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The Value of Offshore Secrets: Evidence from the Panama Papers

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The Value of Offshore Secrets: Evidence from the Panama Papers

Abstract

We exploit one of the largest data leaks to date to study whether and how firms use secret offshore vehicles. From the leaked data, we identify 338 listed firms as users of secret offshore vehicles and document that these vehicles are used to finance corruption, avoid taxes, and expropriate shareholders. Overall, the leak erased $174 billion in market capitalization among implicated firms. Following the increased transparency brought about by the leak, implicated firms experience lower sales from perceptively corrupt countries and avoid less tax. We estimate conservatively that one in seven firms have offshore secrets.

JEL Classification: G32, G38, H25, H26
Keywords: Panama Papers, tax haven, offshore, corruption, tax evasion, expropriation, corporate misbehavior, Paradise Papers.

> "The archetypal tax haven may be a palm-fringed island, but […] there is nothing small about offshore finance. If you define a tax haven as a place that tries to attract non-resident funds by offering light regulation, low (or zero) taxation and secrecy, then the world has 50-60 such havens. These serve as domiciles for more than 2m companies and thousands of banks, funds and insurers. Nobody really knows how much money is stashed away."
>
> *The Economist* February 13, 2013

The deliberate lack of transparency created by tax havens both characterizes their appeal and makes their analysis challenging. As an illustration of the data challenges, consider that even basic estimates of the size of global offshore assets vary widely, ranging from $7 to $32 trillion (Tax Justice Network 2012, BCG 2014, Zucman 2015). Corporations are among the main users of tax havens. The corporate use of a tax haven entails corporate insiders creating an offshore vehicle, typically with help of an offshore service provider. Our paper focuses on those cases where the offshore vehicle is a secrecy device that serves to hide activities and information from outsiders. We attempt to answer how prevalent the corporate use of secret offshore vehicles is, why firms use them, and how their use affects shareholder value.

Understanding the nature of secret corporate offshore activities is difficult but important since those activities may affect outside shareholders and the government alike. For instance, corporations may use secret offshore vehicles to legally avoid, or illegally evade, corporate taxes, thereby reducing governmental claims on corporate cash flows but benefitting outside shareholders (Desai, Dyck and Zingales 2007). We refer to this as the *tax channel*. Similarly, the opaqueness created by offshore vehicles may facilitate circumventing non-tax regulation, giving rise to the *bribery channel*. Offshore vehicles may help firms to make hidden bribe payments to win business, which benefits shareholders (Zeume 2017), but can also reduce investment and economic growth (Shleifer and Vishny 1993; Mauro 1995). Further, the veil of secrecy created by offshore vehicles may allow insiders to divert corporate resources. Prominent cases such as Enron and Parmalat offer anecdotal evidence of insiders expropriating outside investors. This *expropriation channel*

hurts outside investors and reduces governmental claims. Our objective with this paper is to provide novel large-sample evidence that secret offshore vehicles are used to avoid taxes, make bribe payments, and expropriate outside shareholders, and that these activities affect firm value.

A key challenge in an investigation into whether and how firms use secret offshore vehicles is that such vehicles are often completely unobservable. To this end, we exploit one of the largest data leaks to date, the 2016 leak of the Panama Papers. On April 3, 2016, the news media reported a leak of confidential documents concerning the business activities of Mossack Fonseca & Co. (Mossack Fonseca), a Panama-based law firm and offshore service provider.[1] These so-called Panama Papers provide insights into the operations of roughly 214,000 shell companies that were incorporated in tax havens around the world over the past 45 years. We use data from the Panama Papers to identify among all publicly listed firms worldwide those that are users of secret offshore vehicles (SOVs). The existence of these SOVs is unknown to outsiders, and therefore allows corporate insiders to carry out certain activities in secret. We then compare the returns of the firms we identify to those of other firms around the time of the leak using an event study methodology. If sheltering is used predominantly for bribe payments or tax evasion, the surprise leak should be associated with negative returns among firms exposed to the leak because the leak may reduce future cash flows from such activities or result in costly regulatory fines for past activities. If instead offshore structures are predominantly used to divert resources at outside shareholders' expense, the leak should lead to an increase in firm value because the transparency brought about by the leak reduces such activities in the future.

We begin our search for users of SOVs among all 23,540 listed firms, from 73 countries,

[1] See, for example, "The Panama Papers: How the world's rich and famous hide their money offshore," April 3, 2016, *The Guardian* (retrieved April 14, 2016).

that are covered by both Orbis and Datastream. For these firms, we obtain their top executives and board members, their subsidiaries, and the top executives and board members of their subsidiaries. This yields roughly 1.3 million subsidiaries and more than 1.8 million directors, spread across 211 sovereign and non-sovereign territories. We then look for connections between public firms and the offshore vehicles contained in the leaked data. Our search process, which we describe in detail in the Appendix, identifies 338 public firms as users of SOVs operated by Mossack Fonseca. These firms are spread across the globe and operate in a wide range of industries. The firms tend to be large, have more international operations, and are more exposed to perceptively corrupt countries, particularly where country leaders are implicated by name in the leaked data.

Since our data relate to one specific offshore service provider, it is important to understand whether our setting is representative of offshore service providers in general. To this end, we compare the clients of Mossack Fonseca, a controversial law firm in Panama, to the clients of a different offshore service provider, Appleby, whose data were similarly leaked in the so-called Paradise Papers. We find some evidence of specialization. According to media reports, Appleby's expertise is in tax strategies, and we confirm that its clients avoid significantly more tax than Mossack Fonseca's clients. Other than that, users of SOVs via these two offshore service providers have similar characteristics.

More broadly, we provide an estimate of the extent to which firms use SOVs. Even though estimates of the size of the offshore service market differ, sources agree that Mossack Fonseca had 5%-10% of the global market share for shell companies at the time of the Panama Papers leak. In our sample, 1.44% (=338/23,540) of sample firms use Mossack Fonseca as their offshore service provider. If firms use offshore service providers mutually exclusively, this would imply that between 14% and 29% (1.44/10=0.14 and 1.44/5=0.29, respectively) of all firms use SOVs. In

comparison, estimates are that 14% of firms engage in accounting fraud (Dyck, Morse, and Zingales 2014) and 25% of firms engage in some form of corruption (Karpoff, Lee, and Martin 2017).

To quantify how SOVs affect shareholder value we rely on event study techniques and find that users of SOVs experience significantly negative returns around three event dates associated with the leak: April 3, 2016, April 26, 2016, and May 9, 2016. On April 3, 2016, news organizations start reporting the Panama Papers leak; on April 26, 2016, the International Consortium of Investigative Journalists announces a database of the leaked data will be made public; and on May 9, 2016, the database is made public. We find that the leak reduces value of firms connected to the leak by 0.9% relative to other firms. This decline in value is driven by firms whose offshore activities are intense and were unobservable prior to the leak. In economic terms, the Panama Papers leak reduces the overall market capitalization of firms connected to the leak by $174 billion. This market response is the sum of the effects of several channels, and therefore a net effect. Our focus is on attempting to quantify the effects of three specific channels.

We consider the bribery channel first. Firms may use SOVs to finance bribe payments to win contracts tendered by corruptible government agents, and thereby create firm value (Beck and Maher 1986, 1989). Two examples from the news coverage of the Panama Papers leak illustrate this. One firm, a German conglomerate, used offshore vehicles, some of them operated by Mossack Fonseca, to run slush accounts that were used to bribe government officials. Another firm, an Italian contractor, used shell companies incorporated by Mossack Fonseca to pay bribes to win contracts for oil and gas infrastructure. The leak may result in fines for past violations of anti-bribery regulations, and the increased threat of discovery may discourage corporations from future bribes. In line with this idea, we find that the returns of firms connected to the leak are more

negative when they are also exposed to perceptively corrupt countries, and to countries where country leaders are identified as users of SOVs in the leaked data. For instance, firms connected to the leak and with a subsidiary in one of the 13 countries where country leaders are implicated by name are 0.9% more negatively affected than other firms connected to the leak.

Second, we examine the potential role of taxes. Firms may use SOVs to avoid, or even evade, taxes, thereby creating firm value. Consistent with this, the leaked data have prompted thousands of national tax evasion investigations and the creation of an international taskforce involving tax agencies from 30 countries, which highlights that the role of offshore vehicles in reducing taxes goes beyond tax avoidance. The leak may result in fines for past actions or lead to lower future tax avoidance, both of which may decrease firm value. We measure tax avoidance as that part of the statutory tax rate less firms' effective tax rates that is unexplained by firm, country, and industry characteristics. Due to the breadth of our sample—over 23,000 firms headquartered in 73 countries—this metric is general and may capture both tax avoidance and tax evasion. However, the surge in tax evasion investigations in relation to the leaked data (e.g., in Denmark and Germany), suggests that the leaked data also reveal instances of tax evasion, rather than merely instances of legal tax avoidance.[2] We find that tax avoiding firms connected to the Panama Papers are significantly more negatively affected by the leak.

We next examine the hypothesis that expropriation through SOVs can destroy shareholder value. In poorly governed firms, managers may find it easier to extract resources for their own gain. Consistent with this, following the Panama Papers leak there have been press reports of

[2] In the remainder of the paper, we use the term tax avoidance broadly, to include the whole spectrum of actions aimed at reducing taxes, ranging from less aggressive and more likely legal tax planning to more aggressive and more likely illegal tax evasion. As Hanlon and Heitzman (2010) note, the degree of legality of tax transactions is often determined after the fact.

directors being forced out under undisclosed circumstances, and at least one disclosed case of legal proceedings against a director who used SOVs operated by Mossack Fonseca to expropriate funds.[3] If offshore vehicles are indeed used to expropriate shareholders, we expect the leak to reduce such activities, and more so in weakly governed firms. We find precisely this result: For a range of firm-level governance variables, the negative valuation effect of the leak diminishes when governance is weak. Further, offshore sheltering should be more costly to shareholders in countries that feature high expropriation risk. Consistent with this, the negative effect on firms with exposure to the leak is less pronounced among firms headquartered in such countries, although statistical significance levels of these results are sensitive to the choice of country-level governance measure. Overall, the governance results suggest that shareholders in firms with SOVs can benefit from the additional transparency provided by the leak.

Our interpretation of the overall drop in value of implicated firms is that offshore sheltering enables value enhancing activities such as bribery and tax evasion. The Panama Papers leak destroys some of that value. Of course, some of the negative market response around the leak might be explained by regulatory fines for past actions. At the same time, we find that the drop in firm value also seems to reflect reduced future cash flows: Following the leak, firms with Panama Papers exposure reduce their tax avoidance significantly and experience a reduction in their activities in perceptively corrupt regions. Sales from perceptively corrupt regions, for instance, decline by 5% to 6% for exposed firms vis-à-vis unexposed firms.

We contribute to several strands of the literature. We contribute to the literature that broadly analyzes expropriation of resources by corporate insiders from outside shareholders (e.g.,

[3] See, for example, "Panama Papers: German authorities carry out first raids in connection with tax leaks," October 11, 2017, *DW*, retrieved March 2, 2018.

Lombardo and Pagano, 2002; Shleifer and Wolfenzon, 2002). Since diversion and tunneling by their very nature are frequently unobservable, this literature has exploited settings such as cross-country variation in shareholder protection (Johnson, La Porta, Lopez-de-Silanes, and Shleifer, 2000, Durnev and Kim, 2005), the Asian financial crisis (Johnson, Boone, Breach, and Friedman, 2000), and legal enforcement changes in emerging markets (Desai, Dyck, and Zingales, 2007).

Recent papers have highlighted the role of tax havens in facilitating expropriation of outside shareholders (Bailey and Lou 2016; Durnev et al. 2016; Bennedsen and Zeume 2018). Our paper contributes by pointing out a previously undocumented use of SOVs. Not only are SOVs used to expropriate outsiders, but also to violate sanctions, such as anti-bribery regulations. We establish that SOVs are used to finance bribe payments, thereby extending prior evidence on bribery provided by Karpoff, Lee, and Martin (2008, 2017), Cheung, Rau, and Stouraitis (2012), Lin, Morck, Yeung, and Zhao (2016), and Zeume (2017). Ultimately, SOVs may contribute to the costs of corruption documented elsewhere (e.g., Mauro 1995, Giannetti et al. 2018).

Further, to our knowledge, we are the first to identify over 300 international corporations as users of SOVs. Specifically, we focus on offshore vehicles that are unknown to outside investors with access to commercially available databases.[4] Prior work has focused on observable offshore activities, using data on the multinational affiliates of firms (Faulkender and Smith 2016), subsidiaries of U.S. firms from 10-Ks (Dyreng and Lindsey 2009), subsidiaries of global firms (Bennedsen and Zeume 2018), or detected tax shelter cases from news reports (Graham and Tucker 2006).[5] While self-reported or detected offshore activities help identify the costs and benefits

[4] Whether or not firms would have been required to report some of the vehicles uncovered by the Panama Papers data leak is outside the scope of our paper. See, for example, Dyreng et al. (2018) for an analysis of subsidiary disclosure in the U.S.

[5] Some prior work has relied on Tax Information Exchange Agreements, which allow tax authorities to exchange information with tax havens, to show that observable tax haven activities affect round-trip tax evasion (Hanlon, Maydew, and Thornock 2015) and bank deposits (Johannesen and Zucman 2014).

associated with tax haven activity, such observable activities may differ from secret ones along dimensions that correlate with whether and how they create firm value. We instead rely on firms that are detected for an exogenous reason, a leak of the offshore service provider's data. Not least because of this, our analysis highlights the role played by offshore service providers as enablers of corporate offshore activities.

1. Institutional background, hypotheses, methodology, and data

In this section, we discuss the institutional background of the Panama Papers data leak. We then develop our empirical hypotheses, describe our empirical methodology, and discuss our sample construction and data sources in detail.

1.1 The Panama Papers data leak

On April 3, 2016, the news media reported a leak of confidential documents concerning the business activities of Mossack Fonseca, a Panamanian law firm and offshore service provider. Known as the Panama Papers, the leak included 2.6 terabytes of data, or 11.5 million confidential documents. This makes it one of the largest data leaks to date. The documents provide insights into the uses of more than 214,000 shell companies in tax havens around the world over the past 45 years. Of the 214,000 vehicles that appear in Mossack Fonseca's files, 90% are incorporated in just four tax havens: the British Virgin Islands (114,000 firms), Panama (48,000), the Bahamas (16,000), and the Seychelles (15,000).

Following this initial event, which we refer to as Day 1, we identify two additional event dates relevant for our analysis: April 26, 2016 (Day 2) and May 9, 2016 (Day 3). On Day 2, the International Consortium of Investigative Journalists (ICIJ) announced that a searchable database of the leaked data will be made public. On this date, anyone with private information about the exposure of specific firms learns that their informational advantage will disappear on Day 3. Then,

on Day 3, the searchable database is indeed made available through ICIJ's website. The database contains information on all entities incorporated by Mossack Fonseca, as well as relationship information between entities, and individuals such as shareholders and directors attached to the entities.

