CHARLES UNIVERSITY
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Effects on Stock Prices of Companies Involved in Leaks of Offshore Documents

Bachelor's thesis

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Declaration of Authorship

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Abstract

This thesis studies the effect of leaks of secret offshore documents on the value of the implicated firms. Using the entirety of International Consortium of Investigative Journalists (ICIJ)'s Offshore Leak Database, we identify 206 publicly traded firms connected to the implicated offshore firms. Then, we use propensity score matching to obtain a sample of similar non-implicated companies. Finally, the leak's impact on the stock price of both groups is studied using event study methodology. We find implicated firms to have 1.5% lower cumulative abnormal returns during the event window than similar non-implicated firms. Moreover, we provide an updated figure of 105 Million USD of average lost value per firm caused by the leak.

JEL Classification	G14, G15, G32, H26, K42
Keywords	Offshore Leaks, ICIJ, tax evasion and avoidance, event study, propensity score matching

Title	Effects on Stock Prices of Companies Involved in Leaks of Offshore Documents

Abstrakt

Tato práce se zaměřuje na studium vlivu úniků tajných dokumentů na hodnotu implikovaných firem. Pro tento účel využíváme celou Offshore Leaks databázi, kterou publikovalo Mezinárodní konsorcium investigativních novinářů. Identifikovali jsme 206 veřejně obchodovaných firem, které jsou napojeny na implikované offshore firmy. Abychom získali srovnatelný vzorek nezapojených společností, používáme metodu porovnávání podle propensity score. Následně zkoumáme dopad úniku na cenu akcií obou skupin firem pomocí metodologie studie událostí. Zjišťujeme, že zapojené firmy vykazují během okna událostí o 1,5 % nižší kumulativní abnormální výnosy ve srovnání s podobnými nezapojenými firmami. Kromě toho poskytujeme aktualizovanou informaci o průměrné ztrátě hodnoty ve výši 105 milionů USD na jednu firmu způsobenou těmito úniky.

Klasifikace JEL G14, G15, G32, H26, K42
Klíčová slova úniky tajných dokumentů, ICIJ, daňové úniky, studie událostí, propensity score matching

Název práce Vliv úniků tajných dokumentů na ceny akcií zapojených firem

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Acronyms

CAR Cumulative Abnormal Return

ICIJ International Consortium of Investigative Journalists

MNE Multinational Enterprise

OLS Ordinary Least Squares

PSM Propensity Score Matching

SIC Standard Industry Classification

SOV Secret Offshore Vehicle

Chapter 1

Introduction

Tax haven is a term used to describe a jurisdiction that generally has low to non-existent tax rate, offering companies and individuals to escape their own country's rule of law and pay lower taxes (Tax Justice Network n.d.). They also traditionally offer a veil of secrecy for companies seeking to take advantage of them. Those features include lack of regulation, lack of mandatory disclosure of information and overall secrecy. This deliberate policy design attracts millions of companies as well as banks, funds, insurers and similar entities to pursue their interests there, usually through the help of offshore service provider companies. Practices conveyed range from completely legal ones to illegal crimes such as money laundering, fraud, bribery and tax evasion. The annual costs of those activities to governments are estimated to $500 Billion dollars in lost corporate tax revenue (Cobham & Janský 2019).

Moreover, with the lack of mandatory disclosure, those opaque structures are traditionally very hard—if not impossible—to uncover and analyse. However, recent series of leaks of confidential documents from offshore service providers have been compiled and published by the International Consortium of Investigative Journalists (ICIJ). This event, dubbed "the largest ever release of information about offshore companies and the people behind them" (International Consortium of Investigative Journalists n.d.b) is therefore giving us an unique opportunity to study the impacts and offer us a peek into the colossal world of secret offshore activities. ICIJ's Offshore Leaks database contains information on over 800 thousands entities and people from more than 200 countries, including current and past world leaders, billionaires, royalty, celebrities and athletes. The five major data leaks included are Offshore Leaks

(2013), Panama Papers (2016), Bahamas Leaks (2016), Paradise Papers (2017) and the most recent Pandora Papers (2021).

This exogenous source allows us to study the activities pursued and assess its impacts, as the companies involved in the leak are certainly not systematically different from other companies operating in the same jurisdictions. Only a few studies have attempted to connect offshore shell companies to the publicly traded companies who are users of those offshore vehicles and then use those to study various impacts of the leaks. Most notably, O'Donovan *et al.* (2019) have estimated that Panama Papers alone have erased $174 billion in market capitalization of companies involved. Furthermore, Li & Ma (2019) study the effects of multiple leaks and find out that "firms exposed in offshore leaks significantly increase their financial leverage during the post-leak period, suggesting a substitution effect between offshore tax sheltering and financial leverage".

The objective of this thesis is to replicate and expand O'Donovan *et al.* (2019) research by using the entirety of ICIJ's Offshore Leaks database including all the five major leaks. This offers an updated and more realistic figure of lost market capitalisation. Next, similarly to Li & Ma (2019), we strive to improve the estimates by using propensity score matching (PSM) to obtain similar matches of the treated companies, rather than simply using all other companies not included in the leak. By employing those techniques, we believe to have extended the findings and also to have overcame possible specialization bias of different offshore service providers hinted by O'Donovan *et al.* (2019). We find connected companies to have 1.5% lower cumulative abnormal returns in the event window around the time of the leak as compared to similar firms that are not connected to the leaks, supporting the notion that there are no major differences in impact between the different leaks. This work aims to add to existing literature on the topic of tax havens and corporate tax evasion as well as offshore leaks and illicit practices connected to them.

The structure of the rest of the thesis is following: Chapter 2 summarizes the existing literature and introduces our contribution to it, Chapter 3 describes our datasets as well as the process of building them, including the data manipulation and matching process. Next, Chapter 4 describes methodology employed, Chapter 5 provides the results and Chapter 6 concludes our work.

Chapter 2

Literature review

This chapter summarizes existing literature related to our topic. We concentrate on the extensive literature on international profit shifting and tax havens and as well as the more limited material on offshore document leaks that is more closely related to our work.

2.1 International profit shifting

International profit shifting is one of the techniques used by multinational enterprises (MNEs) to avoid paying taxes. It is most commonly conveyed by setting up a subsidiary in a low-tax jurisdiction. The MNE is then free to continue manufacturing and selling its goods and services in high-tax jurisdictions, but the profits get reported under the tax-haven subsidiary, where it gets taxed by a small or even non-existent tax rate. This behavior is recently being exposed to the public in cases of well known enterprises, for example with Starbucks and its 2012 expose of 15-year-long period of no taxes paid in the United Kingdom (Bergin 2012), or similar stories of Amazon and Google (Barford & Holt 2013). Observing this behavior in firms is certainly not a new nor rare occurrence. Mintz & Weichenrieder (2010); Wamser (2011) show that firms strategically locate their affiliates in a way that facilitates tax avoidance. This is further supported by Dischinger & Riedel (2011) findings that MNE prefer to locate their intangible assets in jurisdictions with lower tax rates in order to set favorable intra-firm transfer prices to minimize tax. Karkinsky & Riedel (2012) report similar tax-minimizing behavior of firms locating their patents at low-tax affiliates. Clausing (2000; 2003) reports that U.S. have "less favorable intrafirm trade balances with low-tax countries" and also finds substantial evidence between intrafirm transaction prices and tax rate of the country that the firm operates in, indicating that income shifting is tax-motivated. Similar findings of the fact that profit shifting of European multinational enterprises is contingent on tax rate is presented by Huizinga & Laeven (2008).

