnormal flows is depicted in bars and on the left vertical axis, their associated costs are indicated by the dotted line and on the right vertical axis.

of abnormal flows is in that particular jurisdiction. Assuming linearity, a difference in 10 points on the corporate tax haven indicator score between partner countries (e.g. UK-Netherlands or France-Ireland) is related to a difference in the share of abnormal FDI relative to total FDI of 4.4 percentage points.

Similarly, a higher secrecy score of a partner jurisdiction strongly correlates to a higher share of abnormal banking claims and portfolio investment in that country. Here, a 10-point difference in secrecy scores (e.g. Netherlands-Qatar or Slovenia-Switzerland) relates to an increase in abnormal shares of banking claims by 4 percentage points and portfolio investment by 4.8 percentage points.

The results in Table 3 support the hypothesis that abnormal financial flows are linked to tax evasion, corporate tax avoidance, and corruption. We confirm these findings by employing the Random Forest technique's feature importance rankings. These results are presented in Figure 4, which ranks the independent variables in order of their importance in predicting shares of abnormal flows.

Table 3. Abnormal flows – haven/secrecy scores

Share of abnormal flow	(1) FDI	(2) Banking claims	(3) Portfolio investment
Haven score	0.442***		
	(0.050)		
Secrecy score		0.396***	0.484***
		(0.079)	(0.086)
Constant	30.610***	34.313***	31.394***
	(3.696)	(4.846)	(5.296)
Observations	7,249	6,850	7,158
R^2	0.062	0.022	0.028

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

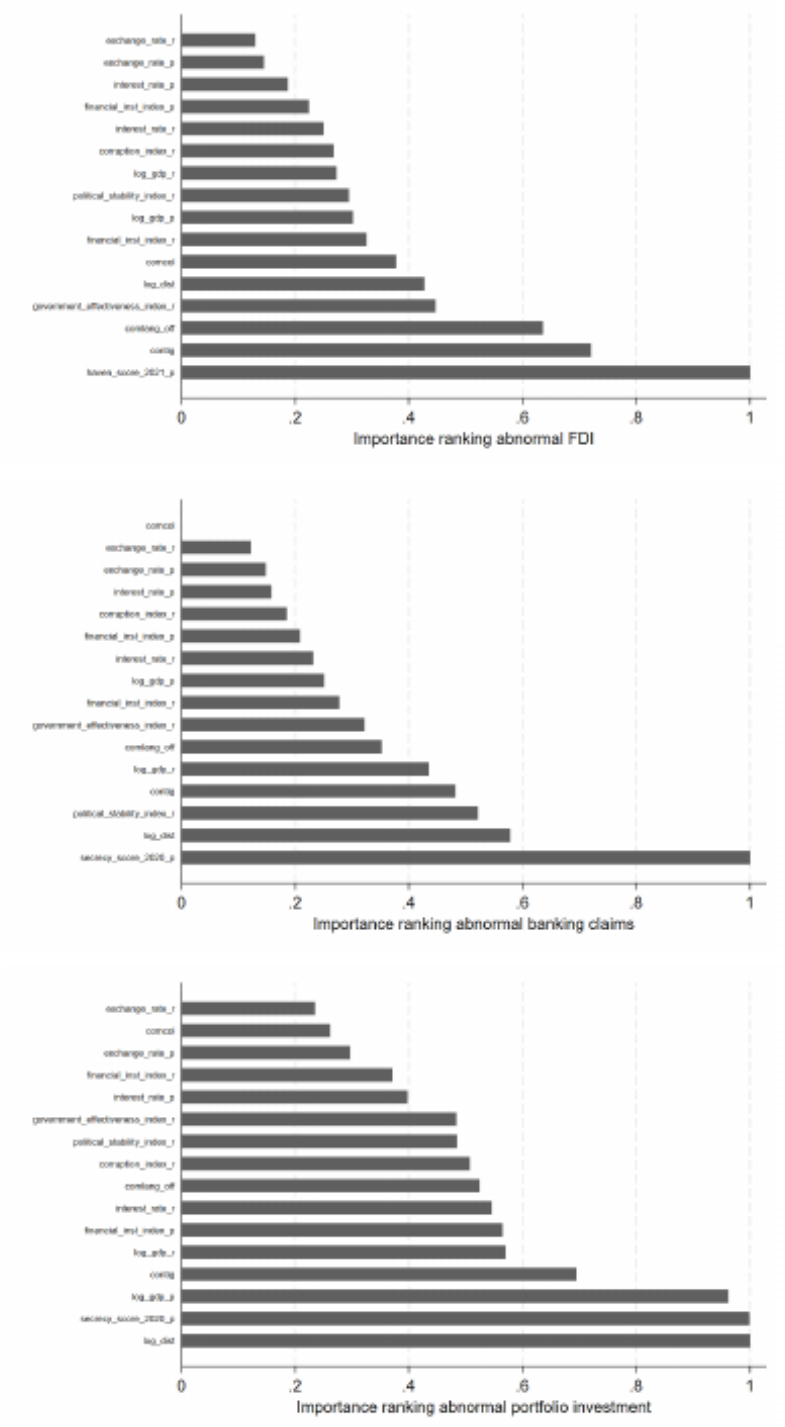
Note: this table presents estimates from regressions of equation 4, using three different outcomes and two explanatory country score variables. As outcome variables, we use the shares (in percentages) of abnormal FDI, abnormal banking claims, or abnormal portfolio investment, all relative to their observed counterparts. Non-positive shares of abnormal flows are dropped.