In our analysis, we focus on Days 1 to 3 as the three event dates of the leak. Further aspects on the leaked data are discussed in Appendix A. As we explain there, investors did not have information about the data leak prior to April 3.

1.2 Hypotheses

The Panama Papers data leak constitutes a rare opportunity to examine how firms use SOVs and opaque corporate structures more generally. Existing theory has focused on the tradeoff between the use of opaque corporate structures in the interest of firm value and their use by corporate insiders in their own interests (for example, Shleifer and Wolfenzon 2002; Desai, Dyck, and Zingales 2007). In the following, we discuss three specific motivations for corporate insiders to use SOVs, we discuss how these uses may affect firm value, and what predictions follow from the data leak if these channels were at play. Specifically, we focus on the bribery channel, the tax channel, and the expropriation channel.

First, the veil of secrecy[6] associated with SOVs may help firms finance corruption and make hidden bribe payments to win business. However, bribery is illegal under the provisions of the U.S. Foreign Corrupt Practices Act of 1977, the OECD Anti-Bribery Convention, and the U.K. Bribery Act of 2010. If the Panama Papers data leak reveals such activities, implicated firms may

[6] What is unobservable to outsiders (secret) prior to the leak is *how* a firm is generating (some) of its cash flows, while the cash flows themselves may be observable. For instance, in the case of bribes, a firm may generate revenues in corrupt countries by using bribes, and these revenues are observable prior to the leak. The Panama Papers therefore do not necessarily reveal new information about cash flows of the firm per se, but how these cash flows were generated.

be subject to regulatory fines. Also, implicated firms may find it optimal to stop using bribes because the leak increases the detection probability, thereby increasing the expected costs of violating anti-bribery regulations. Bribery has been shown to benefit shareholders (Cheung, Rau, and Stouraitis 2012; Karpoff, Lee, and Martin 2017; Zeume 2017). Therefore, if SOVs are used to finance bribe payments, we would expect the revelations of the data leak to reduce firm value. We also expect that, following the revelations of the data leak, firms reduce their activities in perceptively corrupt regions where they are more likely to encounter corruptible government agents.

Second, SOVs may be used to avoid, or evade, corporate taxes. Revealing firms' secret tax structures may result in regulatory fines for past tax evasion or in penalties for overly aggressive tax avoidance conducted in the past. Revelations of tax avoidance schemes, such as transfer pricing arrangements, may also make such strategies harder to defend to regulators. If tax strategies generate free cash flows and therefore increase firm value, as argued in Desai, Dyck, and Zingales (2007), we would expect the revelations the data leak to reduce firm value. As it becomes costlier to maintain such tax strategies, we also expect that firms reduce their tax avoidance in response to the data leak.

Finally, if it were only for the bribery channel and the tax channel described above, the use of SOVs would unambiguously create firm value and the Panama Papers data leak would destroy firm value. However, the veil of secrecy created by offshore vehicles may also allow insiders to divert corporate resources at the expense of outside shareholders. Large-scale evidence of this is provided by Bailey and Liu (2016), Durnev, Li and Magnan (2016), and Bennedsen and Zeume (2018), and prominent cases such as Enron and Parmalat provide anecdotal evidence that SOVs enable insiders to expropriate corporate resources. The Panama Papers data leak makes

expropriation costlier to hide, thereby reducing expropriation. If expropriation by insiders destroys firm value, we expect the data leak to increase firm value.

The overall market response to the Panama Papers leak is the sum of the effects of each of the channels discussed above, and therefore a net effect. The leaked data allow us to identify connected firms and to exploit cross sectional variation in firm characteristics to understand the channels through which offshore vehicles contribute to firm value.

1.3 Methodology

We use event study techniques to analyze the market response of firms connected to the Panama Papers data leak, around its announcement. For our baseline estimates, we run the following regression:

$$CAR_i = \alpha + \beta PanamaPapersExposure_i + \gamma` \boldsymbol{X_i} + \varepsilon_i, \quad (1)$$

where CAR_i denotes the cumulative abnormal return (CAR) of firm i around the three event days relevant to the leak, $PanamaPapersExposure_i$ indicates whether (1) or not (0) our data identify firms as users of SOVs exposed in the Panama Papers, $\boldsymbol{X_i}$ contains controls measured before April 2016, including country and industry fixed effects, and ε is an error term. The coefficient of interest, *ß*, captures whether exposure in the leaked documents impacts firm value. In parts of our analysis, we augment equation (1) with additional firm characteristics and their interaction with $PanamaPapersExposure_i$ to test whether certain types of activities are priced. We use two-way clustering (country and industry), and find that alternative clustering dimensions do not change any of our conclusions.

Our event study methodology follows that in Karpoff and Malatesta (1989), Karpoff et al. (1996), and Zhang (2007). All of our results are robust to using alternative methodology as in

Binder (1985), Brown and Warner (1985), and Campbell, Lo, and MacKinlay (1997), among others. To alleviate concerns that event-day clustering may bias our coefficient estimates, we alternatively use calendar time portfolio and Fama-MacBeth approaches that follow Schipper and Thompson (1983).[7]

To analyze the real implications of the Panama Papers data leak we estimate:

$$Y_{i,t} = \alpha_i + \alpha_t + \beta_1 \, PanamaPapersExposure_i \, x \, PostLeak + \gamma` \boldsymbol{X_{i,t}} + \varepsilon_{i,t}, \qquad (2)$$

where $Y_{i,t}$ is an outcome for firm i at time t (e.g., regional sales or tax avoidance), α_i and α_t denote firm and time fixed effects, and *PostLeak* is a dummy variable set equal to one for observations that are made after April 2016. In these panel regressions, standard errors are two-way clustered by country and time.

1.4 Data and variable construction

We search for connections between public firms and the SOVs contained in the leaked data by combining the ICIJ database with subsidiary and director data of all publicly listed firms in Bureau van Dijk's Orbis database as of December 2015.[8] Firm financials and market data are obtained from Datastream/Worldscope and Orbis. We additionally rely on data from BNY Mellon, FactSet (Lionshares), KPMG, ICRG, Thompson Reuters ASSET4, Transparency International, and the World Bank. All firm characteristics are based on pre-April 2016 data to ensure that they are unaffected by the leak. In this subsection, we focus on the main variables of interest. The

[7] Specifically, we construct daily abnormal returns of portfolios of firms that are exposed and unexposed to the Panama Papers data leak over days [-20;144] relative to April 3. We then explain these portfolio returns using date fixed effects, a control for the portfolio of firms exposed to the Panama Papers, and event date dummies interacted with Panama Papers exposure. Alternatively, we run seemingly unrelated regressions following equation (1) for every event date in [-20;144]. We then establish whether the resulting Panama Papers exposure coefficients are economically and statistically different on relevant event dates when compared to non-event dates.

[8] Although outside the scope of our paper, the Panama Papers also contain data on the use of offshore vehicles by individuals and legal entities other than publicly traded firms (such as private firms and governing bodies).

complete list of variables and their definitions is in Appendix B.

1.4.1 Exposure to the Panama Papers

The corporate use of a tax haven entails corporate insiders creating and operating an offshore vehicle, typically with the help of an offshore service provider. We focus on those cases where the offshore vehicle serves to conceal activities and information from outsiders. In our empirical setting, the corporate insiders are a firm's executives, its board members, and the executives and board members of all of the firm's subsidiaries; the offshore service provider is Mossack Fonseca; and the offshore vehicle(s) are secret and unobservable to outsiders. In this setting, what information is revealed to outside investors by the data leak and how do we identify whether publicly traded firms use SOVs?

In Figure 1 we illustrate the observable and secret activities of a stylized firm in our sample. In the Figure, the firm operates four offshore vehicles. Offshore Vehicle 1 is observable since the firm reports it as a subsidiary in its public filings. Offshore Vehicles 2 - 4 are secret, and outside investors do not know about their existence.

-- Figure 1 about here --

Crucially, the data contained in the Panama Papers allow us to identify the connection between the firm and Offshore Vehicles 2 to 4. In short, we use multiple data sets extracted from the Panama Papers to establish a link: "entities" hold information on the offshore vehicles themselves, "officers" and "intermediaries" hold information on the individuals and legal entities responsible for the operation of these offshore vehicles. We match this information to the observable corporate insiders of listed firms worldwide, extracted from the Orbis database, using string-matching algorithms and then verifying all resulting matches manually. We explain this

process in detail in Appendix A.

From this matching procedure, we develop our key variable of interest: *Has Panama Papers Exposure*. This variable indicates whether (1) or not (0) any officer of a public firm, a subsidiary of a public firm, or any officer of a subsidiary of a public firm is recorded as an intermediary or an officer in the leaked documents. This variable identifies firms that are exposed to the Panama Papers data leak.

1.4.2 Measures of firm value

We quantify the impact of the Panama Papers data leak on firm value using several alternative stock return measures around our three event days. In our main specification, we use cumulative daily raw and abnormal returns for [-1;3] event windows around each of the three event days of the leak. For Sunday, April 3, a non-trading day, we move the event date to the next trading day, Monday, April 4.

We obtain daily stock prices from Datastream and apply standard data filters of dropping penny stocks (prices below $0.10), stocks not actively traded (no price changes between March 31, 2016 and April 6, 2016), and firms with assets below $5 million. We winsorize returns at the 1 and 99 percentiles to remove outliers. In addition to using raw returns, we calculate abnormal returns from a one-factor model estimated for March 4, 2015 to March 3, 2016 (i.e., for the year ending one month before the first event date). We require stocks to have at least 100 non-missing return observations during that period. Where local market indices and risk-free rates are not available, we obtain stock prices in U.S. dollars and use the U.S. market index (CRSP Value-Weighted Return) and U.S. T-bill as the market index and risk-free rate, respectively (11 out of 73 sample countries). For additional robustness tests, we expand this to 3- and 5-factor models using data from Kenneth French's data library.

1.4.3 Other firm characteristics

We construct measures of firms' exposure to corruption, firms' tax avoidance and potential for expropriation. *Has Political 1St Layer Exposure* indicates whether (1) or not (0) a firm has at least one subsidiary in any of the 13 countries where current and former heads of state and heads of government were implicated by name in the Panama Papers leak by May 9, our last event date. We use subsidiary data for 2015 from Orbis to identify subsidiaries from Argentina, Georgia, Iceland, Iraq, Italy, Jordan, Moldova, Pakistan, Qatar, Saudi Arabia, Sudan, Ukraine, and the United Arab Emirates. To capture the idea that firms exposed to perceptively corrupt countries are more likely to face corrupt government officials that may request bribe payments, we construct *Corruption Exposure*, which indicates whether (1) or not (0) a firm via its subsidiaries is exposed to the most perceptively corrupt tercile of countries using Transparency International's Corruption Perception Index. The results are robust when we use a continuous *Corruption Exposure* measure as in Zeume (2017), yet the results are less intuitive to interpret.

We construct two measures of tax avoidance. *Tax Avoidance* (*no FE*) is the residual of a regression where we regress a firm's statutory tax rate at the country level less a firm's effective tax rate on the explanatory variables' return on assets, intangible assets divided by total assets, and losses of the previous year (if any) scaled by assets. *Tax Avoidance* (*FE*) additionally controls for industry and country fixed effects. The effective tax rate is defined as tax divided by EBIT; observations with negative EBIT are denoted as missing. The construction of these variables follows Chen et al. (2010), Desai and Dharmapala (2006, 2009) and Frank et al. (2009), though

we are limited to data items that are available across countries.[9]

Expropriation can be facilitated by weak institutions and by lack of monitoring. At the country level, we measure expropriation risk with commonly used indices, including protection of property rights (Djankov et al. 2010), ICRG country risk ratings (PRS Group), the Anti-Self Dealing Index (Djankov et al. 2008), and protection of minority shareholders (World Bank). These measures capture the extent to which individuals are protected from expropriation by the government and insiders. For each index, we construct an expropriation measure indicating whether (1) or not (0) a country ranks above the median (i.e., has high expropriation risk). All results are robust to using continuous measures instead.

At the firm level, we use five measures of firm governance to capture the degree to which monitoring affects conflicts of interest between principals and shareholders. We use *Foreign Institutional Ownership*, shown by Aggarwal et al. (2011) to promote firm governance, and the *Governance Score* provided by Thomson Reuters' ASSET4 database, which aggregates, for a subset of our sample, firms' governance quality. Further, we measure firms' exposure to U.S. regulations and potential enforcement actions. Cross-listings subject firms to U.S. regulations (Coffee 1999, 2002; Stulz 1999; Doidge 2004; Doidge, Karolyi, and Stulz 2004, 2010; Lel and Miller 2008). We use data from BNY Mellon and split ADRs into unsponsored ones (*Has unsponsored ADR*) that are subject to less stringent regulatory requirements and those that are sponsored (*Has sponsored ADR*) and hence subject to more stringent requirements. We also capture exposure to U.S. regulations and enforcement arising from having any U.S. subsidiaries

[9] See also Dyreng et al. (2008, 2010), Dyreng and Lindsey (2009), and Hanlon and Heizman (2010) for discussions on the interpretation of effective tax rate measures and tax avoidance measures. Note that Chen et al. (2010) refer to their variables as tax aggressiveness measures. Our results are robust to several alternative specifications: (i) measuring tax avoidance as the statutory tax rate at the country level less a firm's effective tax rate, (ii) controlling for country times industry fixed effects, and (iii) using ten-year averages of effective tax rates and profitability to construct our tax avoidance measure.

(*Has U.S. Subsidiary*).

2. Descriptive statistics

We compare firms with and without exposure to the leak in Table 1 and provide detailed summary statistics for our sample in Appendix C. In the sample, 338 (1.44%) of all 23,540 firms are identified as using SOVs. We find that firms connected to SOVs are substantially larger, have more subsidiaries, and are more exposed to foreign countries, tax havens, and perceptively corrupt countries than unconnected firms. Firms that use SOVs are also better governed, but are not different with respect to their tax avoidance. Since firms connected to SOVs are substantially larger and may be concentrated in certain countries and industries, we repeat this analysis using probit regressions that control for size and country and industry fixed effects. Using this procedure, we find that firms with exposure to the Panama Papers are no longer significantly different from other firms in terms of tax avoidance, foreign institutional ownership, and their propensity to be cross-listed. Yet such firms still have substantially more subsidiaries, and more foreign ones, have more tax haven activity, and are more exposed to corruption than unconnected firms. In a similar test, we also match firms by country and size (nearest neighbor, discarding firms that cannot be matched within 30% of their respective size) and confirm the results of the probit regressions. To alleviate concerns that our later results might be due to firm size, we control for size throughout our analysis and ensure that our regression results are robust in a sample of only treatment and matched firms.

-- -- Table 1 about here -- --

Of the 338 firms connected to SOVs in the Panama Papers, most are connected through lower-ranked executives and board members of subsidiaries, rather than through firms' own executives and board members. Appendix A (Table A2) shows this decomposition of connections.