The volume of profits held offshore is certainly not insignificant. It is estimated that as of 2017, Fortune 500 companies alone held $3.2 trillion of profits offshore, resulting in $767 Billion in U.S. taxes avoided (ITEP 2017) Moreover, profit shifting towards tax havens for US corporations has increased from an estimated 5 to 10 percent of gross profits in the 1990s to roughly 25 to 30 percent now (Cobham & Janský 2019). This is why believe it is extremely important to study the topic of corporate tax avoidance and profit shifting and to help shed more light into practices that are only recently being slowly uncovered to the public.

2.2 Tax havens

As summarized by the section above, the benefits of use of tax havens for tax avoidance purposes is unequivocal. However, tax haven use is not without its limitations. According to Desai *et al.* (2004) as of 1999, only 59% of U.S. multinational firms with considerable foreign operations are affiliated with tax haven usage—implying that only certain firms can actually benefit from using tax havens. Desai *et al.* (2006) identifies the firms that are most likely to use tax havens as large firms with international exposure, large volumes of intrafirm trade and high research and development activity. Furthermore, Gumpert *et al.* (2016) specifies that firms that benefit from reallocating taxable income from high-tax jurisdiction to a tax haven will do so only if the profit of doing so is greater than the cost of establishing tax haven affiliate. This is supported by Jones *et al.* (2018) findings that there is a strong correlation between the use of Big 4 accountancy firm services and the extent to which those MNEs use of tax haven subsidiary network.

There is no official metric or definition to determine whether country is considered a tax haven. The general determinants, besides low or non-existing tax rate, is also a level of secrecy that the jurisdition can offer its users, as well as lack of mandatory disclosure. Dharmapala & Hines Jr (2009) explore the determinants of countries that become a tax haven. They find out that some of the requirements are size, funds and governance quality—small, affluent, well governed countries have much bigger likelihood to become a tax haven. Furthermore, Dyreng *et al.* (2020) specifies that "dot havens" (small jurisdictions with small economies) are often used solely for tax planning as they can rarely provide a convenient production site.

2.3 Leaks of offshore documents

As already mentioned, literature on leaks of offshore documents is relatively scarce. Huesecken *et al.* (2018) conduct a study similar to ours on LuxLeaks, a smaller 2014 leak of advance tax rulings and corporate tax returns of companies based in Luxembourg. Their findings include evidence for involved firms' significant positive cumulative abnormal returns following the leak. Moreover, Nesbitt *et al.* (2022) find that investors respond positively to firms being included in a leak, also utilizing LuxLeaks data. Utilizing data from Offshore Leaks, Panama Papers, Bahamas Leaks and Paradise Papers, Schmal *et al.* (2021) study the readability of tax footnotes in annual reports and tax expenses disclosure. Their findings are that firms change behaviour after being involved in a leak, mainly by obfuscating information and hiding unethical conduct by reducing tax footnotes in annual reports. Secondly, they report higher tax expenses after a leak—indicating that firms are aware of their actions and are taking measures to prevent any potential reputational harm. Using customer files leaked from LGT Bank in Liechtenstein in 2008, known as the first-ever leak of information from a tax-haven bank, Johannesen & Stolper (2021) find this leak to cause an abrupt withdrawal of deposits from tax havens. Moreover, they find a significant decline in the market value of banks implicated in facilitating tax evasion, precisely by an abnormal return of -2.2 percent. They also follow up by studying the effect of Swiss Leaks and Panama Papers, finding "modestly sized deposit responses but only weak signs of stock market responses". Their findings suggest that whistleblowing within tax-haven banks is a deterrent for offshore tax evaders, as it heightens the perceived risk associated with engaging in and aiding tax evasion. Recently, Fernando & Antoine (2022) used Panama Papers data to study the network of tax-evasion links between different countries. In this network, they are able to identify the most central havens, which should then be prioritized in evasion deterrence policy-making. Next, they find that for a tax treaty to be efficient, it needs to contain an information exchange clause and link tax havens to non-haven countries—

firmly aligning with the recent policy initiatives, such as the implementation of the Common Reporting Standard by the OECD.

O'Donovan *et al.* (2019) provide perhaps the most similar study to ours. They use data from Panama papers leak only and identify 338 publicly traded firms as users of secret offshore vehicles (SOVs) by finding matches in their top executives and board members and also top executives and board members of their subsidiaries. Then, they uncover that $174 billion have been erased from the market capitalisations of the firms. Also, they identify 3 channels by which SOVs are utilized: bribery channel (used to finance bribes to win tenders, therefore create firm value (Beck & Maher 1986; 1989), tax avoidance or evasion channel and expropriation channel (by expropriating funds through SOVs, shareholder value is destroyed). They also report that the drop in firm value reduces future cash flows and following the leak, firms significantly reduce tax avoidance. In another study somewhat similar to ours, Li & Ma (2019) use data from Offshore Leaks, Panama Papers and Bahamas Leaks to study corporate behavior changes after being included in the leak. Their findings are that firms significantly increase their financial leverage to maintain tax saving targets that were provided by offshore vehicles.

2.4 Our contribution

As mentioned before, we aim to extend and increase the relevance of O'Donovan *et al.* (2019) findings on Panama Papers by including the entirety of the Offshore Leaks Database provided by ICIJ. To our knowledge, no similar work would include all five major leaks. Furthermore, we employ propensity score matching similarly to Li & Ma (2019) to increase the accuracy of our results. We find evidence of involved firms' significant decrease of cumulative abnormal returns as compared to similar firms that are non-connected, which goes in line with findings of O'Donovan *et al.* (2019) and contradicts the results of Huesecken *et al.* (2018), suggesting LuxLeaks to possibly be different from the major leaks, perhaps due to its smaller size. Also, we provide an update on findings of Johannesen & Stolper (2021), who report a weak stock market response to subsequent leaks after an initial 2008 tax-haven affiliated bank leak, suggesting that whistleblowing within tax havens does not necessarily deter offshore tax evasion. Our thesis presents significant findings that hold particular relevance in light of the ongoing global endeavours to combat tax evasion by establishing multilateral agreements focused on the automatic exchange of information between jurisdictions. These efforts aim to enhance transparency and cooperation in tackling tax evasion on a global scale.

Chapter 3

Data

In this chapter, we describe the data used to conduct our study. Also, we provide details on the matching process and data manipulation that was conducted in order to obtain our final dataset.

3.1 ICIJ Offshore leaks database

The International Consortium of Investigative Journalists is an independent network of investigative journalists and media outlets from over 100 countries (International Consortium of Investigative Journalists n.d.b). Starting in 2013, they have released a searchable database of over 100,000 companies, trusts, and funds established in tax havens, as well as the people connected to them. It was based on 2.5 million leaked offshore files from two offshore service provider companies—Portcullis TrustNet based in Singapore and Commonwealth Trust Limited based in the British Virgin Islands (Guevara 2013).

This database, titled Offshore Leaks, was the first public release of this sort and scope. In 2016, it was extended with data from the Panama Papers leak—massive 2.6 terabytes of 11.5 million leaked documents from Panama-based law firm Mossack Fonseca, obtained in collaboration with German newspaper Süddeutsche Zeitung (International Consortium of Investigative Journalists 2018). The database was extended by Bahamas leaks later the same year, providing data based on a leak from a Bahamas corporate registry and Paradise Papers leak in 2017 and 2018, based on a leak from offshore service-providing law firm Appleby. Most recently, in 2021 and 2022, it was extended by Pandora Papers leak from multiple offshore service providers, uncovering information on "35 current and former world leaders, more than 330 politicians and public officials" (International Consortium of Investigative Journalists 2021), as well as exposing offshore affairs of "King of Jordan, the presidents of Ukraine, Kenya, and Ecuador, the prime minister of the Czech Republic and former British Prime Minister Tony Blair" (International Consortium of Investigative Journalists 2021).