In terms of abnormal FDI, the haven score is the most important variable, followed by a shared contiguous border and shared official language. Other explanatory variables for abnormal shares of FDI are less than half as important as the haven score. For abnormal banking claims and portfolio investment, the secrecy score emerges as the most or second most important variable. Distance takes the other spot in the top two, and for banking claims the political stability index in the reporting country is third. Remaining variables are less than half as important as the secrecy score. For abnormal portfolio investment, GDP in the partner country is another very important variable, followed by sharing a contiguous border. Remaining variables are less than two-thirds as important as the secrecy score. These findings align with our hypothesis, demonstrating that tax haven and secrecy scores are among the leading factors influencing abnormal flows, albeit within a broader set of economic and institutional determinants.

A key challenge remains the disentanglement of licit and illicit financial flows. Some flows may be entirely legitimate, while others may stem from unaccounted illicit activities. Despite these limitations, our methodology provides a robust and replicable empirical framework. The combined results allow us to assert with confidence that secrecy jurisdictions and tax havens play a critical role in attracting

abnormal financial flows. However, while we can establish a strong connection between these flows and tax avoidance, tax evasion, and corruption, we cannot precisely quantify the share attributable to each of these illicit practices.

Figure 4. Random Forest feature importance rankings



Note: these figures summarize the feature importance rankings of our independent variables, explaining the shares of abnormal flows in FDI, banking claims, or portfolio investment. Importance is relative, with the most important variable receiving importance score 1. Abnormal flows are calculated without fixed effects, i.e. using the specifications corresponding to columns 1, 3, and 5 in Table 2.

6 The Automatic Exchange of Information (AEOI)

With the proliferation of tax-related illicit financial flows (IFFs) and their detrimental effects on the global economy, the international community has sought comprehensive solutions to mitigate these challenges. In 2014, several OECD and G20 countries endorsed the Declaration on Automatic Exchange of Information (AEOI) for Tax Matters. This initiative promotes financial transparency by mandating financial institutions to collect and report financial information to tax authorities, which is subsequently exchanged among participating jurisdictions (OECD, 2016). The AEOI framework enhances compliance and provides tax authorities with crucial data on offshore wealth held by residents, thereby curbing tax evasion and illicit financial activities.

Since the introduction of AEOI, an increasing number of countries have committed to implementing this standard. Currently, over 100 jurisdictions participate in the annual exchange of financial information, contingent on the existence of a valid information exchange agreement (SARS, 2015). In the absence of such an agreement, tax authorities retain the collected data until an exchange mechanism is established. The inaugural exchange for early adopters occurred in 2016 (OECD, 2014), with subsequent exchanges varying based on the timing of each country's commitment.

To assess the impact of AEOI on IFFs, we utilize data on the initiation of bilateral exchanges between country pairs, drawing from OECD records to determine the precise dates of implementation. The staggered introduction of AEOI across jurisdictions allows for a natural variation in treatment timing, with some countries commencing exchanges in 2016, while others followed in 2017 and 2018. Our study builds on prior research by Beer, Coelho and Leduc (2019), Bénétrix, Emter and Schmitz (2024), Casi, Spengel and Stage (2020) and Menkhoff and Miethe (2019).