Across industries, the use of SOVs is wide spread, and only a minority of industries has no firms with Panama Papers exposure (Appendix D, Table D1). Across the sample, there is variation in the use of SOVs, with the heaviest use in Hong Kong, where roughly one in six firms uses SOVs, and in the U.K., where it is roughly one in nine firms. The U.S. is roughly average with 1.7% of firms using SOVs through Mossack Fonseca. While interesting, these cross-country differences are at least partially driven by two relatively mechanical factors: First, Mossack Fonseca's market share for offshore vehicles differs across countries. Second, within a country, offshore vehicle users can be either corporations or individuals (or other legal entities).[10]

Our estimate of the propensity of firms to use SOVs is likely conservative for several reasons. First, Mossack Fonseca is not the only offshore service provider. Sources agree that the company held a mere 5%-10% of the global market for shell companies at the time of the Panama Papers leak; therefore, users of other offshore providers will therefore go undetected through this data leak.[11] Second, even the Mossack Fonseca data do not always allow identification of ultimate beneficial owners. Nominee *directors* or nominee *shareholders*, or both, may be used in offshore vehicles, making the identification of connections to listed firms difficult or impossible.[12] Further, we are also unable to identify listed firms that are connected to offshore vehicles by specific

[10] To illustrate this, consider Switzerland as an example. None of the 210 listed sample firms in Switzerland are users of SOVs through Mossack Fonseca, while at the same time Switzerland is the second most frequent user (after Hong Kong) to appear as a location reference in the Panama Papers (Appendix A.2, Table A1). This may indicate that Swiss firms do not use SOVs, or it may indicate that when they do, their offshore service provider is not Mossack Fonseca. What is unambiguous is that a significant part of the offshore vehicles operated by Mossack Fonseca have *some* connection to Switzerland. This is also highlighted by the large number of offshore vehicles located (but not incorporated) in Switzerland (see Appendix A.2, Table A1).

[11] See, for example, "A torrential leak," April 9, 2016, *The Economist* (retrieved April 14, 2016). No revenue data of any type are available for Mossack Fonseca. The global market for corporate services in 2014 was estimated to be roughly $6 billion (EUR 5.6 billion, see Intertrust IPO prospectus, October 5, 2015, p. 120).

[12] Offshore vehicles can use nominee directors (i.e., individuals that stand in for the true owners but exercise no real power since they have pre-agreed to act upon instruction of another party), and nominee shareholders (i.e., individuals or companies that stand in for the true shareholders but have no real power, since they have pre-agreed to transfer ownership to another party). A package of nominee directors and nominee shareholders, combined with a third party, such as a private bank, handling all interactions with Mossack Fonseca, can hide the identity of the beneficial owner even from Mossack Fonseca itself.

individuals if those individuals are not reported in the Orbis data (such as lower level managers). Underestimating the number of implicated firms might bias our analysis against finding significant announcement returns of the leak. This is because firms that use SOVs but cannot be identified will become part of the control group.

Since our data relate to one specific offshore service provider, it is interesting to ask whether our setting is representative of offshore service providers in general. To this end, we compare the clients of Mossack Fonseca, a potentially controversial law firm in Panama, to the clients of a different offshore service provider—Appleby—whose data were similarly leaked in the so-called Paradise Papers, in October 2017. We summarize the results (see Table D2 in the Appendix) here: Users of Appleby, just like users of Mossack Fonseca, are larger, have more subsidiaries, and are more exposed to foreign countries, tax havens, and perceptively corrupt countries than non-users. This alleviates some selection concerns that may arise from observing only one offshore service provider.

Second, we find some evidence of specialization. According to media reports, Appleby's expertise is in tax strategies, and we confirm that its clients avoid more tax than Mossack Fonseca's clients. Other than that, the users of SOVs via either offshore service provider have similar characteristics. For example, we find no consistent differences in governance quality or exposure to perceptively corrupt countries between clients of either offshore provider, suggesting no obvious matching on these characteristics.

3. Market response to the Panama Papers data leak

We begin by documenting our baseline effect of the Panama Papers leak on firm value, using cumulative raw and abnormal returns around the leak. We then analyze day-by-day returns and cross-sectional characteristics of firms' use of SOVs.

3.1 Main result

Table 2 shows the results of our analysis of firms' exposure in the Panama Papers. The dependent variables are *Cumulative Raw Return* (*CRR*) and *Cumulative Abnormal Return* (*CAR*) around the event dates of the leak. Panel A presents the results of a univariate split by *Has Panama Papers Exposure*, which indicates whether (1) or not (0) a firm is a uses SOVs. Panels B and C show the results of multivariate analysis and additional robustness tests, respectively.

--- Table 2 about here ---

Firms connected to the Panama Papers have negative *CRR*s during the event window that are 2.4% lower than those of unconnected firms. Matching by country and firm size reduces this return differential to 1.1%. For *CAR*s, connected firms lose 1.4% and 0.8% relative to unconnected firms in full and matched samples, respectively. In the regressions for Panel B, we introduce additional controls. When controlling for size, country and industry fixed effects, connected firms have 1.3% lower *CRR*s and 0.9% lower *CAR*s than unconnected firms. We use the more conservative 0.9% *CAR* as our baseline estimate of the loss of market value. We obtain the overall market impact of the leak by multiplying each firm's market capitalization at the end of 2015 by its CAR. In economic terms, the leak reduces the overall market capitalization of firms connected to the leak by $174 billion. We obtain quantitatively similar results when we instead multiply firms' market value at the end of 2015 by the average percentage drop in firm value net of country and industry fixed effects.

One concern is that the significance levels in these tests are influenced by event date clustering, since all firms with exposure have the same event date. We therefore repeat our analysis using approaches that alleviate such concerns. Using a portfolio approach, we continue to find that exposed firms earn economically and statistically significant negative *CAR*s (Panel C, column (1)).

The economic magnitude of -1.95% is somewhat larger than our baseline effect, but this method does not control for country and industry fixed effects, or firm size. We also implement a Fama-MacBeth approach, using seemingly unrelated regressions for abnormal one-day returns. In column (4), we find that the coefficient for firms with Panama Papers exposure is significantly negative at -1.1% on the relevant event dates.

Overall, firms that use SOVs are adversely affected by the data revelations of the Panama Papers, indicating that the SOVs established by Mossack Fonseca ex ante generate firm value on average. We perform a number of additional robustness tests and report the results in Appendix D (Table D3). These show that 1) multifactor models yield very similar abnormal returns, 2) models with local factors similarly yield comparable results, and 3) we do not find evidence of abnormal returns prior to the leak, nor do we find reverting returns in the three weeks following the event.

3.2 Day-by-day results

We have documented that firms that use SOVs experience negative returns around the data leak. We next decompose the data leak event and consider each of the three event dates individually. As outlined above, Day 1 is day the news media reported the Panama Papers leak, Day 2 is the announcement by ICIJ that the leaked data will be made public, and Day 3 is the day the leaked data were made public in a database. We find a negative market response on all three event dates, with the largest response of -0.6% on Day 2 (Table 3, Panel A).

--- Table 3 about here ---

This may seem counterintuitive, given that investors can presumably identify firms only on Day 3, when the database became public. However, Day 2 is informative for some investors. Specifically, by making an informed guess about which firms will likely be exposed on Day 3, and

by trading accordingly on Day 2 rather than on Day 3, a sophisticated trader may front-run other traders. In guessing which firms will be exposed, sophisticated investors may identify firms that are ultimately *truly exposed,* along with others that are ultimately *not exposed*. The testable implications are that on Day 2, ex post truly exposed firms and not exposed ones will have the same market response, while on Day 3, when it becomes possible to distinguish truly exposed from not exposed firms, the former should have a more negative price response.

While it is impossible for us to observe the information set available to sophisticated traders to identify candidate firms on Day 2, we design two plausible proxy strategies. The first strategy is to predict a firm's exposure to the data leak by whether that firm has observable tax haven operations. This may be an informative signal, since even observable offshore activities are associated with potentially dubious activities (e.g., Bailey and Liu 2016; Durnev, Li, and Magnan 2016; Bennedsen and Zeume 2018). Under this strategy, we classify firms as candidates if they have a subsidiary in one of the top four tax havens used by Mossack Fonseca (the British Virgin Islands, Panama, the Bahamas, and the Seychelles). The second strategy is to predict firms' exposure to the data leak by using information about firms' history of financial misconduct. For this, we identify cases of detected misconduct from three of the data sources discussed by Karpoff et al. (2017). Using these both strategies, a total of 1,083 firms of our global sample have a subsidiary in any of the top four tax havens, 1,178 firms appear in one of the misconduct data sets, and some firms appear in both.

We test whether investors trade on Day 2 using predictions of which firms will ultimately be exposed by repeating the day-by-day analysis in the sample of firms that are likely exposed to the Panama Papers data leak by either of the two strategies. In Panel B of Table 3, we find that firms that are later exposed by the Panama Papers data leak have no different returns vis-à-vis

firms that are ultimately not exposed to the leak on Day 1 and Day 2. However, exposed firms have significantly more negative returns vis-à-vis unexposed firms on Day 3 (-0.8%). The effect is stronger in the subset of firms that have had cases of financial misconduct (columns (7)-(9)) but qualitatively also present among firms with observable tax haven exposure (columns (4)-(6)).

Taken together, these results support the hypothesis that sophisticated traders attempt to identify which firms will ultimately be exposed to the Panama Papers data leak and trade accordingly on Day 2. In additional tests, we also investigate whether abnormal trading activity can be detected around the leak among short sellers, insiders, and institutional investors, but find no such evidence (see Appendix E).

3.3 Characteristics of firms' connections to offshore activities

We also test whether the specific ways in which firms are connected to SOVs matter. For instance, according to Mossack Fonseca's internal data, many vehicles had been "deactivated" at some point in the past prior to the Panama Papers leak: 69% of firms exposed to the leaked data have active links, while the remaining 31% deactivated their offshore vehicles an average 6.1 years ago (summary statistics are in Appendix D, Table D4). The use of some offshore vehicles dates back decades, and even though the median firm has exactly one connection to the leaked data, some firms are much more tightly linked. The average firm has 9.9 connections and one firm has 591 connections. The average firm has 3.8 active connections at the time of the leak. For the average firm, these connections go to several distinct offshore vehicles, but they are almost always established by one or a small number of officers of the firm, suggesting that specific individuals handle a number of vehicles simultaneously.

In Table 4, we analyze whether the dynamics of these connections influence the market

response. We find that firms with stronger ties to the offshore world (more connections, more officers involved, more vehicles used) have more negative returns around the leak. The market response, however, does not significantly depend on whether the vehicle is in active use (or has been deactivated), or how long ago the use of the offshore vehicle presumably stopped. This may suggest that at least some of the share price decline is reflecting expected fines for past corporate misbehavior revealed by the leak.

--- Table 4 about here ---

Our analysis focuses entirely on secret offshore activities but the data leak also reveals some offshore activities that were plausibly observable prior to the leak. We can therefore investigate whether our main effect—the drop in value of firms that use SOVs—is also present in observable offshore activities. For these tests (see Appendix D, Table D5), we additionally include 59 firms that are connected to the leaked data through an offshore vehicle that was not secret in the sense that outside investors could plausibly observe its existence, as a subsidiary. Consistent with outside investors pricing new information about offshore activities previously unknown to them, the results show that the loss in firm value is entirely driven by the revelation of secret offshore activities. Using the full specification, firms whose secret offshore activities are revealed by the leak lose 0.9% of firm value, while observable activities do not contribute to this loss.

4. Benefits and costs of offshore secrets

We have so far established that firms use SOVs and that the Panama Papers data leak has a negative aggregate impact on firm value. We next investigate the three specific channels that may, in theory, explain the corporate use of SOVs: bribing foreign government officials (the bribery channel), saving taxes through tax avoidance or tax evasion (the tax channel), and diverting corporate resources (the expropriation channel).

4.1 The bribery channel

Corporations may use SOVs to finance corruption, which may create shareholder value. We use event study techniques to test this idea. The results in Panel A of Table 5 show that among firms connected to the Panama Papers, having a subsidiary in a country where government leaders are implicated by name in the data leak is associated with more negative abnormal returns. The effect is not statistically significant in the subset of firms connected to the Panama Papers (column (1)) but statistically significant in the full sample (columns (2)-(3)).[13] Firms that have both subsidiaries in countries where government leaders are implicated and exposure to the Panama Papers experience a reduction in firm value of 0.9%, which translates into a $274.7 million more negative market value response per firm on average, or $39.6 billion when aggregated over these 144 firms (column (3)).

-- Table 5 about here --

We also use an alternative measure of exposure to corruption (columns (4) to (6) in Table 5). Firms with Panama Papers exposure and subsidiaries in the most perceptively corrupt countries are again more negatively affected. Specifically, having subsidiaries in perceptively corrupt countries and being exposed to the leak is associated with a 1.2% more negative share price response, which translates into a $256.8 million more negative market value response per firm on average, or $58.6bn aggregated over these 228 firms (Column (6)).

As outlined in the hypothesis section, the decline in value for firms with exposure to both

[13] One explanation of why the coefficient is economically smaller in the subset of firms with Panama Papers exposure is that countries where government leaders are implicated by name in the data leak also experience positive (economic) news around dates relevant to the data leak. Stock index returns in those countries are positive around relevant event dates (+0.8%), while stock index returns in all other countries are negative (-1.0%) on average. The specifications in the regressions for columns (2) and (3) alleviate concerns arising from such difference in returns by including all firms, allowing for controlling for exposure to countries where government leaders are implicated by name in the data leak, Panama Papers Exposure, and the interaction of the two.

corrupt countries and the Panama Papers data leak may be explained by expectations that firms will be fined for past violations of anti-bribery regulations. Indeed, anti-corruption authorities around the world have started using the leaked data to investigate individuals and firms.

Similarly, the decline in firm value may be because firms stop using bribes in the face of higher detection probabilities. In this case, we would expect firms implicated by the leak to experience lower sales in more corrupt countries after the event. We test this possibility by estimating equation (2) using quarterly data on subsidiaries and their revenues.[14] The results are shown in Panel B of Table 5. We find that after the leak, firms with exposure to the Panama Papers experience a reduction in economic activity in locations where country leaders are implicated by the leak and in the most perceptively corrupt countries. For instance, relative to firms not implicated by the leak, implicated firms experience a 5% to 6% reduction of sales in these regions (columns (1) and (4)). Implicated firms also have a reduced subsidiary presence in locations where country leaders are implicated by the leak (columns (2) to (3)). These estimates of negative real effects may be conservative if the impact on firms' operations is not instantaneous; for instance, if firms have long-term contracts in perceptively corrupt countries.

Taken together, these results are in line with the idea that SOVs may have been used to bypass anti-corruption regulations. The leak's real implications for revenues from countries prone to corruption suggest a reduced ability for firms to win business in such locations following the leak.

4.2 The tax channel

SOVs may also be used to avoid, or even evade, taxes. We test this idea by studying

[14] The sample consists of 7,538 firms for whom quarterly data on subsidiaries and their revenues are available at least once prior to the data leak (2014:Q2 to 2016:Q1) and at least once after the data leak (2016:Q2 to 2017:Q1).

whether tax avoiding firms with exposure to the Panama Papers leak are differentially affected around the leak.