As of 2023, ICIJ's Offshore Leaks Database contains information on more than 810,000 offshore entities from over 200 countries, and it is dubbed "the biggest cross-border journalism project ever conducted" (International Consortium of Investigative Journalists n.d.a).

For our study, we download the entirety of the database. We work with the four main files included in the database— entities, officers, intermediaries, and relationships. As the data is structured as interconnected nodes, we connect the three former datasets using the latter. ICIJ defines the partial datasets followingly:

- Entity: "A company, trust, or fund created in a low-tax, offshore jurisdiction by an agent."
- Officer: "A person or company who plays a role in an offshore entity."
- Intermediary: "A go-between for someone seeking an offshore corporation and an offshore service—usually a law firm or a middleman that asks an offshore service provider to create an offshore firm for a client."

After merging, cleaning and preprocessing the raw data from ICIJ, our dataset consists of 342,407 entities and 1,112,407 individuals associated with those entities, residing in 228 countries. We also include other information further essential for our research—the jurisdiction where the company operates, the incorporation date and the name of the leak where the data appeared.

Henceforth, this combined dataset will be referred to as "leaked data" throughout this thesis.

3.2 Company ownership and stock data

In order to match companies from the leaked data to publicly traded companies that are users of those SOVs, we obtain a list of all publicly traded companies from Bureau Van Dijk's Orbis database. Similarly to O'Donovan *et al.* (2019), we apply standard filters—we drop penny stocks (stocks with prices less than $0.10) and companies with assets less than $5 million. However, we cannot obtain data on the firm's subsidiaries and managers of those subsidiaries (similarly to O'Donovan *et al.* (2019); Li & Ma (2019)), as we do not have access to that data. Considering that our research process continues to yield sufficient matches, we maintain the perspective that the absence of this data does not significantly undermine our research—in fact, we believe that matches involving firm subsidiaries may not carry as much relevance in our study. Moreover, we obtain names of the companies' board members and members of senior management, arriving at 97,664 public limited companies and 483,908 names of managers and directors. We also obtain information on the manager's country of residence, as well as the ISIN numbers and ticker symbols for the companies. This dataset will be referred to as "company ownership data" to maintain consistency and clarity throughout the thesis.

Finally, we use Refinitiv Eikon to obtain stock price data. For each company, we obtain daily closing price in USD.

3.3 Matching process

The next step is to match the offshore companies to publicly traded ones in order to identify the public companies who are users of those SOVs. We do that by preprocessing the datasets in R and then employing a fuzzy matching algorithm in Python.

The initial step in data preparation involves employing standard preprocessing techniques, which include removing salutations and standardizing the spelling of company abbreviations. We also remove any rows with missing or placeholder values indicating an unknown entity, such as "The Bearer".

Furthermore, we perform fuzzy matching of the two datasets based on the names of managers and directors (from company ownership data) and names of officers and intermediaries (from leaked data). We choose fuzzy matching instead of regular matching to control for possible variations in spelling, and also since according to ICIJ, the leaked data can include typos and misspellings. For a match to be considered valid, we also require a match in the country of residence. Finally, we manually verify all the matches and remove potentially false ones.

The final output of this procedure yields 548 matches between the two datasets. By excluding private and unlisted companies and companies for which we do not have stock data available, we are able to identify 206 publicly traded companies connected to offshore companies named in the leaks. Those companies serve as the basis for our analysis.

3.4 Summary statistics of identified companies

This section serves as an overview and includes summary statistics of the 206 companies that were identified as users of offshore vehicles.

First, we provide information on the country of origin of the identified company. The fifteen most frequent countries are summarised in Table 3.1. Due to brevity considerations, the remaining 31 countries, which mainly consist of only one observation each, are not included, as they are located all around the globe with no apparent patterns; we believe it brings no informational value.

Table 3.1: List of most frequent countries of origin of identified companies

Country	Frequency
China	25
Australia	15
United States of America	14
United Kingdom	13
India	12
Hong Kong	10
Germany	9
Canada	9
Sweden	9
Switzerland	7
Indonesia	7
Japan	6
Malta	6
Italy	5
Spain	5

Next, we provide overview of tax havens that the identified companies use. This is the location of the offshore company connected to our identified company. The countries are listed in Table 3.2. Majority of the countries is located in Malta, followed by British Virgin Islands. We speculate that the higher frequency of Malta in the dataset is attributed to a substantial portion of the Paradise Papers leak originating from the Malta corporate registry. This particular circumstance makes Malta's representation above the average among the countries. Additionally, the frequent appearance of the British Virgin Islands can be attributed to its widespread popularity as a tax haven across all the leaks.

Table 3.2: List of tax havens used by identified companies

Country	Frequency
Malta	103
British Virgin Islands	80
Samoa	5
Seychelles	2
Singapore	2
Bermuda	2
Labuan Island (Malaysian territory)	1
Panama	1
Ireland	1

Additionally, we present a list of the leaks from which the identified companies originate. The distribution is displayed in Table 4.1. The variation in frequencies folows our expectation and reflects the notable difference in scale between more recent leaks and those from earlier periods.

Table 3.3: List of leaks of origin

Leak Source	Frequency
Paradise Papers - Malta & Samoa	108
Pandora Papers - (1)	38
Offshore Leaks	18
Panama Papers	16
Pandora Papers - Alcogal & Fidelity	21
Pandora Papers - Alpha Consulting	3
Paradise Papers - Appleby	2

(1) The providers: Asiaciti Trust Asia Limited, CILTrust International, Commence Overseas Limited, IlShin, Overseas Management Company Inc, SFM Corporate Services and Trident Trust Company Limited

Chapter 4

Methodology

This chapter describes the methodology used in our research. First, we comment on event study methodology in general and we use it to explain our research choices. We also talk about propensity score matching (PSM) that was used in order to improve the balance of our dataset.

4.1 Event study

An event study is a tool typically used in order to assess the market's response to a specific event. The objective is to assess the magnitude of abnormal returns around the time of the event, where the abnormal return is the difference between the observed return and an estimated normal return that is computed using an appropriate return-generating model (Peterson 1989). Typical steps used in event study literature include (1) the definition of the event window, (2) the estimation of normal returns in case no event occurred, from that follows (3) the calculation of abnormal returns, followed by (4) cross-firm and cross-time aggregation of the abnormal returns, and finally (5) testing the statistical significance of the aggregate abnormal returns. We will now walk through this five-step process and explain our choices for our study.