To quantify the effect of AEOI on abnormal financial flows held in offshore financial centers, we adopt the model proposed by Johannesen and Zucman (2014):

$$log(IFF_{ijt}) = \beta_0 + \beta_1 AEOI_{ijt} + \delta_{ij} + \nu_t + \epsilon_{ijt} \tag{6}$$

where IFF_{ijt} represents abnormal financial flows from country i to country j at time t. The key coefficient, β_1, captures the effect of AEOI implementation. $AEOI_{ijt}$

is a binary variable indicating whether a given country pair has initiated financial information exchange. Country-pair fixed effects (δ_{ij}) control for unobserved bilateral characteristics, while year-quarter fixed effects (ν_t) account for period-specific shocks. Standard errors are clustered at the country-pair level.

Given that AEOI primarily targets tax evasion, we focus our analysis on abnormal flows derived from the banking claims channel, which is directly linked to tax evasion.[6] Quarterly data is employed to align with the timing of bilateral exchanges, which predominantly occur in the first and fourth quarters. To mitigate potential confounding effects from prior regulatory interventions—such as the Tax Information Exchange Agreements (2008–2011) and the Foreign Account Tax Compliance Act (2010–2013)—our analysis begins in the fourth quarter of 2014 (Casi, Spengel & Stage, 2020).

Our study extends the sample period to the fourth quarter of 2022 and incorporates a broader set of highly secretive jurisdictions. This extended timeframe enables a more comprehensive evaluation of AEOI's long-term effects. We focus on abnormal flows held in highly secretive jurisdictions, defined as those with secrecy scores above 65 (see Table A1 in the Appendix). We anticipate a statistically significant negative coefficient for β_1, indicating a reduction in abnormal flows in secrecy jurisdictions following AEOI implementation.

Figure A2 in the Appendix illustrates quarterly trends in total banking claims and abnormal banking claims held in secrecy jurisdictions. Both exhibit an upward trajectory, with fluctuations culminating in a sharp increase in the third quarter of 2021.

Table 4 presents our main findings based on equation 6. We estimate the average treatment effect for abnormal flows held by residents of non-secretive countries across four models: (a) and (b) using the full sample, and (c) and (d) the reduced sample for robustness checks. The primary distinction between models (a) and (b) lies in the inclusion of reporting-year and partner-country fixed effects in (b). Our results indicate that AEOI significantly reduces abnormal flows in secrecy jurisdictions. Specifically, models (a) and (b) show reductions of 68% and 78%, respectively, with statistically significant coefficients. To validate our findings, we conduct two robustness checks. First, in (c) we restrict our sample to match that

[6] Other forms of IFFs, such as those associated with tax avoidance, may be influenced by different regulatory frameworks.

Table 4. Effect of AEOI on Abnormal Flows

	Full Sample		**Reduced Sample**	
	(a)	(b)	(c)	(d)
Variables				
AEOI	-0.682**	-0.777**	-0.724**	-0.836***
	(0.304)	(0.327)	(0.305)	(0.310)
Fixed Effects				
Quarter_year FE	Yes	No	Yes	Yes
Country_pair FE	Yes	Yes	Yes	Yes
Reporting_year FE	No	Yes	No	No
Partner FE	No	Yes	No	No
Fit Statistics				
Observations	54,147	54,147	49,390	18,818
R^2	0.806	0.805	0.817	0.788

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

used by Casi, Spengel and Stage (2020). In (d), we exclude the United States to address concerns regarding the Tax Cuts and Jobs Act (2017). Even after reducing the samples, our results remain stable, with models (c) and (d) showing significant reductions in abnormal flows, aligning with (a) and (b).

The event study plot in Figure 5 illustrates the temporal effects of AEOI implementation. Consistent with Casi, Spengel and Stage (2020), we include country-pair and partner-year fixed effects while clustering standard errors at the reporting-country level. Additionally, we incorporate reporting-year fixed effects to control for unobserved time-specific shocks. The pre-treatment period shows no significant divergence from zero, supporting the parallel trends assumption. Post-treatment, abnormal flows exhibit a significant decline, particularly in the initial quarters following implementation.