In Table 6, we find that, among firms connected to the Panama Papers, the ones that are also more tax avoiding have significantly more negative returns around the leak (column (1)). When we extend our analysis to the full sample of firms, this effect is still present and statistically significant (columns (2) and (3)). This test alleviates concerns that tax avoiding firms are negatively affected around the event for reasons unrelated to the leak. Our results are similar when we use an alternative tax avoidance measure that also incorporates industry and country characteristics (columns (4)-(6)). Economically, a one standard deviation increase in tax avoidance is associated with a 0.75% (=26.2%*2.859%) more negative firm value response in column (1) and the economic magnitude is similar across specifications.

--- Table 6 about here ---

These results are consistent with firms being expected to be fined for past tax evasion or overly aggressive tax avoidance. Another (not mutually exclusive) explanation for the decline in firm value is that firms respond to the Panama Papers leak by reducing their tax avoidance activities. We test this by estimating equation (2) using annual tax avoidance data as the dependent variable.[15] The results, shown in Panel B of Table 6, confirm the idea that part of the drop in firm value reflects a reduction in future tax avoidance. In column (2) of Table 6, tax avoidance declines by 26% (=6.7%/25.8%) of one standard deviation (by construction, the tax avoidance measures have a mean of zero, making the expression of economic effects relative to the mean less useful).

This finding—that implicated firms avoid less tax after the leak—also helps address an

[15] This sample includes 8,832 firms for whom yearly data are available to construct our measures of tax avoidance at least once prior to the data leak (fiscal year end before 2016Q2) and at least once after the leak.

alternative interpretation of our results. Specifically, the abnormal returns we observe might be due to investors learning about managerial types from the data leak. Using taxes as an example, shareholders might learn that managers, by avoiding taxes, attempted to do something better than expected (for shareholders). This should lead to a positive market reaction to the data leak. Since we observe an overall negative market response, the effect of learning about managerial type will at best be economically small. More importantly however, shareholder learning should not on its own lead to a reduction in tax avoidance following the leak, but we find exactly that reduction. We cannot econometrically estimate such shareholder learning, and therefore acknowledge that it might be a possible driver of the overall stock market response, but also note that this alternative hypothesis cannot explain all of our results.

4.3 The expropriation channel

The two channels documented so far suggest that SOVs can be used to create firm value. But at the same time, the veil of secrecy associated with SOVs may also allow insiders to divert corporate resources at the expense of outside shareholders. As outlined in the hypothesis section, we predict that firms with weak governance are less adversely affected by the Panama Papers data leak. This is because diversion of resources is more likely in such firms, and the leak makes diversion more costly.

4.3.1 Firm-level governance

Starting with firm-level governance, we formally test this idea by interacting *Panama Papers exposure* with various measures of governance. Note that for all of our firm-level governance measures, lower values indicate weaker governance. All results are reported in Panel A of Table 7. Generally, better governance is associated with more negative returns for firms connected to the Panama Papers, indicating that weak governance firms are less adversely affected.

In column (1), firms with high foreign institutional ownership are significantly more negatively affected when implicated in the leaked data, with Aggarwal et al. (2011), among others, showing that foreign institutional ownership improves governance.

--- Table 7 about here ---

In column (2), for the subsample for which the Thomson Reuters *Governance Score* is available, firms with exposure to the leak and high governance scores are more adversely affected by the leak. This, again, is in line with an interpretation in which weakly governed firms are less adversely affected because the leak essentially shuts down expropriation, while some of the value created offshore by strongly governed firms is erased by the leak. Further, the negative market reaction is larger for offshore vehicle users that are cross-listed with sponsored ADRs, and that have U.S. subsidiaries, while there is no incremental effect for firms with unsponsored ADRs (columns (3)-(5)).[16] We interpret such U.S. exposure as a sign of better governance that makes expropriation less likely, which is in line with our previous results. An alternative interpretation could be the greater exposure such firms have to potential U.S. regulatory enforcement actions in the wake of the leak. Examples include fines for violations of the 1977 Foreign Corrupt Practices Act and the 2002 Sarbanes-Oxley Act.

Our preferred interpretation of these firm-level governance results is that the data leak reduces the cost of expropriation associated with SOVs. However, an alternative interpretation is that weakly governed firms merely benefit less from SOVs. For instance, managers in such firms might be ex ante under less pressure to engage in tax avoidance. In additional tests that are

[16] In line with prior work, we run additional tests where we further distinguish sponsored OTC-traded (Level I) from sponsored exchange-traded (Level II/III) ADRs. As expected, economically, the effect is strongest among firms with exposure to the leaked data and exchange-traded sponsored ADRs. However, the number of firms with both exposure to the Panama Papers and Level II/III ADRs is too small to allow for meaningful statistical tests.

available upon request, we test this idea but find that firm-level governance and tax avoidance are uncorrelated. Moreover, one testable prediction of this alternative interpretation is that weakly governed firms should not avoid less tax after the data leak, i.e. that the reduction in tax avoidance we find in Table 6 should be driven by strong governance firms. However, we find that weakly governed firms reduce their tax avoidance to the same degree as firms with strong governance, suggesting that this alternative interpretation does not explain our results.

4.3.2 Country-level expropriation

To support our interpretation of the firm-level results, we next turn to country-level evidence. The leak should make expropriation observable and harder to maintain in the future, and therefore benefit outside shareholders, more so in countries that feature high expropriation risk. We test this by augmenting our main specification by interactions between *Panama Papers exposure* and country-level measures associated with expropriation risk and investor protection. This setup allows us to compare firms implicated by the leak to other firms headquartered in the same country.

The results in Table 7 confirm that the negative effect on firms with exposure to the leak is generally less pronounced in countries with weak property rights and minority shareholder protection and this effect is distinct from any effects of firms' headquarter country development. Firms headquartered in low ICRG countries and countries with low anti-self dealing index are also less adversely affected, although this result is statistically insignificant (columns (1) to (4)).

Though statistically weaker, these country-level results are consistent with the idea that offshore vehicles are used for expropriation. One alternative interpretation could be that weak rule of law countries might make litigation against or penalties for expropriation less likely, accounting for the less adverse effect among firms headquartered in these countries. However, in additional

tests, we find that firms in such countries reduce their exposure to perceptively corrupt countries and their tax avoidance as much as firms in strong-rule-of-law countries.

In sum, the results presented in this section support the three channels that may explain the corporate use of SOVs. Specifically, SOVs are used as a means for bribing foreign government officials and saving taxes through tax avoidance or tax evasion. At the same time, the opaqueness associated with SOVs facilitates the expropriation of corporate resources.

5. Conclusion

We exploit one of the largest data leaks to date, the 2016 leak of the Panama Papers, and identify 338 listed firms that can be directly linked to SOVs. Our analysis of the specific motives for the corporate use of SOVs shows that these serve to finance corruption and to reduce taxes, which creates firm value. Firms implicated in the data leak subsequently demonstrate reduced economic activity in perceptively corrupt countries and avoid less tax. However, some of the benefits of using offshore vehicles may be offset by diversion of firm resources by insiders, who appear to take advantage of the opaque structures that offshore vehicles provide. Our paper provides support for anecdotal evidence about the uses of SOVs for activities that are at least partially illegal. Offshore service providers play an important role in facilitating such activities.

While our analysis focuses on the benefits and costs of SOVs to shareholders, the use of SOVs may also have important welfare implications. Their role in facilitating hidden bribe payments, for example, may contribute to the substantial social costs of corruption, estimated at $2.6 trillion, or 5% of global GDP per year (2001-2002 survey data, World Bank Institute). A similar argument applies for SOVs as a tool to avoid or evade taxes. At the same time, prior papers have shown that tax haven activities may also foster regional growth (Desai, Foley, and Hines 2004) and create employment in firms' home countries (Suarez Serrato 2018). An extension of our

research agenda is to analyze the welfare implications of the Panama Papers leak, including spillover effects of the leak on direct competitors of implicated firms, which we leave for future research.

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Figure 1
Connections between public firms and secret offshore vehicles (SOVs)

The figure illustrates links between firms and their observable offshore vehicles (left) as well as secret offshore vehicles (right), such as those revealed by the Panama Papers data leak. Offshore Vehicle 1 is observable since outside investors observe it as a subsidiary in public filings. Offshore Vehicles 2, 3, and 4 are secret and outside investors do not know about their existence. Connections to secret offshore vehicles are through a firm's directors, subsidiaries, and directors of subsidiaries, each of which are listed as officers or intermediaries of a secret offshore vehicle in the leaked data. A description of the matching process is in Appendix A.

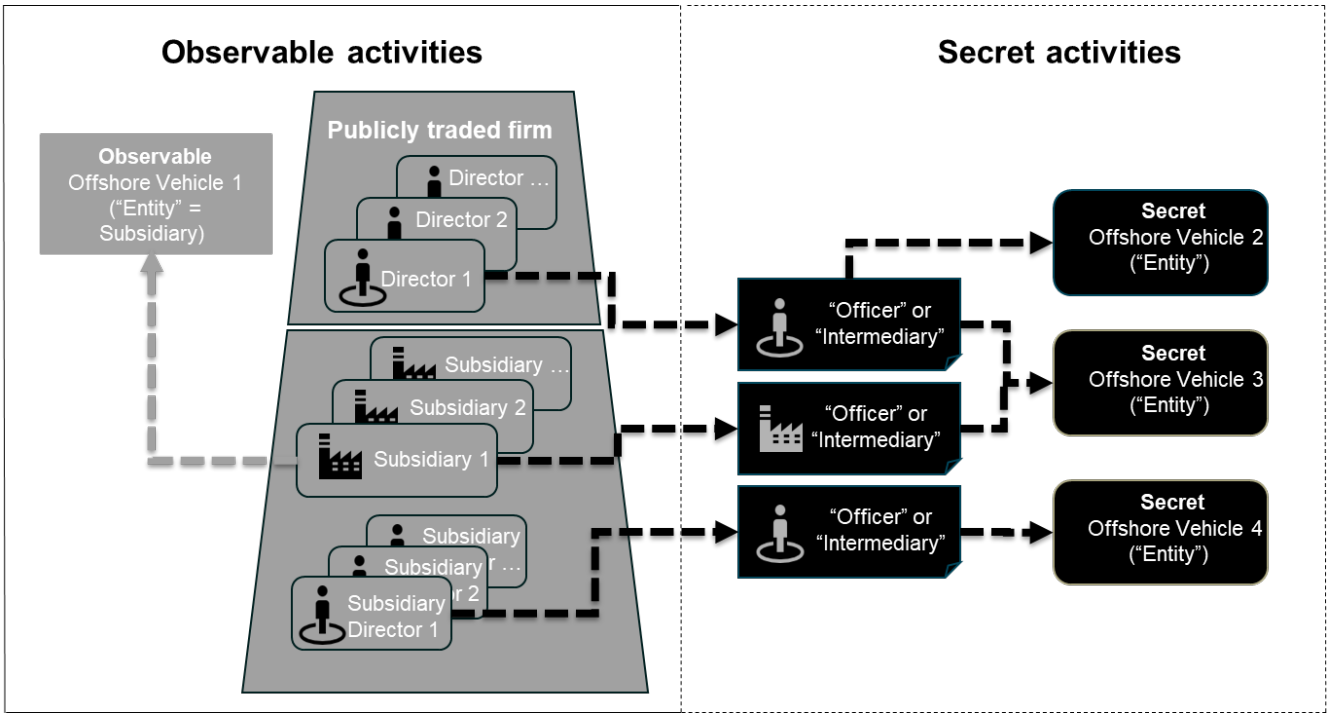


Table 1
Summary statistics

This table provides characteristics of sample firms with and without Panama Papers Exposure. *Has Panama Papers Exposure* (*PPE*) indicates whether or not any intermediary or person listed in the Panama Papers is connected to an officer of a firm in our sample, a subsidiary of a sample firm, or an officer of a sample firm's subsidiary. The column labeled *Full Sample Diff* captures the difference in means between the two groups for the full sample of firms. The column labeled *Full Sample Probit* shows the coefficients (reported as marginal effects) from 15 separate probit regressions, where the dependent variable in each regression is *Has Panama Papers Exposure*, while each of the 15 shown variables is included as a control variable one at a time; all 15 regressions include log of total assets, industry, and country fixed effect controls. The column labeled *Matched Sample* captures the mean of matched firms and the difference in means between firms with exposure and matched firms (with replacement). Firms are matched by country and closest neighbor by size. Firms without match within 30% of size are discarded. All other variables are defined in Appendix B. All continuous variables are winsorized at the 1% and 99% levels. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Firms with Panama Papers Exposure		Firms without Panama Papers Exposure		Full Sample	Full Sample	Matched Sample	
	N	Mean	N	Mean	Diff	Probit	Mean	Diff
Firm characteristics								
Total assets ($mn)	338	104,256	23,202	5,457	98,799***	n/a	90,426	13,830
N subsidiaries	338	164	23,202	20	144***	0.000***	75	89***
Has foreign subsidiary (1/0)	338	0.92	23,202	0.44	0.48***	0.018***	0.71	0.21***
Perc. foreign subsidiaries	338	0.49	23,202	0.20	0.28***	0.022***	0.33	0.16***
N foreign subsidiaries	338	17.20	23,202	2.89	14.31***	0.001***	8.04	9.16***
Has TOP4 Tax Haven (1/0)	338	0.34	23,202	0.04	0.30***	0.017***	0.15	0.19***
Corruption exposure								
Corruption Exposure (1/0)	337	0.45	23,142	0.15	0.31***	0.015***	0.21	0.24***
Political 1st Layer Exp. (1/0)	338	0.43	23,202	0.11	0.31***	0.014***	0.22	0.21***
Tax avoidance								
Raw Tax Avoidance	257	0.18	15,269	0.18	0.00	0.006	0.17	0.01
Tax Avoidance (no FE)	260	-0.01	15,558	-0.01	-0.01	-0.005	(0.00)	-0.01
Tax Avoidance (FE)	260	-0.02	15,558	-0.00	-0.02	0.000	(0.01)	-0.01
Governance								
Foreign institutional ownership	274	0.13	17,484	0.06	0.08***	0.012	0.12	0.01
Governance score	209	68	4,057	50	18***	0.062*	63	5**
Has sponsored ADR (1/0)	338	0.20	23,202	0.04	0.16***	0.004*	0.18	0.02
Has unsponsored ADR (1/0)	338	0.31	23,202	0.08	0.23***	0.000	0.27	0.04
Has U.S. subsidiary (1/0)	338	0.43	23,202	0.18	0.25***	0.008***	0.33	0.10***