4.1.1 Event window

As we work with different leaks, we must set an event window to observe the abnormal returns. This gets difficult as the leaks are slightly different from each other. In our study, we work with three types of leaks. First, there are leaks that are not pre-announced at all, and the entire database is released in one day, taking the market by surprise. This means the release can not be expected, as there is no prior information about which companies will be included in the leak. This is the case of Bahamas Leaks, Paradise Papers (Barbados, Bahamas, Aruba, Nevis corporate registries), Paradise Papers (Cook Islands, Samoa, Malta corporate registries) and Pandora Papers (Alpha Consulting, Asiaciti Trust Asia Limited, Asiaciti Trust Asia Limited, CILTrust International, Commence Overseas Limited, IlShin, Overseas Management Company Inc, SFM Corporate Services and Trident Trust Company Limited). Next, there are leaks that first get announced, and only sometime later, a searchable database is made available to the public—this is the case of Offshore Leaks, Paradise Papers (Appleby provider) and Pandora Papers (Alcogal and Fidelity Corporate Services). This means that the market knows and expects that the information is at some point going to be made available but only learns about the names of companies involved in the actual release of the database. Finally, there is a third type that only occurs in the case of the Panama Papers. This type of leak consists of a first report of a leak, followed by the announcement of the future release of a searchable database on a later date, followed by the actual release of the database even later. This means there are two possible anticipation dates for the market, but it only learns the names of companies involved on the day of database release.

In order to capture the effect of all those events in our analysis, we chose to group the events under three event days. We refer to Day 1 as the day of the first media report of the respective leak. Day 2 is the day when ICIJ announced that a searchable database would be made available in the future, and Day 3 is when the database is made public. Around each of those days, we set an event window of 5 trading days, denoted $(-1, 3)$, with day 0 being the respective event day. Table 4.1 summarises the respective event dates, as well as the data sources from which the dates were obtained. As those dates are later used to obtain stock data, we mark nontrading days with an asterisk, and in those cases in the research, we then use the data for the next trading day.

4.1.2 Normal and abnormal returns estimation

As the next step, we need to estimate the hypothetical normal returns, as if no event has occurred, to subtract those from the actual stock returns later to arrive at the abnormal returns of a given stock. In the usual event study

Table 4.1: Leak Timeline

Leak	**Day 1**	**Day 2**	**Day 3**	**Source**
Offshore Leaks	4/4/13	-	14/6/13	1, 2
Panama Papers	3/4/16*	26/4/16	9/5/16	3
Bahamas Leaks	-	-	21/9/16	4
Paradise Papers (1)	20/10/17	-	5/11/17*	5, 6
Paradise Papers (2)	-	-	19/12/17	7
Paradise Papers (3)	-	-	12/2/18	7
Pandora Papers (4)	3/10/21*		6/12/21	7
Pandora Papers (5)	-	-	11/4/22	7
Pandora Papers (6)	-	-	3/5/22	7

* = non-trading day

To enhance readability, the following list presents the data providers for each respective leak:
(1) Appleby
(2) Barbados, Bahamas, Aruba, Nevis corporate registries
(3) Cook Islands, Samoa, Malta corporate registries
(4) Alcogal and Fidelity Corporate Services
(5) Alpha Consulting
(6) Asiaciti Trust Asia Limited, CILTrust International, Commence Overseas Limited, IlShin, Overseas Management Company Inc, SFM Corporate Services and Trident Trust Company Limited

Source: 1 - Brinkmann *et al.* (2013) , 2 - Guevara (2013), 3 - O'Donovan *et al.* (2019), 4 - Fitzgibbon (2016), 5 - Truong (2017), 6 - International Consortium of Investigative Journalists (2017), 7 - International Consortium of Investigative Journalists (n.d.c) methodology, many models can be used for this estimation. Due to the similarity to our work, we chose to follow O'Donovan *et al.* (2019) and use the single-factor market model. The market model is a linear regression model that estimates stock returns from regressing stock returns on market returns of a reference market index during a specified estimation period. The market model has the following form:

$$R_{it} = \alpha_i + \beta_i \cdot R_{mt} + \epsilon_{it} \tag{4.1}$$

where R_{it} is the return of the i-th stock in time t, R_{mt} is the return of the reference market index in time t, α_i is the intercept, β_i is the slope parameter measuring the sensitivity of market returns, ϵ_{it} is the error term which is assumed to have expected value equal to zero and finite variance equal to $\sigma^2_{\epsilon_i}$. The statistical assumption for the market model to be correctly specified is that the asset returns are jointly multivariate normal and independently and identically distributed through time. This assumption, although strong, is widely supported by empirical evidence and has been deemed reasonable. Notably, studies such as MacKinlay (1997) have shown that inferences made using normal return models remain robust even in the presence of deviations from this assumption.

Under general assumptions Ordinary Least Squares (OLS) is a consistent estimator for the market model parameters, and further under the above-mentioned assumptions, it is efficient. Using the standard OLS framework, we use returns from the estimation period and a return of the reference market index to predict the normal returns. Following O'Donovan *et al.* (2019), we set the estimation period as one year of stock returns, ending one month before the first event day. This setup ensures no overlap between the event and estimation windows, thereby preventing any bias in the estimation of normal returns (MacKinlay 1997). Finally, the abnormal returns are then computed as

$$AR_{it} = R_{it} - (\alpha_i + \beta_i \cdot R_{mt}). \tag{4.2}$$

Under the null hypothesis of leak inclusion having no impact on the returns, conditional on the event window, the abnormal returns are jointly normally distributed with zero mean and variance $\sigma^2(AR_{it})$. The equation for the variance is following:

$$\sigma^2(AR_{it}) = \sigma^2_{\epsilon_i} + \frac{1}{L_1}\left[1 + \frac{(R_{mt} - \hat{\mu}_m)^2}{\hat{\sigma}^2_m}\right] \tag{4.3}$$

where $\sigma^2_{\epsilon_i}$ is the error variance from the market model equation 4.1 and the second part of the equation is additional variance due to sampling error in α_i and β_i. This sampling error, which is common for all event window observations, according to MacKinlay (1997), causes serial correlation of the abnormal returns even though the real disturbances are independent over time. However, as the sample of observations in the estimation period, denoted as L_1 in the equation, gets large, the second term approaches zero as the sampling error diminishes. This further supports our choice of a sufficiently large estimation window of one year, allowing us to assume abnormal returns to be independent through time. Finally, the mean is defined as

$$\hat{\mu}^2_m = \frac{\sum_{t=T_0}^{T_1} R_{mt}}{L_1} \tag{4.4}$$

As the companies in our dataset come from a large number of stock exchanges all around the world[1], we chose MSCI All-Country World Equity Index as our reference market index, as it includes a broad cross-section of markets from both developed and emerging economies and also its data are available for the entirety of our estimation period.

4.1.3 Aggregation of returns and statistical testing

In order to be able to run statistical tests on our dataset, the normal returns need to be cross-time, and cross-firm aggregated. In our analysis, we work with mean abnormal returns for all firms on event window days, computed as follows:

$$\overline{AR}_t = \frac{\sum_{i=1}^{N} AR_{it}}{N} \tag{4.5}$$

where N represents the number of stocks included in the event window. Next, following the usual event study methodology, we compute cumulative abnormal returns (CARs) for stock i and event window days. Denoting the estimation period as T_0 to T_1 and the event period as T_1 to T_2, the CAR is computed as follows:

$$CAR_i(T_1, T_2) = \sum_{t=T_1}^{T_2} AR_{it} \tag{4.6}$$

[1] For full list of stock exchanges in our dataset see Appendix 2.