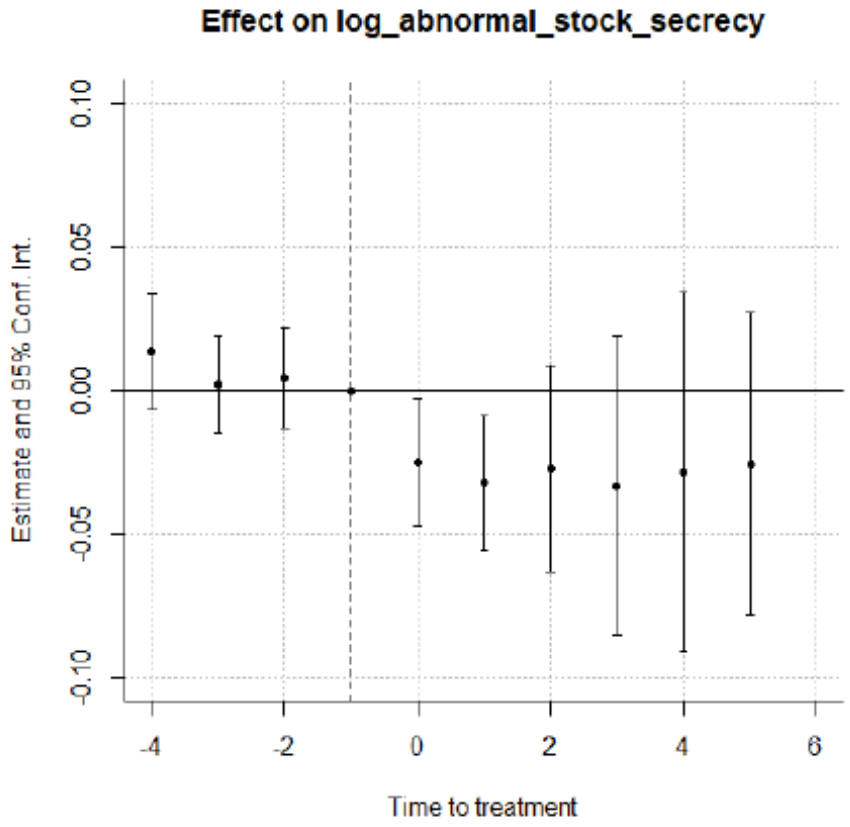


Figure 5. ATT for flows from non-secretive countries into secrecy jurisdiction j

7 Conclusion

This study contributes to the literature on illicit financial flows, tax havens, and the efficacy of AEOI in curbing cross-border financial movements. Employing a novel "abnormality method" to estimate illicit financial flows, we provide a comprehensive global assessment of their scale and distribution. Our results highlight the prominence of Luxembourg, the Netherlands, and the Cayman Islands as major destinations for IFFs. Furthermore, secrecy jurisdictions such as Switzerland and the Cayman Islands play a central role in facilitating illicit fund transfers.

In 2020 alone, global tax losses due to tax havens and secrecy jurisdictions amounted to US$50 billion in lost tax revenues. Abnormal flows correlate strongly with secrecy scores and haven scores, and Random Forest feature importance rankings confirm that status as a tax haven or secrecy jurisdiction is an important

explanation for abnormal flows, reinforcing their link to tax avoidance, tax evasion, and corruption.

Using our abnormal flows estimates, we examine the impact of AEOI on these flows held in secretive jurisdictions. We show that the abnormal flows held by residents of non-secretive jurisdictions in secretive jurisdictions significantly reduced following the exchange of AEOI.

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Appendix

A.1 Haven/secrecy scores (Tax Justice Network)