Table 2
Returns of firms implicated by the leak

This table reports the returns of listed firms around the Panama Papers data leak. In Panels A and B, the dependent variables are *Cumulative raw return* and *Cumulative abnormal return* over days around three dates related to the data leak. The event window is [-1;3] for each date. In Panel A, the sample is split into firms with and without secret exposure to the Panama Papers. The splits are on the full sample and matched firms as described in Table 1. Panel B presents the results of multivariate regressions. Controls include *Size* (the natural logarithm of assets in $000s) and country and industry fixed effects (49 Fama–French industries). Standard errors are clustered at country and industry level (2-way cluster). Panel C presents results of robustness tests. In column (1), portfolios of *PPE* firms and non-*PPE* firms are formed on day [-20] relative to April 3 and returns are calculated for all dates through to day 144. The daily returns of the two portfolios are regressed on the interaction between *Has PPE* and *event date dummies*. Controls include *Has PPE* and day fixed effects. We use a Fama-MacBeth approach in column (4), where the specification from column (1) in Panel B is run individually for each day [-20;144] around the main event date. The resulting *PPE* coefficients are then regressed on dummy variables indicating relevant event days. Robust *t*-stats are presented in parentheses and the economic magnitudes, obtained by multiplying the coefficients on the interaction term by 15 (the number of days in the event windows around the three event dates), are presented in square brackets. Appendix B provides the variable definitions. Throughout, all continuous variables are winsorized at the 1% and 99% levels. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Univariate split

	Firms with Panama Papers Exposure		Firms without Panama Papers Exposure		Full Sample	Matched Sample	
	N Firms	Mean	*N* Firms	Mean	Diff	Mean	Diff
Cumulative Raw Returns (%)	338	-3.80***	23,202	-1.40***	-2.40***	-2.73***	-1.07**
Cumulative Abnormal Returns (%)	338	-1.45***	23,202	-0.01	-1.44***	-0.62*	-0.83*

Panel B: Multivariate regressions

Dependent variable	(1) Raw Returns	(2) Abnormal Returns
Has Panama Papers Exposure (PPE)	-1.260***	-0.909***
	(-3.48)	(-3.62)
Controls/Country and industry fixed effects	Size/Yes	Size/Yes
N	23,540	23,540
Adj. R^2	0.170	0.094

Panel C: Main robustness tests

Method	(1) Portfolio Approach	(2) Fama-MacBeth
(Has Panama Papers Exposure) x (Event day)	-0.130**	-0.075**
	(-2.38)	(-2.24)
	[-1.951%]	[-1.125%]
Controls/Fixed effects	Has PPE/Day	None/None
N	330	165
Adj. R^2	0.342	0.021

Table 3
Day-by-day returns and information

This table reports returns of listed firms around the leak for each of three individual event date, Day 1 (April 3), Day 2 (April 26), and Day 3 (May 9). *Has PPE* indicates whether (1) or not (0) a firm is connected to the Panama Papers, as defined in Table 1. In Panel A, the sample consists of the full sample of firms. In Panel B, the sample consists of firms that are potential users of SOVs only. These are firms that have a subsidiary in any of the top four tax havens used by Mossack Fonseca (columns (4)-(6)) and firms that have a history of financial misconduct by any of the measures in Karpoff et al. (2018; columns (7)-(9)). Columns (1)-(3) present results for all potential users by any of the criteria used for the specifications for columns (4)-(9). Appendix B provides variable definitions. All continuous variables are winsorized at the 1% and 99% levels. Fixed effects as well as a size control are included as indicated. Standard errors are clustered at country and industry level (2-way cluster). *t*-statistics are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Full sample

	(1)	(2)	(3)
Period	Day 1	Day 2	Day 3
Has PPE	-0.168	-0.604***	-0.152
	(-0.97)	(-2.91)	(-1.13)
Controls	Size	Size	Size
Country FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
N	23,540	23,091	22,980
Adj. R^2	0.086	0.050	0.140

Panel B: Subsample of potential users of SOVs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Sample	Combined TOP4 Tax Haven and Misconduct Sample			TOP4 Tax Haven Sample			Misconduct Sample		
Event day	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3
Has PPE	0.225	-0.385	-0.758***	0.158	-0.362	-0.490	-0.598	-0.363	-1.019***
	(0.54)	(-1.51)	(-2.67)	(0.33)	(-0.96)	(-1.27)	(-1.50)	(-1.27)	(-4.96)
Controls	Size	Size	Size	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2,147	2,130	2,126	1083	1068	1063	1178	1176	1177
Adj. R^2	0.142	0.084	0.043	0.100	0.033	0.027	0.173	0.140	0.060

Table 4
Cross-sectional characteristics of secret offshore activities

This table provides returns of listed firms around the leak. The dependent variable is *Cumulative abnormal return* as defined in Table 2. *Has Panama Papers Exposure* (*PPE*) indicates whether (1) or not (0) a firm is connected to the Panama Papers, as defined in Table 1, *Interaction* denotes the interaction between *Has PPE* and characteristics of the firm's connection to the Panama Papers. In columns (1)-(3), the characteristics are, respectively, the natural logarithm of one plus the number of distinct connections between firm and leaked data, the number of distinct firm officers connected to the leaked data, and the number of distinct vehicles a firm is connected to. In column (4), *Has PPE* is interacted with a dummy variable equal to one if a firm has at least one connection to a secret offshore vehicle that has not been deactivated, and in column (5), with the natural logarithm of one plus the number of years since the last vehicle was deactivated (zero if at least one connection is still active). Appendix B provides variable definitions. All continuous variables are winsorized at the 1% and 99% levels. Country and industry fixed effects (Fama–French 49), as well as a control for size are included as indicated. Standard errors are clustered at country and industry level (2-way cluster). *t*-statistics are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
	Number of connections (Log)	Number of distinct officers connected (Log)	Number of distinct vehicles connected (Log)	Connection is active (1/0)	Years since deactivation (Log)
Has PPE	0.346	-0.185	0.339	-0.618	-1.088**
	(0.91)	(-0.67)	(0.87)	(-1.13)	(-2.47)
Interaction	-1.075***	-0.942**	-1.080***	-0.423	0.331
	(-4.10)	(-2.53)	(-3.97)	(-0.43)	(0.76)
Controls	Size	Size	Size	Size	Size
Industry FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
N	23,540	23,540	23,540	23,540	23,540
Adj. R^2	0.094	0.094	0.094	0.094	0.094

Table 5
Users of secret offshore vehicles and financing corruption

This table provides the results of the analysis of the role of financing corruption. In Panel A, the dependent variables are *Cumulative abnormal returns* around three event days associated with the leak. *Has Panama Papers Exposure (PPE)* indicates whether (1) or not (0) a firm is connected to the Panama Papers, as defined in Table 1. In columns (1)-(3), the measure of interest is *Political 1st Layer Exposure*, a dummy variable equal to one if a firm has at least one subsidiary in any of the countries where heads of state/government are implicated by name in the leak. In columns (4)-(6), the measure of interest is corruption exposure, measured by a dummy variable that is equal to one if a firm is exposed to the most perceptively corrupt tercile of countries using Transparency International's Corruption Perception Index. Standard errors are clustered at country and industry level. In Panel B, the dependent variables are measures of firm activity in the countries whose presidents or major officials were implicated by the Panama Papers (columns (1)-(3)) and the most corrupt tercile of countries (columns (4)-(6)). Measures of firm activity are at the quarterly level over the 2014:Q2-2017:Q1 period. *Treated* is a dummy equal to one in periods 2016:Q2-2017:Q1. The measure of firm activity of interest is the natural logarithm of total sales in USD (Columns 1 and 4), the natural logarithm of the number of subsidiaries (columns (2) and (5)), and a dummy that equals one if a firm has at least one subsidiary in the respective region (columns (3) and (6)). Standard errors are clustered at year-quarter level. Controls including fixed effects are included as indicated. Appendix B provides the variable definitions. All continuous variables are winsorized at the 1% and 99% levels. *t*-statistics are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Event study results

	(1)	(2)	(3)	(4)	(5)	(6)
Corruption Variable	Political 1st Layer Exposure			Corruption Exposure (most corrupt tercile)		
Has PPE		-0.452***	-0.475***		-0.083	-0.131
		(-2.99)	(-3.05)		(-0.19)	(-0.34)
Corruption Variable	-0.537		-0.159	-1.212		-0.083
	(-0.74)		(-0.92)	(-1.57)		(-0.77)
Interaction		-1.069*	-0.945*		-1.235**	-1.152**
		(-1.90)	(-1.69)		(-2.03)	(-2.08)
Controls	Size	Size	Size	Size	Size	Size
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
N	338	23,540	23,540	337	23,471	23,471
Adj. R^2	0.181	0.094	0.094	0.190	0.094	0.094

Panel B: Real implications for subsidiary revenues

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Sales in 1st layer countries (Log)	# Subsidiaries in 1st layer countries (Log)	Has subsidiary in 1st layer countries (1/0)	Sales in most corrupt tercile (Log)	# Subsidiaries in most corrupt tercile (Log)	Has subsidiary in most corrupt tercile (1/0)
Treated x *Has PPE*	-0.057***	-0.011***	-0.008***	-0.054*	-0.005	-0.002
	(-4.34)	(-6.05)	(-3.13)	(-1.81)	(-1.42)	(-0.34)
Controls	Size	Size	Size	Size	Size	Size
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
N Observations	72,102	72,102	72,102	72,095	72,102	72,102
N Firms	7538	7538	7538	7538	7538	7538
Adj. R^2	0.910	0.954	0.950	0.941	0.986	0.983

Table 6
Users of secret offshore vehicles and tax avoidance

This table provides results of the analysis of the role of tax avoidance. In Panel A, the dependent variables are *Cumulative abnormal returns* around three event days associated with the leak. *Has Panama Papers Exposure (PPE)* indicates whether (1) or not (0) a firm is connected to the Panama Papers, as defined in Table 1. In columns (1)-(3), *Tax Avoidance* (*no FE*) is the residual of a regression of firm's (statutory tax rate at the country level less a firm's effective tax rate*)* on return on assets, intangible assets, and lagged returns on assets. The effective tax rate is defined as tax over EBIT; observations with negative EBIT are set to missing. In columns (4)-(6), the regressions ran to obtain the residual additionally control for country and industry fixed effects. Standard errors are clustered at country and industry level (2-way cluster). In Panel B, the dependent variable is *Tax Avoidance* (*no FE*) in column 1 and *Tax Avoidance* (*FE*) in column (2), both constructed as for Panel A. Dependent variables are measured annually over the 2010-2017 period. *Treated* is a dummy equal to one for observations based on fiscal year ends after 2016:Q3. Standard errors are clustered at year level. In both Panels, controls including fixed effects are included as indicated. Appendix B provides the variable definitions. All continuous variables are winsorized at the 1% and 99% levels. *t*-statistics are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Event study results

	(1)	(2)	(3)	(4)	(5)	(6)
Tax Variable	Tax Avoidance (no FE)			Tax Avoidance (FE)		
Has PPE		-0.666***	-0.668***		-0.603***	-0.603***
		(-2.87)	(-2.89)		(-2.63)	(-2.63)
Tax Variable	-2.859***		0.210	-3.176***		-0.018
	(-4.56)		(1.18)	(-3.01)		(-0.08)
Interaction		-1.721***	-1.920***		-2.678***	-2.660***
		(-3.61)	(-3.15)		(-6.44)	(-4.09)
Controls	Size	Size	Size	Size	Size	Size
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
N	260	15,818	15,818	260	15,818	15,818
Adj. R^2	0.171	0.112	0.112	0.173	0.112	0.112

Panel B: Real implications for tax avoidance

	(1)	(2)
Dependent variable	Tax Avoidance (no FE)	Tax Avoidance (FE)
Treated x *Has PPE*	-0.108***	-0.067***
	(-6.86)	(-3.54)
Controls	Size	Size
Firm FE	Yes	Yes
Fiscal Year Fixed Effects	Yes	Yes
N Observations	44,055	44,055
N Firms	8832	8832
Adj. R^2	0.162	0.172

Table 7
Users of secret offshore vehicles and expropriation

The table reports the results of an analysis of the role of expropriation explaining returns of publicly listed firms around the leak. The dependent variables are *Cumulative abnormal returns* around three event days associated with the leak. *Has Panama Papers Exposure* (*PPE*) indicates whether (1) or not (0) a firm is connected to the Panama Papers, as defined in Table 1. *Interaction* denotes the interaction between *Has PPE* and the respective firm- and country-level expropriation measures. In Panel A, *Foreign Institutional Ownership* is a dummy equal to one if a firm's fraction of outstanding shares held by foreign institutional owners in 2015 is above the median; *Governance* Score is a dummy equal to one if a firm's governance score is above the median (median defined at firm level). *Has Sponsored ADR* is a dummy variable equal to 1 if a non-U.S. firm has a sponsored ADR (Level II or III) in 2015, *Has Unsponsored ADR* indicates an unsponsored or Level I ADR in 2015. *Has U.S. Subsidiary* whether a non-U.S. firm has a U.S. subsidiary in 2015. In Panel B, the focus is on country-level expropriation measures. Countries are split into those with above-median and below-median scores (median defined at country level). Measures include Property Rights, ICRG index, Anti-Self Dealing Protection, and Minority Shareholder Protection. All regressions additionally control for the interaction between GDP per capita and *Has PPE*. All regressions include firm size and fixed effects as indicated. Appendix B provides detailed variable definitions. All continuous variables are winsorized at the 1% and 99% levels. Standard errors are clustered at country and industry level (2-way cluster). *t*-statistics are in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Firm-level governance

	(1)	(2)	(3)	(4)	(5)
Governance Variable	Foreign Institutional Ownership	Governance Score	Has Sponsored ADR	Has Unsponsored ADR	Has U.S. Subsidiary
Has *PPE*	0.349	-0.389	-0.631**	-0.818**	-0.411***
	(0.60)	(-1.01)	(-2.17)	(-2.30)	(-2.78)
Governance Variable	-0.058	0.180	-0.590***	-0.461	-0.415***
	(-0.35)	(0.64)	(-2.82)	(-1.46)	(-3.82)
Interaction	-1.359**	-0.979*	-1.226***	-0.228	-1.095*
	(-2.04)	(-1.79)	(-3.56)	(-0.41)	(-1.74)
Controls	Size	Size	Size	Size	Size
Industry FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
N	17,758	4,284	23,540	23,540	23,540
Adj. R^2	0.104	0.139	0.094	0.094	0.094

Panel B: Home-country expropriation measures

	(1)	(2)	(3)	(4)
	Weak Property Rights	Low ICRG	Weak Anti-Self Dealing Protection	Weak Minority Shareholder Protection
Has *PPE*	-1.388***	-1.259***	-0.942	-1.180**
	(-5.31)	(-3.84)	(-1.66)	(-2.38)
Has PPE x Governance	2.234**	1.335	1.130	2.973**
	(2.27)	(1.18)	(1.30)	(2.37)
Has PPE x LN(GDP per capita)	0.386	0.316	0.344	0.220
	(0.95)	(0.62)	(0.51)	(0.34)
Controls	Size	Size	Size	Size
Industry FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
N	21,954	22,311	21,582	22,331
Adj. R^2	0.095	0.094	0.098	0.094

Appendix A

The Panama Papers and Sample Construction

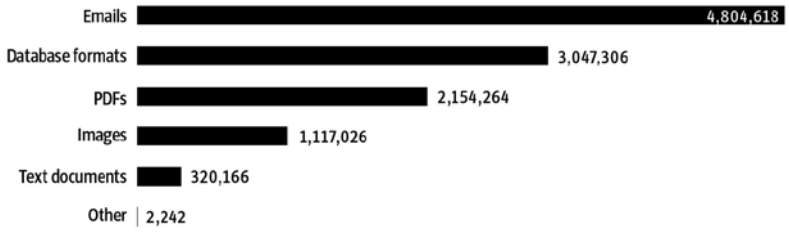
In the following, we provide an overview of the Panama Papers data leak. We discuss the background of the data leak, specifics of the leaked data, and how we link the leaked data to Orbis data on directors, subsidiaries, and subsidiary directors. We conclude with anonymized illustrations of public firms that are linked to the data leak.