Finally, the CARs are averaged as follows:

$$\overline{CAR(T_1, T_2)} = \sum_{t=T_1}^{T_2} \overline{AR_t} = \frac{\sum_{i=1}^{N} CAR_i(T_1, T_2)}{N} \tag{4.7}$$

In order to conduct statistical tests, it is necessary to compute the variances of mean abnormal returns ($\overline{AR_t}$) and mean cumulative abnormal returns ($\overline{CAR(T_1, T_2)}$). The definitions are as follows:

$$var(\overline{AR_t}) = \frac{\sum_{i=1}^{N} \sigma^2(AR_{it})}{N^2} = \frac{\sum_{i=1}^{N} \sigma^2_{\epsilon_i}}{N^2} \tag{4.8}$$

$$var(\overline{CAR}(T_1, T_2)) = \sum_{t=T_1}^{T_2} var(\overline{AR_t}) = \frac{\sum_{i=1}^{N} \sigma_i^2(T_1, T_2)}{N^2} \tag{4.9}$$

The two choices of testing that can be done to our data are a parametric and a non-parametric test. Parametric tests have specific assumptions about the distribution of abnormal returns, while non-parametric tests are free of those assumptions. The major issue with parametric tests is that the returns are assumed to be normally distributed, which tends not to be the case with daily stock returns (Brown & Warner 1985). Despite the non-normality of daily stock returns, previous studies such as Berry *et al.* (1990) and Dyckman *et al.* (1984) have demonstrated the robustness and efficacy of parametric tests. Therefore, in line with their findings, we employ the parametric test as a tool for our analysis, acknowledging the assumption it entails. To enhance the robustness of our analysis, we incorporate a non-parametric Mann-Whitney U test as an additional approach.

As a parametric test, we use Welch's t-test:

$$\theta_1 = \frac{(\overline{CAR_0}(T_1, T_2) - \overline{CAR_1}(T_1, T_2))}{\sqrt{\frac{\sigma_0^2(\overline{CAR}(T_1,T_2)}{N_0} + \frac{\sigma_1^2(\overline{CAR}(T_1,T_2)}{N_1}}} \tag{4.10}$$

where $\overline{CAR_i}(T_1, T_2)$ denotes the mean cumulative abnormal return over the event window, N_i is the respective sample size, and $\sigma_i^2(\overline{CAR}(T_1, T_2)$ is the variance of the respective group, with i distinguishing the two groups—taking value of 1 for leaked (treatment) companies and 0 for non-leaked (control) companies. The test is used in order to compare the means of the two groups, with the null hypothesis being that they are the same among the two groups.

For the non-parametric test, we use the Mann-Whitney U test. This test is used to compare the medians of two groups without assuming a specific distribution of the data. The test is conducted by first combining the data from both groups into a single ranked dataset based on their value, regardless of the original group membership. Then, a sum of ranks for each group is computed, and the U statistic is obtained. The formula for the U statistic is following:

$$\theta_2 = R - \frac{N_1(N_1 + 1)}{2} \tag{4.11}$$

where θ_2 is the U statistic, R is the sum of the ranks of one of the groups (usually the group with a smaller sum of the ranks), and N_1 is the sample size of the group with a smaller sum of ranks. The test's null hypothesis is that there are no differences between the medians of the two groups.

4.2 Propensity score matching

As only a few companies are exposed in the leaks compared to all the other companies we use for our analysis, we strive to improve the balance of our dataset by using Propensity Score Matching (PSM). PSM is a statistical method that strives to mimic randomization and reduce the effect of confounders of sample selection by creating a new group of control subjects that exhibit a similar propensity for treatment based on preexisting covariates that influence treatment selection (Kane *et al.* 2020). That way, we are able to arrive at more precise estimates of treatment, as without it, we shall not assume that treated and control groups are similar. To estimate the propensity scores, we run a logistic regression of the fact whether a firm is exposed in the leaks (denoted by $leaked_i$):

$$\text{Logit}(leaked_i) = \alpha + \beta_1 haven\_sub\_count_i + \beta_2 total\_assets_i + e_i \tag{4.12}$$

where α is the intercept, *haven_sub_count* is the natural logarithm of 1+number of tax haven[2] subsidiaries, a variable serving as a predictor of leak exposure

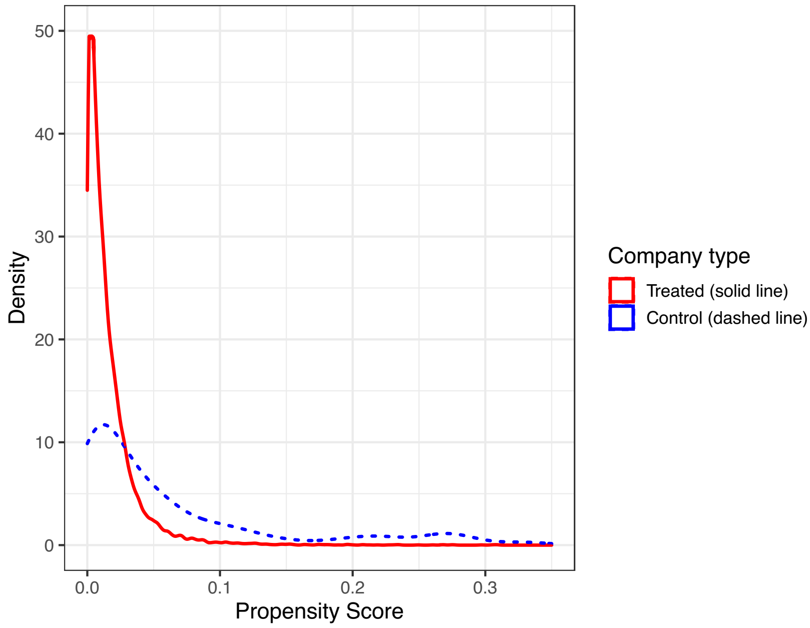
[2] We use an edited version of a list of tax haven countries as per Dyreng & Lindsey (2009), who compile the list from following sources: Organization for Economic Cooperation and Development (OECD), the U.S. Stop tax Havens Abuse Act, The International Monetary Fund (IMF) and the Tax Research Organisation. For full list see Table A.1 in Appendix A.

as per Dyreng & Lindsey (2009), *total_assets* is a natural logarithm of total assets, serving as a measure of firm size and e_i is the error term. Using the propensity score, we perform a 1-to-1 nearest neighbour matching, without replacements, within the same Standard Industry Classification (SIC) industry. Regression results are presented in Table 4.2. The number of tax haven subsidiaries and firm size are statistically significant and positively associated with leak exposure. Moreover, with pseudo R^2 being equal to 21%, we believe our propensity equation works well. With the PSM, we arrive at a new sample of 412 firms—206 control and 206 treatment firms. A plot of the propensity score distribution before and after matching is presented in Figure 4.1 and Figure 4.2. Also, Figure 4.3 and Figure 4.4 provide an overview of the distribution between SIC industries in our sample before and after matching. We believe that we have arrived at a more balanced sample in both the propensity score distribution and SIC industries' distribution. The only prominent spike at SIC code 6 represents the division of Finance, Insurance and Real estate (Occupational Safety and Health Administration *et al.* 2019), which we believe aligns with expectations about the nature of the treated companies in our dataset.