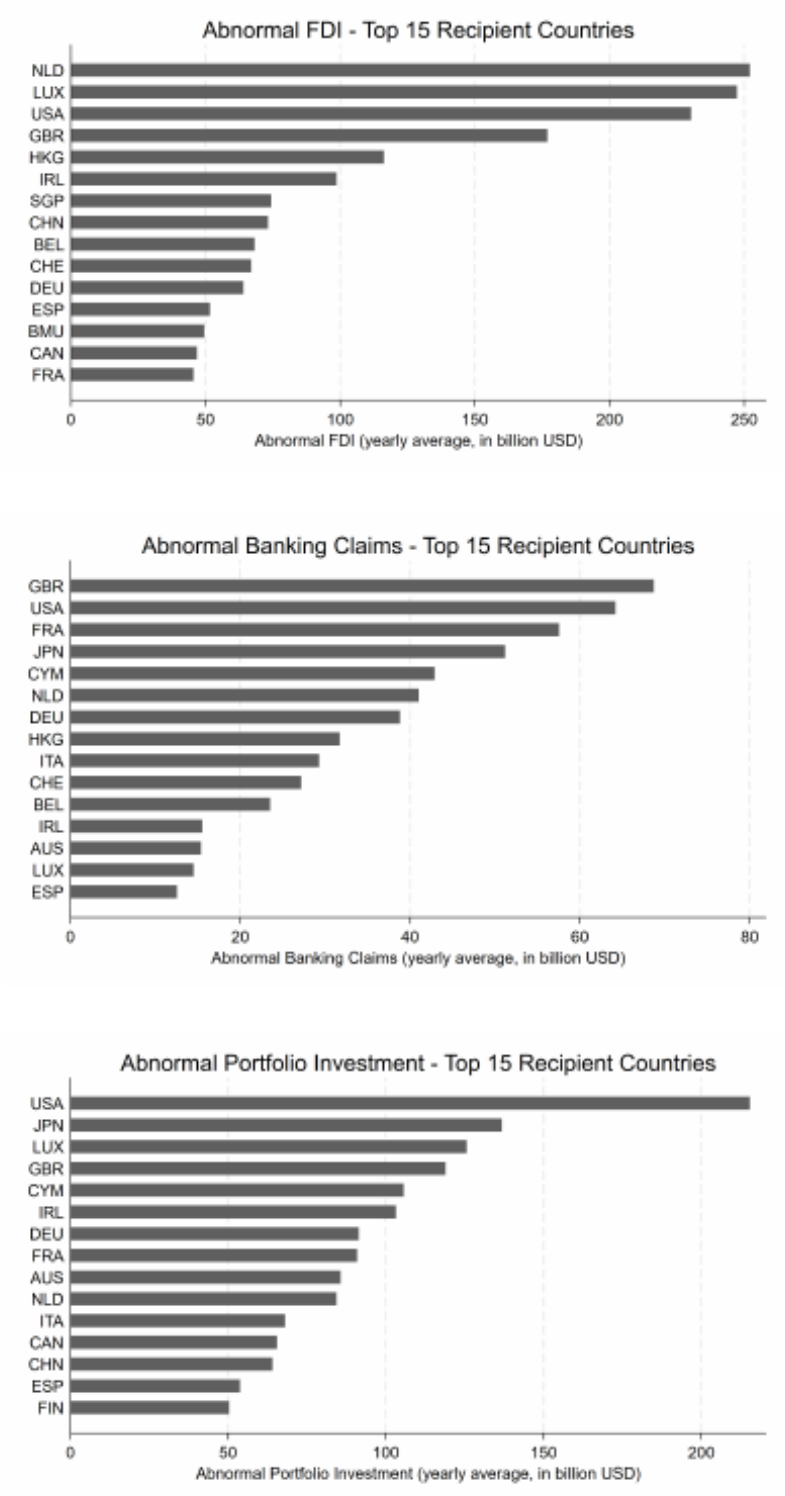
Table A1. Tax havens and secrecy jurisdictions

Country	Haven score	Secrecy score	Country	Secrecy score
Anguilla	100	78	Maldives	80
Turks and Caicos Islands	100	78	Angola	80
Cayman Islands	100	76	Algeria	80
Bahamas	100	75	Bolivia	79
Bermuda	100	73	Jordan	78
British Virgin Islands	100	71	Brunei Darussalam	78
Jersey	100	66	Liberia	78
Isle of Man	100		Paraguay	77
United Arab Emirates	98	78	Qatar	77
Guernsey	98	71	Vanuatu	76
Switzerland	89	74	Antigua and Barbuda	76
Cyprus	85		Kenya	76
Singapore	85		Saint Kitts and Nevis	75
Mauritius	81	72	Gambia	75
Netherlands	80	67	Samoa	75
Malta	79		Montserrat	75
Hong Kong	78	66	Vietnam	74
Ireland	77		Barbados	74
Lebanon	75		Belize	74
Luxembourg	74		United States Virgin Islands	74
Latvia	73		Dominica	74
Belgium	73		Guatemala	74
Curaçao	72	75	Thailand	73
Panama	72	72	Puerto Rico	73
Hungary	72		Bangladesh	73
Liechtenstein	71	75	Sri Lanka	72
Aruba	70	73	Cameroon	71
Estonia	70		Egypt	71
			Saint Lucia	71
			Tanzania	71
			Kuwait	71
			Grenada	71
			Seychelles	70
			Monaco	70
			Cook Islands	70
			Nigeria	70
			Marshall Islands	70
			Malaysia	70
			Gibraltar	69
			Venezuela	69
			Morocco	68
			Saudi Arabia	67
			Tunisia	66
			Saint Vincent and the Grenadines	66
			Taiwan	66
			Macao	65

Note: scores are rounded to integers, haven score taken from CTHI (2021), secrecy score taken from FSI (2020). Scores are only presented if they exceed 70 (haven score) or 65 (secrecy score).

A.2 Additional results

Figure A1. Abnormal flows, separate types – top 15 recipient countries



Note: yearly average of the three types of inward abnormal flows are presented for the top 15 countries of these abnormal flows.

Figure A2. Quarterly stocks in secrecy jurisdictions