A.1 The data leak: Background and general characteristics

Unknown to the public, in early 2015 an anonymous whistle blower contacted journalists at *Sueddeutsche Zeitung* (SZ), a German newspaper, with documents about a few individuals' offshore activities. After verification of the leaked data, the journalists arranged for the whistle blower to hand over 2,600 gigabytes of data, containing 11.5 million files concerning 214,000 shell companies incorporated in tax havens around the world over the past 45 years. The composition of these files is shown in Figure A1. The data contained confidential documents concerning the business activities of Mossack Fonseca, a Panamanian law firm and provider of corporate offshore services. The identity of the whistle blower who released the files to SZ remains unknown.

Figure A1
Composition of Panama Papers data leak files

This figure shows the distribution of the leaked documents by file type. Source: https://neo4j.com/blog/analyzing-panama-papers-neo4j/ (accessed February 20, 2018).



News sources suggest that the public was unaware of the data leak until April 3, 2016, the day on which news sources reported the leak. For instance, a Factiva search of 'Mossack Fonseca' from January 1, 2015 to April 2, 2016 (the day prior to the leak) results in a mere 25 articles, many of which report on the political engagement of Ramón Fonseca Mora, founding partner of Mossack Fonseca. As of April 2, 2016, the Wikipedia entry for "Mossack Fonseca" had not been edited for almost a year. The last edit of this entry prior to the leak is on July 29, 2015. On April 3, 2016, the entry is edited 15 times.[17]

In fact, the data leak shed some light on the otherwise unknown activities of Mossack Fonseca. A few years prior to the data leak, the company was described by *The Economist* (2013) as a "big provider" of offshore services, but reported to be smaller than the offshore industry's two largest service providers (Offshore Incorporations Ltd., Hong Kong and OCRA Worldwide Ltd., Isle of Man). Since being founded in 1977, the firm had never experienced any known data breach.

17 As part of our analysis, we indirectly test whether some information may have leaked prior to April 3, 2016 by studying returns prior to that date (see Table D32, column (3)). We find no abnormal returns prior to the data leak. The news stories pertaining to Mossack Fonseca's founding partner document that Ramón Fonseca Mora requested a leave of absence from his political duties in early March, 2016, stating personal reasons. Whether he knew about the leak at this point is subject to speculation. At around that time, Mossack Fonseca also made headlines in Malta for being involved in creating offshore vehicles on behalf of numerous Maltese law firms. In early March 2015, a German newspaper dedicated an article to German founding partner Jürgen Mossack, mentioning vehicles created for HSBC chief executive Stuart Gulliver and for Rami Makhlouf, a close cousin of Syrian President Bashar al-Assad.

Online sources report that Mossack Fonseca may have informed some of its clients about the data leak on Friday, April 1, by sending an email to an unknown distribution list. It stated that the firm believed that they had been subject to "an unauthorized breach of our email server." The message did not mention confidential data other than email and it is unknown which clients were informed. Even though that email was sent 32 minutes after the NYSE and NASDAQ markets closed, we include April 1 in our event analysis.[18]

The earliest news stories about the Panama Papers were published in the afternoon (Eastern Standard Time) on Sunday, April 3, 2016. Thousands of news reports published by over 100 media organizations on that day and the following days stressed that the use of secret offshore vehicles goes well beyond tax avoidance.[19]

A.2 Offshore vehicle data

On Tuesday, April 26, 2016, the International Consortium of Investigative Journalists (ICIJ) announced that a searchable database of the leaked data would be made public on Monday, May 9, 2016. On that day, the searchable database was made available through ICIJ's website. We downloaded these data on May 9 and 10, 2016. These files are still hosted on the ICIJ webpage as of June 2018.[20]

The ICIJ data contains three main files: "Entities," "Officers," and "Intermediaries." We use all three for our analysis and link them using the file "all_edges" provided by the ICIJ to establish links between these three files where needed. The three files have a network structure in the sense that each officer or intermediary can ultimately be traced to one or more entities (i.e., offshore vehicles).

In the following, we detail each of the three leaked data sets, following partly the ICIJ definitions.

> *Entity*: "a company, trust or fund created in a low-tax, offshore jurisdiction by an agent" (ICIJ definition). There are 214,000 such entries in the Entities file. Of those, 90% are incorporated in just four tax havens: the British Virgin Islands (114,000 firms), Panama (48,000), the Bahamas (16,000), and the Seychelles (15,000). The remaining firms are incorporated in Niue (9,600), Samoa (5,300), British Anguilla (3,200), Nevada (1,300), Hong Kong (450), the United Kingdom (150), and a few other locations. Although these firms are incorporated in a select few jurisdictions, the data provide information on contact addresses for the entity which frequently are outside the tax haven of incorporation. For example, an entity incorporated in Samoa has a contact address in Geneva, Switzerland.
>
> *Officer*: "a person or company who plays a role in an offshore entity" (ICIJ definition). There are 238,404 such entries in the Officers file. The most frequent jurisdictions, in declining order, are China (24,635), Hong Kong (13,362), the British Virgin Islands (11,231), Jersey (6,892), Panama (5,069), the United Kingdom (4,914), Switzerland (4,269), and Russia (4,119), which account for roughly half of all officers with valid country data.
>
> *Intermediary*: "a go-between for someone seeking an offshore corporation and an offshore service provider -- usually a law-firm or a middleman that asks an offshore service provider to create an offshore firm for a client" (ICIJ definition). There are 14,110 intermediaries including: Hong Kong, the United Kingdom, Switzerland, the United States, Panama, and Guatemala, which make up just over 50% of the intermediary countries.

In Table A1, we illustrate the global distribution of entities, officers, and intermediaries included in the data leak. We also list the number of public firms in each country. It is noteworthy that some countries, particularly tax havens, are frequently associated with offshore vehicles (entities), officers, and intermediaries are countries with few (or no)

18 See, for example, https://goo.gl/vS1EHR (accessed on May 15, 2017). The email on April 1 was sent at 3:32 p.m. local time in Panama, equivalent to 4:32 p.m. in New York (Panama does not participate in daylight saving time).
19 See, for example, "The Panama Papers: How the world's rich and famous hide their money offshore," April 3, 2016, *The Guardian* (retrieved April 14, 2016).
20 See https://offshoreleaks.icij.org/pages/database.

publicly listed firms. The relational structure of the data renders summary statistics of other kinds relatively uninformative. For instance, an entity incorporated in one jurisdiction may have a contact address in another, with officers and services intermediated in yet other places.[21]

Table A1
Summary statistics for countries of offshore vehicles

This table provides summary statistics of offshore vehicles (entities), their officers, and intermediaries in the Panama Papers by location, as well as the number of public firms in each in Orbis. Locations are sorted by declining number of entities. Channel Isl. refers to the islands of Jersey and Guernsey.

	Panama Papers Data			Orbis		Panama Papers Data			Orbis
Country	#Entities	#Officers	#Intermed.	#Firms	Country	#Entities	#Officers	#Intermed.	#Firms
Hong Kong	37,912	13,362	2,208	161	Spain	1,166	761	195	124
Switzerland	37,911	4,269	1,231	210	B.V.I.	1,107	11,231	31	-
Panama	15,811	5,069	588	-	Thailand	963	774	186	206
Channel Isl.	14,311	6,892	314	-	Costa Rica	886	448	118	-
Luxembourg	10,840	1,745	399	47	Venezuela	749	655	180	13
U.K.	9,619	4,914	1,376	1,080	Seychelles	683	1,706	7	-
U.A.E.	7,269	2,990	134	39	Israel	663	956	133	326
Bahamas	4,984	1,442	107	-	Lebanon	486	746	42	-
Uruguay	4,906	2,003	298	-	Canada	347	824	96	696
Isle of Man	4,892	1,989	207	-	Italy	346	1,097	50	216
Russia	4,197	4,119	75	100	France	285	849	99	551
Singapore	4,081	2,273	63	305	Ukraine	274	484	13	22
Cyprus	3,613	2,684	113	17	Argentina	270	1,253	90	63
China	3,213	24,635	256	2,269	St. Kitts & Nevis	189	783	6	-
Monaco	3,168	1,339	164	-	South Africa	108	1,917	57	179
U.S.	3,066	3,612	624	3,506	Saudi Arabia	106	698	34	-
Taiwan	2,725	3,692	50	1,120	Cayman Islands	106	631	32	-
Liechtenstein	2,066	1,082	117	-	Turkey	101	655	18	279
Gibraltar	2,039	893	72	-	Australia	94	1,099	39	587
Colombia	1,854	1,228	230	-	Dominica	66	551	1	-
Ecuador	1,852	922	324	-	Peru	52	1,650	23	91
Brazil	1,399	2,008	399	251	Malaysia	36	1,483	15	602
Belize	1,351	519	9	-	Indonesia	28	1,038	14	56
Guatemala	1,233	527	441	-	Vanuatu	4	553	2	-
Mauritius	1,217	1,306	56	20					

A.3 Matching offshore vehicles to publicly listed firms

We now describe how we match secret offshore vehicles to public firms. To identify firms connected to the Panama Papers leak, we combine the ICIJ databases with data on subsidiaries, directors, and subsidiary directors of publicly listed firms from Orbis. We start with all publicly listed firms in Bureau van Dijk's Orbis database as of 2015, worldwide. We remove penny stocks, non-active stocks, and firms with assets below $5 million as described in the paper. For the remaining 23,540 firms from 73 countries, we obtain the names and locations of their directors, the names and locations of their subsidiaries, and the names and locations of the directors of their subsidiaries. We obtain 7,034,413 director entries, of which 2,493,922 have location data and 1,879,048 have country data. We also obtain a total of 1,311,643 subsidiaries, of which 913,819 have valid country data.

In matching the leaked data to Orbis data, we first standardize the names of entities and persons across the data sets. For person names we remove honorifics, titles and other additions that may not be constant across datasets. For entity names we standardize spelling of legal structures such as "Inc." Then, we match data points between the public data and the Panama Papers data. For a match, we require that name and country of the data points match. Because of missing country data, some data points cannot be matched.[22] While matching names, we allow for variations in

[21] See https://alexandreafonso.me/2016/05/11/mapping-the-panama-papers for illustrations.
[22] In the ICIJ data, country data are missing for 93,613 out of 238,404 officers, for 1,512 out of 14,111 intermediaries, and for 790 out of 213,635 entities.

spelling across the data files, using a fuzzy matching algorithm.[23] We verify all algorithmic matches manually and remove potentially false matches that arise from repeated names. We take great care adjusting the matches on person names for potential false matches due to repeated names, proceeding as follows. First, we calculate the number of unique directors associated with matched names. Second, we calculate a name frequency variable that reflects the number of unique directors associated with a given name (in Orbis).[24] Third, we use this name frequency as an estimate of the probability of a match being due to a repeated name. The median name frequency of matched names is one, indicating that the name in the Panama Papers file can be linked to only one director/director pair in the Orbis file. The number of links from a firm to a director also has a median of one, with a handful of firms with many linked directors to the files.

Table A2 shows the number of connections we uncover between public firms and offshore vehicles. As the table shows, publicly listed companies can be connected to the Panama Papers in three distinct ways: through an intermediary, officer, or an entity. We consider links through officers and intermediaries as being secret links, while links through entities are potentially observable links. What is observable and what is secret can be understood by considering the nature of the offshore vehicles and the information available to investors before the leak. The primary goal of most offshore vehicle owners is to separate their name from being a beneficial owner/originator of the offshore vehicle. Corporate service providers go to great lengths to obscure the relationship between the officers/intermediaries and the ultimate entities. The names of these offshore vehicles are typically kept in a list of registered companies, without any information on directors or beneficial owners. An interested party could therefore have checked the register of companies, and then try to use public data to trace a particular company to a subsidiary of a listed company. However, one would not be able to trace firms to offshore vehicles if the link is obscured though an officer or subsidiary who acts as an operator of the offshore vehicle and this is not declared.

Table A2
Number of Connections between Public Firms and Offshore Vehicles

This table provides data on the number of connections between data on public firms from Orbis and the leaked entity, officer, and intermediary datasets from the Panama Papers data leak. Some sample firms are connected to the leaked data through more than one link.

	Entity	Officer	Intermediary
Director of public firm	0	3	0
Subsidiary of public firm	95	146	60
Director of public firm's subsidiary	2	274	45

A.4 Examples of specific links

We now provide two examples, one of a secret offshore vehicle and one of an observable offshore vehicle. The names of legal entities and individuals have been changed.

Example 1: Secret offshore vehicle
ABC SA/NV is a public company incorporated in Belgium and connected to a secret offshore entity associated with Mexico through one of its Mexican subsidiaries: The names of the company's subsidiaries and the names of the

[23] Fuzzy matching is performed on cleaned and standardized strings using the COMPGED function in SAS 9.4. For the initial match, we allow a maximum threshold of the generalized edit distance of 80. This precludes operations such as inserting, deleting, or replacing letters at the start of strings, and allows operations such as adding or truncating characters at the end of strings, or ignoring duplicated or concatenated characters within the word. For robustness we alternatively perform exact matches only, and conclude that the fuzzy matching adds minor variations only, in line with our goals. It is difficult to make statements about the number and impact of false non-matches, but we note that these would work against us identifying any significant relationships between PEE exposure and market returns.
[24] For example, if a name turns up once in the leaked data, but it is associated with three different individuals in Orbis, we cannot be certain of the match. If instead a name is associated with only one unique director ID then it may be considered an unlikely director name and the match with MF is cleaner.

directors of these subsidiaries are publicly available. One of the directors of one of the firm's Mexican subsidiaries is Juan Hernández, in Mexico. According to the data leak, Mossack Fonseca incorporated an offshore vehicle, Blue Crystal Limited, in the Bahamas in 2014. ABC Corporation does not disclose a subsidiary called Blue Crystal. At the time of the data leak in 2016, this vehicle is still active. The data leak lists Juan Hernández as an officer of this offshore vehicle, in Mexico. Juan Hernández thus appears in both data sets. He is both a director of a subsidiary of a publicly listed company (observable) and an officer of a secret offshore vehicle (secret prior to the leak).