Table 4.2: Regression results of PSM equation (4.12)

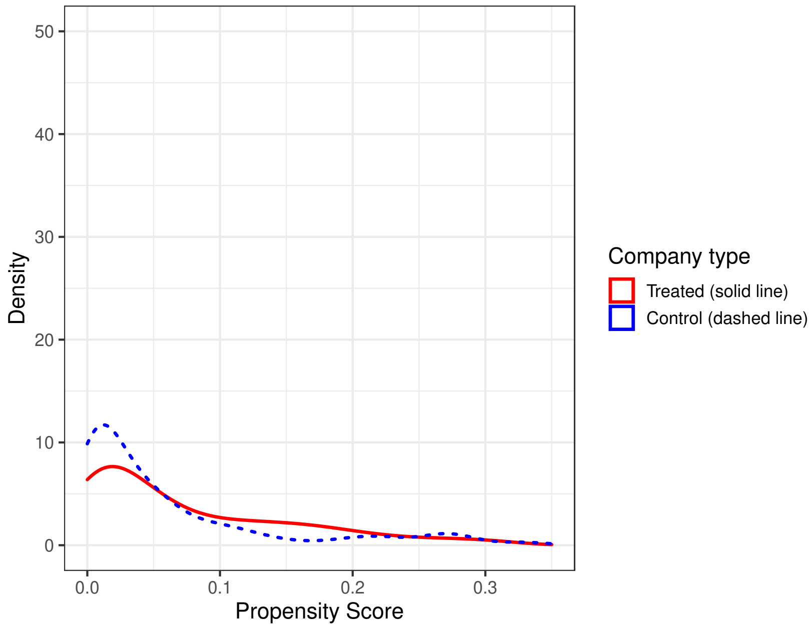
	Dependent variable:
	Leaked
Logarithm of total assets	-0.915^{***}
	(0.051)
Logarithm of 1 + number of tax haven subsidiaries	0.664^{***}
	(0.070)
Constant	8.519^{***}
	(0.681)
Observations	10,184
Log Likelihood	−795.775
Akaike Inf. Crit.	1,597.550
Pseudo R^2	0.210
Note:	*p<0.1; **p<0.05; ***p<0.01

Figure 4.1: Propensity score distribution before matching



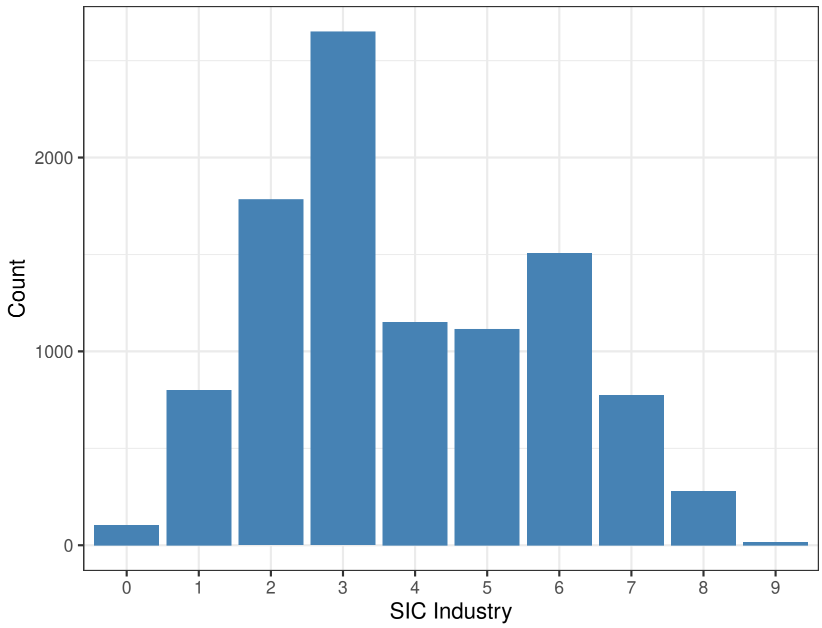
Note: The figure displays the distribution of propensity scores of the treated companies (206) and all of the remaining publicly traded companies (9,978) before improving the balance of the dataset by matching based on the propensity score.

Figure 4.2: Propensity score distribution after matching



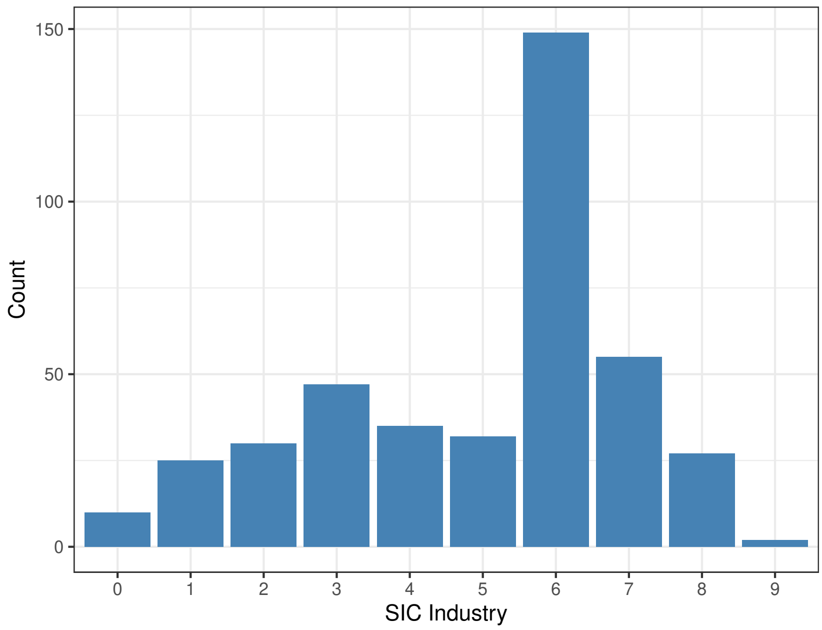
Note: The figure displays the distribution of propensity scores of the treated companies (206) and the newly selected control companies (206) based on the propensity score.

Figure 4.3: Distribution of SIC industries before matching



Note: The figure displays the counts of respective SIC industries in the full dataset of 10,184 companies before adjustments based on the propensity score matching. For breakdown of the SIC codes as well as their descriptions see Appendix C.

Figure 4.4: Distribution of SIC industries after matching



Note: The figure displays the counts of respective SIC industries in the matched dataset of 206 control and 206 treated companies after adjustments based on the propensity score matching. For breakdown of the SIC codes as well as their descriptions see Appendix C.

Chapter 5

Results

We begin the discussion of our findings by providing the regression results for the market model estimation of normal returns. As explained in detail in Chapter 4, the estimates of this model are used to compute abnormal returns and cumulative abnormal returns are then used to assess the overall effect of leak inclusion.

The market model has the following formula:

$$log\_return_{it} = \alpha + \beta_1 market\_return_{it} + e_{it} \tag{5.1}$$

where log_return_{it} is the logarithmic return of firm i at time t, α is the estimated intercept, β_1 is the estimated slope parameter measuring the sensitivity of market returns, $market\_return_{it}$ is the logarithmic return of a reference market index (MSCI All-Country World Equity Index) at time t, e_{it} is the error term and time t is from the estimation period T_0 to T_1. We provide the full regression results in Table 5.1.