Example 2: Observable offshore vehicle
XYZ AG is a public company incorporated in Germany and connected to an observable offshore entity associated with the British Virgin Islands through one of its UK subsidiaries. The names of the company's subsidiaries are publicly available. One of the firm's subsidiaries is called Transnational Shipping Limited. According to the data leak, Mossack Fonseca incorporated an offshore vehicle, Transnational Shipping Limited, in the British Virgin Islands in YYYY. At the time of the data leak in 2016, this vehicle is still active. The offshore vehicle thus appears in both data sets. It is a disclosed subsidiary of a publicly listed company that is located in the U.K. and incorporated in the British Virgin Islands (observable), and an offshore vehicle (presumably the only new information outsiders obtain about the subsidiary via the leak is that Mossack Fonseca is the law firm in charge of maintaining the subsidiary as a legal entity).

Appendix B—Data Sources

Variable	Description	Source
Types of Panama Papers links		
Has Panama Papers Exposure (Has PPE)	A dummy variable equal to 1 if any entity, intermediary, or person listed in the leaked Mossack Fonseca documents is connected to an officer of a firm in our sample or an officer of a sample firm's subsidiary, and 0 otherwise. Persons are matched using exact country matches and fuzzy name matches. All fuzzy matches have been checked manually. See Appendix A.3 for more detail.	ICIJ, Orbis
Has entity link	A dummy variable equal to 1 if a firm has Panama Papers exposure to a legal entity listed in the leaked Mossack Fonseca documents.	
Has person link	A dummy variable equal to 1 if a firm has Panama Papers exposure to a person listed in the leaked Mossack Fonseca documents.	
Has intermediary link	A dummy variable equal to 1 if a firm has Panama Papers exposure to an intermediary listed in the leaked Mossack Fonseca documents.	
Panama Papers country	The country of a person, entity or intermediary included in the leaked Mossack Fonseca documents where non-missing.	ICIJ
Exposure of Observable Activity	A dummy variable equal to 1 if an entity in the leaked Mossack Fonseca documents is connected to a subsidiary of a firm in our sample, an officer of a firm in our sample, or an officer of a sample firm's subsidiary, but if no person and no intermediary in the leaked Mossack Fonseca documents is connected to a subsidiary of a firm in our sample, an officer of a firm in our sample, or an officer of a sample firm's subsidiary.	ICIJ, Orbis
Exposure of Secret Activity	A dummy variable equal to 1 if a person or an intermediary listed in the leaked Mossack Fonseca documents is connected to a subsidiary of a firm in our sample, an officer of a firm in our sample, or an officer of a sample firm's subsidiary, but if no entity in the leaked Mossack Fonseca documents is connected to a subsidiary of a firm in our sample, an officer of a firm in our sample, or an officer of a sample firm's subsidiary.	ICIJ, Orbis
Both Types of Exposure	A dummy variable equal to 1 if both an entity and a person or an intermediary in the leaked Mossack Fonseca documents is connected to a subsidiary of a firm in our sample, an officer of a firm in our sample, or an officer of a sample firm's subsidiary.	ICIJ, Orbis
Dummy (Has active link)	A Dummy variable equal to one if a firm has PPE to at least one vehicle that has not been inactivated as of April 2016.	ICIJ
Years since first link	*Years since first link* denotes the number of years that have passed since the first link to one of the Mossack Fonseca vehicles was established (activation years are missing for some firms) using 2016 as the base year.	ICIJ
Years since last link	*Years since last link* denote the number of years that have passed since the last Mossack Fonseca vehicle was deactivated, using 2016 as the base year.	ICIJ
Number of links	The number of distinct links between a firm and the leaked data.	ICIJ
Number of active links	The number of distinct links between a firm and the leaked data that are still active, i.e., that have not been inactivated as of April 2016.	ICIJ

Number of distinct active officer links	The number of a firm's distinct officers linked to the leaked data, ignoring inactive links.	ICIJ
Number of distinct active vehicles linked to	The number of distinct offshore entities a firm is exposed to.	ICIJ
Measures of firm value		
Cumulative raw returns [a;b]	Cumulative *daily stock returns* in % from closing on day *a*-1 to closing of day *b* relative to an event date.	Datastream
Cumulative abnormal returns [a;b]	Cumulative *daily abnormal returns* in % from closing on day *a*-1 to closing of day *b* relative to an event date. *Daily abnormal returns* are obtained from parameters of a one-factor model estimated over days [−294; −41] relative to event dates. The factor is the *excess return on the market* of the local index in U.S. dollars over and above the U.S. risk-free rate.	Datastream
Measures of propensity to face corruption		
Political 1st Layer Exposure	A dummy variable equal to 1 if a firm has at least one subsidiary in any of the countries whose presidents or major officials were implicated by the Panama Papers (Argentina, Georgia, Iceland, Iraq, Italy, Jordan, Moldova, Pakistan, Qatar, Saudi Arabia, Sudan, Ukraine, United Arab Emirates).	Orbis
Exposure to Most Corrupt Tercile	A dummy variable that is equal to one if a firm is exposed to the most perceptively corrupt tercile of countries using Transparency International's Corruption Perception Index.	Orbis, Transparency International
Revenues from *region*	A firm's revenues generated from subsidiaries headquartered in a certain region. Measured quarterly. Regressions use the natural logarithm.	Orbis
# subsidiaries from *region*	A firm's number of subsidiaries headquartered in a certain region. Measured quarterly. Regressions use the natural logarithm.	Orbis
Has subsidiary in *region*	A dummy variable equal to one if a firm has at least one subsidiary headquartered in a certain region. Measured quarterly.	Orbis
Tax avoidance measures		
Raw tax avoidance	The statutory tax rate at the country level less a firm's effective tax rate. The effective tax rate is defined as tax over EBIT. Observations with negative EBIT are denoted as missing. Used to construct other measures of tax avoidance.	KPMG, Orbis
Tax avoidance (no FE)	The residual of a regression of firm's *Tax Avoidance* (*Unadj. Floor*) on return on assets, intangible assets divided by total assets, and losses of the previous year scaled by assets. High values denote high tax avoidance.	KPMG, Orbis
Tax avoidance (FE)	The residual of a regression of firm's *Tax Avoidance* (*Unadj. Floor*) on return on assets, intangible assets divided by total assets, losses of the previous year scaled by assets, industry fixed effects, and country fixed effects. High values denote high tax avoidance.	
Firm-level governance		
Foreign institutional ownership	Fraction of shares held by foreign owners.	FactSet ownership (Lionshares)
Governance score	A measure of governance quality, this is an equally weighted score of several components: Board of directors/Board functions, Board of directors/Board structure, Board of directors/ Compensation policy, Integration/ Vision and strategy, Shareholder/ Shareholder rights.	Thomson Reuters ASSET4
Has sponsored ADR	A dummy variable equal to 1 if a firm is not headquartered in the U.S. and has a sponsored ADR in 2015.	BNY Mellon
Has unsponsored ADR	A dummy variable equal to 1 if a firm is not headquartered in the U.S. and has an unsponsored ADR in 2015.	BNY Mellon
Has U.S. subsidiary	A dummy variable equal to 1 if a firm is not headquartered in the U.S. and has a U.S. subsidiary in 2015.	Orbis
Country-level expropriation		
Property rights	An assessment of the ability of individuals to accumulate private property, secured by clear laws that are fully enforced by the state, as in Djankov, Ganser, McLiesh, Ramalho, and Shleifer (DGMRS; 2010). Regressions use a dummy variable equal to one if country scores among the 50% of countries with weakest property rights.	DGMRS 2010
ICRG	Country risk as per the International Country Risk Guide. Takes value between 0 and 100. Obtained using average values over the 2006-2015 period. Regressions use a dummy variable equal to one if country scores among the 50% of countries with lowest ICRG.	ICRG

Anti-Self Dealing Index	A measure of legal protection of minority shareholders against expropriation by corporate insiders assembled based on legal rules prevailing in 2003 from Djankov, La Porta, Lopez-de-Silanes, and Shleifer (2008). Regressions use a dummy variable equal to one if country scores among the 50% of countries with weakest anti-self dealing index.	Djankov et al. 2008
Minority Shareholder Protection index	A measure of the strength of minority shareholder protections against misuse of corporate assets by directors for their personal gain as well as of shareholder rights, governance safeguards and transparency requirements. Regressions use a dummy variable equal to one if country scores among the 50% of countries with the lowest index.	The World Bank
Firm characteristics		
Total assets	Total assets. Regressions use the natural logarithm.	Osiris
Number of subsidiaries	Number of domestic and foreign subsidiaries.	Osiris
Has foreign subsidiary	Dummy variable equal to 1 if a firm has at least one subsidiary outside of its parent headquarter country.	Osiris
% Foreign subsidiaries	Fraction of a firm's subsidiaries headquartered outside of its parent headquarter country.	Osiris
Has TOP4 haven exposure	A dummy variable equal to 1 if a firm has at least one subsidiary in any of the four main tax havens used by Mossack Fonseca (Panama, British Virgin Islands, Bahamas, Seychelles).	Osiris
Other controls		
GDP per capita	Country-level GDP per capita measured in 2015. Regressions use the natural logarithm.	World Bank

Appendix C—Additional Summary statistics

We provide additional summary statistics for the full sample of firms below. All variables are defined in Appendix B.

	N	Mean	Standard Dev	P25	Median	P75
Firm characteristics						
Total assets ($mn)	23,540	6,875	63,045	83	317	1,393
N subsidiaries	23,540	23	64	1	5	17
Has foreign subsidiary (1/0)	23,540	0.45	0.50	0.00	0.00	1.00
Perc. foreign subsidiaries	23,540	0.21	0.31	0.00	0.00	0.36
N foreign subsidiaries	23,540	3.10	8.23	0.00	0.00	2.00
Has TOP4 Tax Haven Exposure	23,540	0.05	0.21	0.00	0.00	0.00
Corruption exposure measures						
Corruption Exposure (1/0)	23,479	0.15	0.36	0.00	0.00	0.00
Political 1st Layer Exposure (1/0)	23,540	0.12	0.32	0.00	0.00	0.00
Tax Avoidance Measures						
Raw Tax Avoidance	15,526	0.18	0.15	0.07	0.15	0.25
Tax Avoidance (no FE)	15,818	-0.01	0.28	-0.10	-0.02	0.07
Tax Avoidance (FE)	15,818	0.00	0.28	-0.10	-0.02	0.07
Governance measures						
Foreign institutional ownership	17,758	0.06	0.10	0.00	0.02	0.08
Governance score	4,284	51	30	24	55	79
Has sponsored ADR (1/0)	23,540	0.04	0.19	0.00	0.00	0.00
Has unsponsored ADR (1/0)	23,540	0.08	0.28	0.00	0.00	0.00
Has U.S. subsidiary (1/0)	23,540	0.18	0.38	0.00	0.00	0.00

Appendix D—Additional Analysis

Table D1
Firms Implicated By The Leak, By Country and Industry

This table provides the number and fraction of firms linked to the Panama Papers by country and industry. In Panel A, countries with fewer than 50 firms are aggregated to *Rest of the World*. *N* Panama Papers Location indicates the total number of legal entities, persons, or intermediaries in the leak with location in a given country. In Panel B, Fama-French 49 industry classifications are used; one industry (Soda Candy) with fewer than five firms is aggregated under Other.[25]

Panel A: Firms with Panama Papers exposure by country

Country	*N* Firms	*N* Panama Papers Exposure	Fraction Panama Papers Exposure	*N* Panama Papers Addresses	Country	*N* Firms	*N* Panama Papers Exposure	Fraction Panama Papers Exposure	*N* Panama Papers Addresses
Hong Kong	161	27	16.77%	53,482	Turkey	279	1	0.36%	774
U.K.	1,080	115	10.65%	15,909	Poland	352	1	0.28%	305
Austria	66	3	4.55%	132	Japan	3,442	1	0.03%	432
Belgium	108	3	2.78%	386	Argentina	63	-	0.00%	1,613
Italy	216	6	2.78%	1,493	Bulgaria	83	-	0.00%	164
France	551	14	2.54%	1,233	Brazil	251	-	0.00%	3,806
Germany	493	12	2.43%	526	Switzerland	210	-	0.00%	43,411
Spain	124	3	2.42%	2,122	Chile	111	-	0.00%	384
Philippines	90	2	2.22%	424	Egypt	89	-	0.00%	349
Australia	587	12	2.04%	1,232	Finland	115	-	0.00%	111
Russia	100	2	2.00%	8,391	Croatia	71	-	0.00%	36
Singapore	305	6	1.97%	6,417	Indonesia	56	-	0.00%	1,080
Israel	326	6	1.84%	1,752	Korea	1,681	-	0.00%	188
U.S.	3,506	61	1.74%	7,302	Kuwait	73	-	0.00%	231
Norway	127	2	1.57%	113	Sri Lanka	117	-	0.00%	28
Sweden	257	4	1.56%	225	N. Zealand	90	-	0.00%	411
Greece	81	1	1.23%	632	Peru	91	-	0.00%	1,725
Canada	696	8	1.15%	1,267	Pakistan	129	-	0.00%	226
China	2,269	22	0.97%	28,104	Romania	55	-	0.00%	104
Netherlands	107	1	0.93%	487	Thailand	206	-	0.00%	1,923
Mexico	109	1	0.92%	344	Vietnam	385	-	0.00%	112
Denmark	111	1	0.90%	74	S. Africa	179	-	0.00%	2,082
Malaysia	602	4	0.66%	1,534	Rest of world	637	8	1.26%	40,779
Taiwan	1,120	5	0.45%	6,467					
India	1,583	6	0.38%	432	**Total**	**23,540**	**338**	**1.44%**	**240,754**

[25] The number of addresses (240,754) exceeds the number of roughly 214,000 vehicles contained in the leaked data. The difference occurs for two reasons. First, besides addresses of vehicles, we consider addresses of officers (144,791) and intermediaries (12,599), which increases the number of addresses. Second, 129,481 addresses are in territories that are not home to any public firm (mostly tax havens). We exclude those from Table C1, which decreases the number of addresses. Note though that we used these 129,481 addresses to search for connections to public firms via public firms' directors and directors of subsidiaries.

Panel B: Firms with Panama Papers exposure by industry

Industry	*N* Firms	*N* Panama Papers	Percent Panama Papers	Industry	*N* Firms	*N* Panama Papers	Percent Panama Papers
Trading	881	55	6.24%	Communication	433	5	1.15%
Mining	188	7	3.72%	Construction Materials	625	7	1.12%
Aircraft	56	2	3.57%	Beer & Liquor	179	2	1.12%
Restaurants&Hotels	303	9	2.97%	Other	7,432	74	1.00%
Insurance	39	1	2.56%	Food Products	508	5	0.98%
Real Estate	795	20	2.52%	Steel Works	417	4	0.96%
Business Services	801	20	2.50%	Agriculture	220	2	0.91%
Retail	620	15	2.42%	Computer Software	907	8	0.88%
Construction	499	12	2.40%	Consumer Goods	365	3	0.82%
Banking	224	5	2.23%	Printing and Publishing	127	1	0.79%
Recreation	91	2	2.20%	Electronic Equipment	553	4	0.72%
Petroleum and Gas	461	10	2.17%	Computer Hardware	167	1	0.60%
Personal Services	156	3	1.92%	Rubber&Plastic Products	200	1	0.50%
Coal	53	1	1.89%	Medical Equipment	203	1	0.49%
Transportation	536	10	1.87%	Chemicals	633	3	0.47%
Apparel	192	3	1.56%	Textiles	293	1	0.34%
Machinery	713	11	1.54%	Pharmaceutical Products	634	2	0.32%
Business Supplies	219	3	1.37%	Electrical Equipment	498	1	0.20%
Precious Metals	149	2	1.34%	Tobacco Products	24	-	0.00%
Automobiles and Trucks	307	4	1.30%	Healthcare	153	-	0.00%
Utilities	476	6	1.26%	Fabricated Products	67	-	0.00%
Meas.&Control Equipmt	159	2	1.26%	Ships&Railroad Equipmt	51	-	0.00%
Entertainment	163	2	1.23%	Defense	8	-	0.00%
Wholesale	674	8	1.19%	Shipping Containers	88	-	0.00%

Table D2
Univariate split for Users of Secret Offshore Vehicles

This table follows Table 1, Panel B but is split between users of Mossack Fonseca (Panama Papers), users of Appleby (Paradise Papers), variations/combinations of these users, and non-users. All variables are defined in Appendix B. All continuous variables are winsorized at the 1% and 99% levels. *, **, and *** indicate statistically significant differences at the 10%, 5%, and 1% levels, respectively.

	(1) Has Any Link (*N*=1,700)	(2) Only Panama Papers (*N*=107)	(3) Only Paradise Papers (*N*=1,362)	(4) Both (*N*=231)	(5) Neither (*N*=21,840)	(6) Col. (1)-(5)	(7) Col. (2)-(5)	(8) Col. (3)-(5)	(9) Col. (4)-(5)	(10) Col. (2)-(3)
Firm characteristics										
Total assets ($mn)	47,145	10,448	32,972	147,708	3,741	43,404***	6,707*	29,231***	143,967***	(22,524)
N Subsidiaries	106	61	92	212	16	90***	45***	76***	196***	(31)**
Has Foreign Subsidiary (1/0)	0.87	0.88	0.86	0.94	0.41	0.46***	0.46***	0.45***	0.52***	0.02
Perc. Foreign Subsidiaries	0.44	0.43	0.43	0.52	0.19	0.25***	0.24***	0.24***	0.33***	(0.00)
N Foreign Subsidiaries	14.26	7.08	13.53	21.89	2.23	12.03***	4.86***	11.30***	19.66***	(6.44)***
Has TOP4 Tax Haven Exposure	0.21	0.38	0.17	0.32	0.03	0.17***	0.35***	0.14***	0.29***	0.21***
Corruption Exposure Measures										
Corruption Exposure (1/0)	0.37	0.29	0.35	0.53	0.13	0.24***	0.16***	0.21***	0.39***	(0.06)
Political 1st Layer Exposure (1/0)	0.38	0.24	0.37	0.51	0.10	0.29***	0.15***	0.28***	0.42***	(0.13)***
Tax Avoidance Measures										
Raw Tax Avoidance	0.20	0.16	0.20	0.19	0.17	0.03***	(0.02)	0.03***	0.02*	(0.05)***
Tax Avoidance (No FE)	0.02	(0.03)	0.03	0.00	(0.01)	0.03***	(0.02)	0.03***	0.01	(0.06)**
Tax Avoidance (FE)	0.01	(0.03)	0.02	(0.01)	(0.01)	0.02**	(0.03)	0.02***	(0.01)	(0.05)*
Governance measures										
Foreign Institutional Ownership	0.13	0.09	0.13	0.16	0.05	0.08***	0.04***	0.08***	0.11***	(0.04)***
Governance Score	56	53	56	58	48	9***	5***	8***	11***	(3)**
Has Sponsored ADR (1/0)	0.13	0.17	0.11	0.21	0.03	0.10***	0.14***	0.08***	0.18***	0.05*
Has Unsponsored ADR (1/0)	0.25	0.27	0.23	0.33	0.07	0.18***	0.20***	0.16***	0.26***	0.04
Has U.S. Subsidiary (1/0)	0.38	0.35	0.36	0.46	0.16	0.21***	0.18***	0.20***	0.30***	(0.02)

Table D3
Returns of firms implicated by the leak—alternative risk factors and time periods

This table provides results of a range of robustness tests of the main specification (Table 2, Panel B, column (2)). *Has PPE* indicates whether (1) or not (0) a firm is connected to the Panama Papers, as defined in Table 1. The dependent variables the regressions for columns (1) and (2) are abnormal returns obtained from 3- and 5-factor models based on U.S. factor-mimicking portfolios (from Kenneth French's Data Library). In columns (3) and (4), *Cumulative abnormal returns* are calculated over the three trading weeks before *Event Day 1* and the three trading weeks after *Event Day 3*, respectively. Appendix B provides variable definitions. All continuous variables are winsorized at the 1% and 99% levels. Fixed effects as well as a size control are included as indicated. Standard errors are clustered at country and industry level (2-way cluster). *t*-statistics are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Model	3-Factor	5-Factor	1-Factor	1-Factor
Period	Event	Event	Before Event	After Event
Has PPE x Event day	-0.791***	-0.689***	0.065	-0.026
	(-2.94)	(-3.42)	(0.18)	(-0.08)
Controls	Size	Size	Size	Size
Country FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
N	23540	23540	23500	23353
Adj. R^2	0.088	0.084	0.078	0.060

Table D4
Summary statistics for Panama Paper exposure types

This table is based on all firms exposed to the leak and provides summary statistics for types of Panama Paper exposure. *Dummy* (*Has active link*) is a dummy variable equal to one if a firm has at least one link to a Mossack Fonseca vehicle that has not been inactivated by April 2016. *Years since first link* and *Years since last link* denote the number of years that have passed since the first link to one of the Mossack Fonseca vehicles was established, and the number of years since the last Mossack Fonseca vehicle was deactivated (excluded if at least one link is still active), using 2016 as the base year. Further variables of interest include the number of distinct links between firm and leaked data, the number of such links that are still active, the number of distinct firm officers linked to the leaked data, and the number of distinct Mossack Fonseca vehicles a firm is linked to.

	N	Mean	SD	Min	Median	Max
Dummy (Has active link)	338	69.2%	46.2%	0%	100%	100%
Years since first link	338	13.5	6.8	1	13	32
Years since last link	104	6.1	4.8	1	5	23
Number of links	338	9.9	47.7	1	1	591
Number of active links	338	3.8	15.0	0	1	143
Number of distinct active officer links	338	2.4	5.6	0	1	63
Number of distinct active vehicles linked to	338	9.7	47.5	1	1	591

Table D5
Secret and observable offshore connections

This table provides returns of listed firms around the leak. The dependent variable in the regressions is *Cumulative raw return* in column (1) and *Cumulative abnormal return* in column (2) as defined in Table 2. *Exposure of Secret Activity* [*Exposure of Observable Activity*] is a dummy variable that takes a value of 1 if a person or an intermediary [an entity] listed in the leaked data is connected to a subsidiary of a firm in our sample, an officer of a firm in our sample, or an officer of a sample firm's subsidiary, but if no entity [person or intermediary] in the leaked data is connected to a subsidiary of a firm in our sample, an officer of a firm in our sample, or an officer of a sample firm's subsidiary. *Both Types of Exposure* is a dummy variable that takes a value of 1 if both an entity and a person or an intermediary in the leaked data are connected to one of our sample firms. Appendix B provides variable definitions. All continuous variables are winsorized at the 1% and 99% levels. Country and industry fixed effects (Fama–French 49) as well as a control for size are included as indicated. Standard errors are clustered at country and industry level (2-way cluster). *t*-statistics are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)
Dependent variable	Raw Returns	Abnormal Returns
Exposure of Observable Activity	0.465	0.496
	(0.76)	(0.73)
Exposure of Secret Activity	-1.322***	-0.941***
	(-3.62)	(-3.63)
Both Types of Exposure	-0.528	-0.493
	(-0.53)	(-0.90)
Controls	Size	Size
Country FE	Yes	Yes
Industry FE	Yes	Yes
N	23,540	23,540
Adj. R^2	0.170	0.094

Appendix E

Additional evidence on trading

In the following, we describe results from an analysis of additional data sources that might help illuminate who is trading around the data leak, and based on what information. Our setting mirrors well standard microstructure models, such as Glosten and Milgrom (1985) and Kyle (1985), where traders with heterogeneous information about SOVs trade with each other as the data leak and the information contained in it unravel. Unfortunately, in our cross-country setting, it is especially challenging to identify information-based trading. Nevertheless, we outline trading motives and present results from three separate data sources for trading activity: short sellers, insiders, and institutional investors. We also outline the limitations of each data set, among them the lack of global coverage and the possibility of traders contained in a dataset trading among themselves.

E.1 Short-selling

Rather than selling stocks already held, some investors might take on short positions to further benefit from SOV users being exposed. If investor expectations of net profits from such trades are positive, we would expect an increase in short interest in firms exposed to the data leak, especially around Day 2. We use bi-weekly short interest from Compustat and calculate the percentage change in the level of short interest at the firm level around our event dates. We test whether exposed firms have abnormal changes in short interest vis-à-vis unexposed firms and report the results in Table E1. We find no evidence of abnormal short selling. A limitation is that Compustat data are limited to large firms traded in U.S. markets. Therefore, this analysis covers a mere 45 (13%) of our 338 exposed firms.

Table E1
Change in short interest around the Panama Papers data leak

This table shows the average percentage change in short interest (from the previously available date) for firms with and without exposure to the Panama Papers data leak. The column labelled *Difference* captures the difference in means between the two groups for the full sample of firms. *Difference Matched* captures the difference between firms with and without exposure whether firms are matched by size (closest neighbor match with replacement, within 30% of total assets). The change in short interest is winsorized at the 1% and 99% levels. None of the differences are statistically significant.

	Firms with Panama Papers Exposure		Firms without Panama Papers Exposure		*Difference*	*Difference Matched*
Date	#Firms	Mean	#Firms	Mean		
Feb 29, 2016	44	-0.92%	2,844	5.82%	6.74%	4.08%
Mar 15, 2016	45	-0.85%	2,864	15.30%	16.15%	3.04%
Mar 31, 2016	45	0.20%	2,885	6.06%	5.86%	-14.54%
Apr 15, 2016	46	-2.68%	2,887	2.57%	5.25%	-2.17%
Apr 29, 2016	44	-2.97%	2,872	0.41%	3.39%	0.60%
May 13, 2016	47	12.76%	2,856	7.51%	-5.25%	-8.45%
May 31, 2016	47	7.93%	2,845	11.34%	3.41%	-0.79%
Jun 15, 2016	46	-0.94%	2,832	8.53%	9.46%	-1.01%
Jun30, 2016	44	3.75%	2,843	55.93%	52.17%	-29.93%
Jul 15, 2016	46	0.28%	2,827	5.43%	5.15%	0.45%
Jul 29, 2016	44	-1.27%	2,824	0.16%	1.42%	-7.57%

E.2 Insider trading

Corporate insiders might opportunistically sell as soon as they learn that firms' use of SOVs will become public knowledge. At the same time, they may decide against trading on inside information, since, as you note in your comment, insiders may face lawsuits over violations of insider trading regulations. In fact, around the Panama Papers data leak, insiders may have received specific legal advice concerning trading. We examine insider trades at the monthly level using the Thomson Reuters insider filings database. In Table E2, we analyze the monthly dollar volumes

of shares sold by insiders of exposed and unexposed firms in 2016. We find that there is no difference in trading activity between insiders of exposed and unexposed firms around the leak. We evaluated different empirical strategies, and all of them deliver similar results. Our results are also similar if we consider only opportunistic insider trades, following Cohen, Malloy, and Pomorski (2012). Again, a limitation is that this analysis is limited to large firms traded in U.S. markets.

Table E2
Insider Trades around the Panama Papers data leak

This table shows the average dollar volume (in million USD) of insider sales for firms with and without exposure to the Panama Papers. The column labelled Difference captures the difference in means between the two groups for the full sample of firms. Difference Matched captures the difference between firms with and without exposure whether firms are matched by size (closest neighbor match with replacement, within 30% of total assets). *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Firms with Panama Papers Exposure		Firms without Panama Papers Exposure		*Difference*	*Difference Matched*
Date	#Firms	Mean	#Firms	Mean		
Jan 2016	35	0.21	1,691	0.18	-0.03	0.45
Feb 2016	35	0.90	1,691	0.55	-0.35	-0.01
Mar 2016	35	0.47	1,691	0.59	0.12	-0.39
Apr 2016	35	0.54	1,691	0.44	-0.10	0.24
May 2016	35	2.07	1,691	1.07	-1.00	-1.75
Jun 2016	35	0.14	1,691	0.35	0.20	0.11
Jul 2016	35	1.34	1,691	0.35	-0.99***	-1.43**
Aug 2016	35	1.19	1,691	0.92	-0.27	-0.86
Sep 2016	35	0.96	1,691	0.37	-0.60*	-0.57
Oct 2016	35	0.52	1,691	0.17	-0.35**	-0.15
Nov 2016	35	1.84	1,691	0.80	-1.04	0.46
Dec 2016	35	0.51	1,691	0.41	-0.11	-0.37*

E.3 Trading by institutional investors

We also consider trading by institutional investors, who may wish to disinvest from exposed firms. We measure institutional ownership using the FactSet's ownership database, which reports institutional investors' equity holdings internationally from a variety of sources (e.g., Ferreira and Matos 2008). We test whether firms exposed to the leak experience changes in institutional ownership that are significantly different from changes experienced by unexposed firms. Results are presented in Table E3. We find no significant differences in institutional ownership. We repeat our analysis using panel regressions with year-quarter and firm fixed effects and obtain similar results (results untabulated). While coverage is not a concern for this data source, one challenge with this data arises from the fact that some institutional owners with incentives to disinvest might sell to other institutional owners, thereby generating a zero net effect.

Table E3
Changes in institutional ownership around the Panama Papers data leak

This table shows the average quarter to quarter change of institutional ownership for firms with and without exposure to the Panama Papers. The column labelled Difference captures the difference in means between the two groups for the full sample of firms. Difference Matched captures the difference between firms with and without exposure whether firms are matched by size (closest neighbor match with replacement, within 30% of total assets). None of the differences are statistically significant.

Quarter	Firms with Panama Papers Exposure		Firms without Panama Papers Exposure		*Difference*	*Difference Matched*
	#Firms	Mean Diff. Inst. Ownership	#Firms	Mean Diff. Inst. Ownership		
Sep 30, 15	316	0.02%	15,809	0.11%	0.09%	0.07%
Dec 31, 15	317	-0.05%	15,732	0.22%	0.28%	-0.22%
Mar 31, 16	319	-0.13%	15,956	-0.08%	0.05%	-0.06%
Jun 30, 16	317	-0.06%	15,861	0.06%	0.11%	0.09%
Sep 30, 16	314	-0.04%	15,770	0.10%	0.14%	0.16%
Dec 31, 16	311	0.26%	15,641	0.31%	0.05%	0.17%