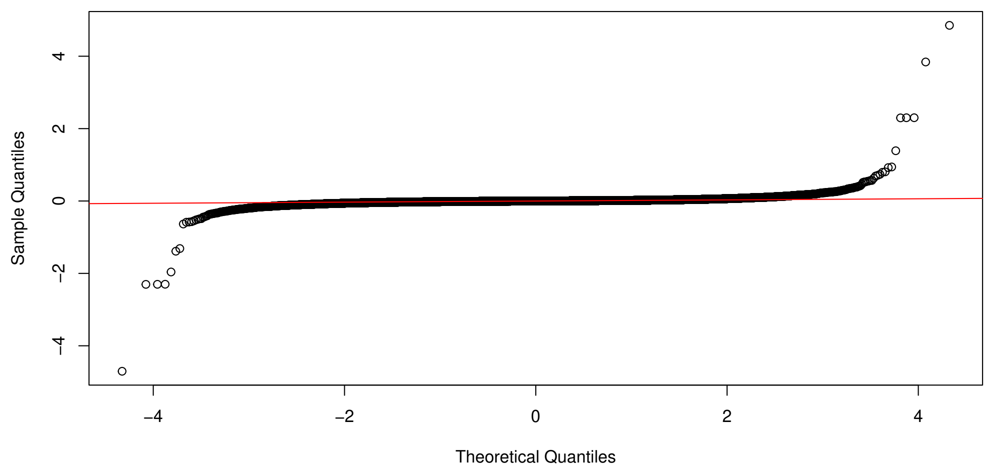
We find the market return to have a significant positive relationship with the firm returns. For diagnostics, we conduct the Durbin-Watson test, which detects no autocorrelation present, Breusch-Pagan test, which detects no heteroskedasticity; furthermore, we find no correlation between independent variables and residuals. While plotting the quantile-quantile (Q-Q) plot as per Figure 5.1, by visual inspection, we see that there is a deviation from the theoretical line, suggesting residuals are not normally distributed. The Jarque-Bera test results further support this belief, with a strong rejection of the null hypothesis of normality. These findings indicate the need for caution when

Table 5.1: Regression results of normal returns estimation using the market model

	Dependent variable:
	Logarithmic return
Market return	0.820***
	(0.032)
Constant	−0.0001
	(0.0002)
Observations	65,770
R^2	0.010
Adjusted R^2	0.010
Residual Std. Error	0.051 (df = 65768)
F Statistic	636.483*** (df = 1; 65768)
Note:	*p<0.1; **p<0.05; ***p<0.01

interpreting the results of parametric t-tests and highlight the importance of incorporating non-parametric tests as a complementary analysis.

Figure 5.1: Q-Q plot of residuals of the market model



Note: The quantile-quantile (Q-Q) plot provides a visual assessment of the distributional assumptions of the residuals in the model. The (Q-Q) plot compares the quantiles of the observed residuals against the quantiles of a theoretical normal distribution. If the residuals follow a perfect normal distribution, the points in the Q-Q plot would fall along a straight line. Deviations from this line indicate departures from normality.

Next, we provide the main result of our research. Following O'Donovan *et al.*, we assess the overall impact of leak inclusion on the firm's returns and value. The formula estimated is following:

$$CAR_{it} = \alpha + \beta_1 leaked_i + e_i \tag{5.2}$$

where CAR_i is the cumulative abnormal return for firm i over the period t, with t denoting the full event window (T_1 to T_2), α is the intercept, β_1 is the estimated coefficient of interest denoting the effect and $leaked_i$ is a variable indicating whether a firm belongs to the treatment or control group. From the regression results provided in Table 5.3, we find a significant decrease in returns of firms identified as a user of offshore services by being named in the leak by 1.5 %. To contrast, firms that are not connected but chosen by PSM to be similar to the connected companies only have an insignificant decrease of 0.2%. To obtain the overall effect of all the leaks on the market, we multiply the estimated 1.5% by the implicated firm's value at the end of the year when the respective year took place. By that, we arrive at a figure of $21.7 Billion in erased market capitalization of the 206 connected firms caused by the leaks.

Comparing our results to O'Donovan *et al.*, who identify 338 firms as connected to the Panama Papers leak alone, we find that our estimate of lost return is similar to their findings of 1.4%. This allows us to conclude that there is no major difference between the impact of the different leaks. The key disparity lies in the quantification of the lost value of the firm, where O'Donovan *et al.* report $174 Billion, which averages at $515 Million per firm, while our estimate averages at $105 Million. We attribute this difference to the design of the matching process. In O'Donovan *et al.*'s study, a firm is considered compromised if there is a match between any person's name, not only in its direct management and board members but also across any of its subsidiaries. Conversely, our analysis only takes into account direct matches between companies. This dissimilarity in the matching criteria substantially impacts the reported loss figures. By concentrating solely on direct matches, we believe that our approach provides a clearer picture of the immediate impact on the directly affiliated entities, allowing for a more precise assessment of the average loss per firm.

For diagnostics of the model, we again conduct the Durbin-Watson test, which finds no evidence of autocorrelation as well as the Breusch-Pagan test, which finds no evidence of heteroskedasticity and we also find no correlation between independent variables and residuals. Both the Jarque-Bera test and the Shapiro-Wilk test indicate strong evidence to reject the null hypothesis of normally distributed residuals. This is further supported by visual inspection of the Q-Q plot provided in Figure 5.2 and the kernel density plot of the residuals in Figure 5.3. Therefore, as already closely explained in Chapter 4, we proceed with caution when interpreting the results and incorporate the non-parametric Mann-Whitney U test test alongside parametric t-test.

The results of the tests are summarised in Table 5.2. Both of the tests provide evidence indicating a statistically significant difference between the cumulative abnormal returns between the leaked and non-leaked companies, supporting the hypothesis that the leaks have a significant impact on the stock price of the implicated companies.

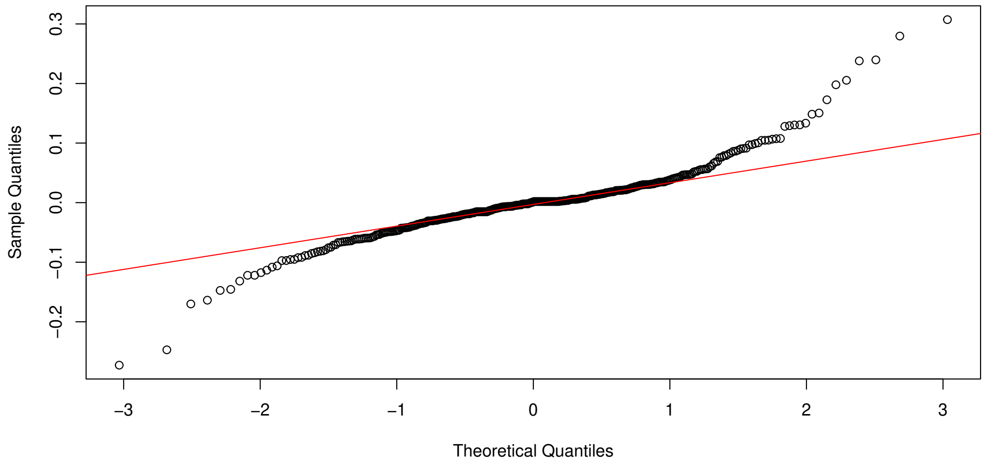
Table 5.2: Test Results

Test Name	Test Statistic	p-value	H_A
Welch's t-test	-2.592	0.009	true difference in means is not equal to 0
Mann-Whitney U test	18216	0.013	true location shift is not equal to 0

Table 5.3: Regression results of estimation of the leak impact model

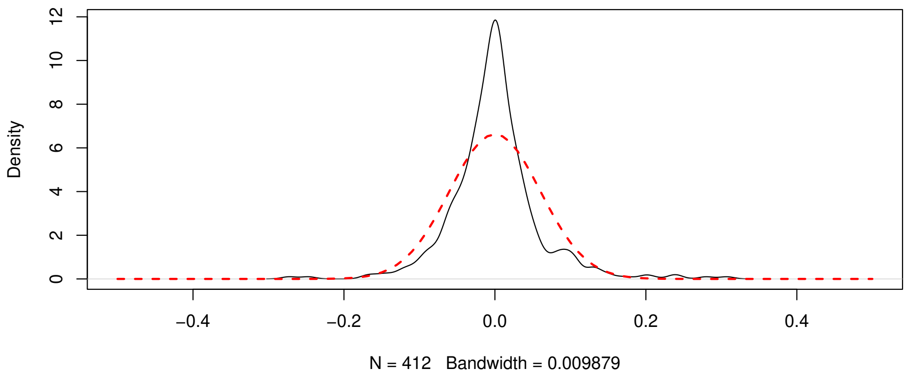
	Dependent variable:
	Cumulative abnormal returns
Leaked	-0.015^{***}
	(0.006)
Constant	-0.002
	(0.004)
Observations	412
R^2	0.016
Adjusted R^2	0.014
Residual Std. Error	0.060 (df = 410)
F Statistic	6.720^{***} (df = 1; 410)
Note:	$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Figure 5.2: Q-Q plot of residuals of the leak impact model



Note: The quantile-quantile (Q-Q) plot provides a visual assessment of the distributional assumptions of the residuals in the model. The (Q-Q) plot compares the quantiles of the observed residuals against the quantiles of a theoretical normal distribution. If the residuals follow a perfect normal distribution, the points in the Q-Q plot would fall along a straight line. Deviations from this line indicate departures from normality.

Figure 5.3: Kernel density plot of residuals of the leak impact model



Note: The kernel density plot of the residuals in the model is a non-parametric way to estimate the underlying probability density function of the residuals. The density plot illustrates the shape of the distribution of the residuals. The solid curve represents the estimated density, while the dashed bell curve represents a theoretical normal distribution with the same mean and standard deviation as the residuals. If the residuals are normally distributed, the shape of the estimated density curve should resemble the bell curve, indicating a symmetrical distribution around the mean. Deviations from the bell curve suggest departures from normality.

Chapter 6

Conclusion

This thesis studies the effect of leaks of secret offshore documents on the value of the implicated firms. It extends prior work of O'Donovan *et al.* (2019), who assess the sole impact of the Panama Papers leak by including all the major leaks in ICIJ Offshore Leaks Database. To our knowledge, there is no work that would estimate the impact of all of the leaks in this database.

First, the data from the leaks is used to identify links of the offshore companies to publicly traded companies using the matches in the names of persons among the companies' management and board members. This way, we are able to identify 206 publicly traded companies as users of offshore vehicles. Moreover, for added accuracy of the results, we use propensity score matching (PSM) to find a sample of 206 publicly traded companies that are not implicated by the leaks but are similar to the implicated companies. Finally, we obtain the companies' stock prices and conduct an event study that assesses the leak's impact on the companies' cumulative abnormal returns during five days around each of the 3 identified important event days. Moreover, we also provide an estimate of the lost market value of those firms, providing an updated figure as compared to O'Donovan *et al.* (2019).

Our work's main finding is that firms implicated in the leak have negative CARs during the event window that are 1.5% lower than those of similar firms that are not implicated. This aligns with O'Donovan *et al.*'s findings, allowing us to conclude that there are no major differences between the impacts of the respective leaks. Next, we estimate that the average loss of firm value per firm is $105 Million. We believe this offers an updated and more precise assessment as compared to those of O'Donovan *et al.*, as we only identify direct matches between the firms, unlike O'Donovan *et al.* who take into account also the matches using the firm's subsidiaries, inflating the average loss per firm to $515 Million. For robustness of our estimates, we conduct testing of all the assumptions and support our results with both parametric and non-parametric tests.

We believe we have chosen appropriate methodological steps to provide a coherent and robust analysis that brings value and new insights into the topic of offshore activities that otherwise remain relatively opaque. However, some next steps might include using different approaches to deepen the analysis further. Those can include re-defining the matching algorithm to include also firm's subsidiaries, as mentioned earlier. Moreover, a different model than the market model used in this analysis can improve the accuracy of estimated normal returns. Finally, the number of implicated companies identified could be improved, were more expansive datasets available, allowing us to match companies on more factors rather than solely on names of managers and board members. Also, were we not forced to eliminate several companies based on stock data availability. By increasing the number of implicated companies identified, there would also be a possibility to offer a more detailed glimpse into the impact of the leaks, such as day-by-day results or analyzing each leak separately.

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Appendix A

List of Tax Haven Countries

Table A.1: List of Tax Haven Countries Used in the Research

Andorra	Liberia
Anguilla	Lichtenstein
Antigua and Barbuda	Luxembourg
Aruba	Macao
Bahamas	Maldives
Bahrain	Malta
Barbados	Marshall Islands
Belize	Mauritius
Botswana	Monaco
British Virgin Islands	Nauru
Brunei Darussalam	Palau
Cape Verde	Panama
Cayman Islands	Samoa
Costa Rica	San Marino
Curacao	Seychelles
Cyprus	Singapore
Dominica	St. Kitts and Nevis
Gibraltar	St. Lucia
Grenada	St. Vincent and the Grenadines
Ireland	Switzerland
Latvia	Uruguay
Lebanon	Vanuatu

Source: Dyreng & Lindsey (2009), edited by author

Because of data availability, the following countries that are included in the original source are not included in our research: Cook Islands, Guernsey and Alderney, Isle of Man, Jersey, Montserrat, Bonaire and Leeward islands (Netherlands Antilles), Niue, U.S. Virgin Islands.

Appendix B

Full list of stock exchanges

Table B.1: Stock exchange and firm count

Stock Exchange	Firm Count
Hong Kong Stock Exchange	53
New York Stock Exchange (NYSE)	34
London Stock Exchange	29
Tokyo Stock Exchange	25
NASDAQ National Market	24
Bombay Stock Exchange	23
Singapore Exchange	22
Australian Securities Exchange	19
Euronext Paris	16
Indonesia Stock Exchange	13
Nasdaq OMX - Stockholm	12
Boerse Frankfurt	11
Korea Stock Exchange	10
Shenzhen Stock Exchange	9
Swiss Exchange (SWX)	9
Borsa Italiana - MTA	9
Taiwan Stock Exchange	9
Toronto Stock Exchange	9
Athens Stock Exchange	8
Bursa Malaysia	8
Johannesburg Stock Exchange	8
Stock Exchange of Thailand	7
BM&F Bovespa	6
Bolsa de Madrid	6
New Zealand Stock Exchange	6
Shanghai Stock Exchange	6
Wiener Boerse	6
Bulgarian Stock Exchange	5
Canadian Securities Exchange	5
Istanbul Stock Exchange	5

Appendix C

List of SIC industry codes

SIC codes are a system of codes for unifying the industry classification of firms. Usually a four-digit code, the codes are comprised of groups of progressively narrower classes. The ten most broad groups, denoted by letters A-J, signify a division, the first two digits are a "major group", and finally, the first three digits signify an "industry group". When working with SIC codes throughout this thesis, we use the classification into ten groups based on the first digit of the full SIC code. Table C.1 provides an overview of all the categories, the division and major groups that belong there, and most importantly, the code we use for each group in our research.

Table C.1: List of SIC codes, their descriptions and respective codes used in the research

Division	**Description**	**Major Group**	**Code**
A	Agriculture, Forestry, Fishing	01 - 09	0
B & C	Mining and Construction	15 - 17	1
D	Manufacturing	20 - 39	2 & 3
E	Transportation, Communications, Electric, Gas, And Sanitary Services	40 - 49	4
F & G	Wholesale and Retail Trade	50 - 59	5
H	Finance, Insurance and Real Estate	60 - 67	6
I	Services	70 - 89	7 & 8
J	Public Administration and Non-classifiable	91 - 99	9

Source: Occupational Safety and Health Administration *et al.* (2019)