The deterrence effect of whistleblowing*

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Abstract

We document that the first leak of customer information from a tax haven bank caused a sudden flight of deposits from tax havens and a sharp decrease in the market value of banks known to be assisting with tax evasion. The loss of market value was largest for the banks most strongly involved in tax evasion and zero for banks with no known ties to tax evasion. Subsequent leaks had qualitatively similar although smaller effects. Our findings suggest that whistleblowing in tax haven banks deters offshore tax evaders by increasing the perceived risk of committing and assisting with tax evasion.

Keywords: whistleblowing, economic crime, tax evasion, tax havens

JEL codes: G21, H26, K42

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1 Introduction

In the digital age, whistleblowing scandals have become the order of the day. Anyone holding confidential information can easily make it available to the rest of the world by posting it online and organizations like *WikiLeaks* have specialized in receiving, processing and disseminating leaked information.

Whistleblowers are celebrated as "the heroes of our time" who are "contributing to ethics and integrity" (UN, 2016) and whose legal protection is considered an important concern for public policy (Economist, 2015). In the public debate, it is often presumed that whistleblowing does not merely lead to sanctions against the individuals and companies whose illegal or immoral actions are exposed, but affects and improves behavior more broadly; for instance that athletes were deterred from using illicit drugs when whistleblower Yuliya Stepanova revealed the existence of a large-scale Russian doping program and that radical islamists became less inclined to join the army of the Islamic State when the former insider Abu Hamed exposed the identities of thousands of secretly enlisted jihadis. Such responses would be consistent with standard economic theories of crime (Becker, 1968), in which whistleblowing should act as a deterrent of criminal behavior by increasing the likelihood of exposure and, thus, of legal as well as other social sanctions.

This study provides empirical evidence on the deterrence effect of whistleblowing in the context of offshore tax evasion. Specifically, we investigate whether leaks of customer information from banks in tax havens have deterred the criminal use of offshore banking services. While bank accounts in tax havens are not illegal *per se*, they often serve to evade taxes, which makes account holders and sometimes also the bankers assisting with the tax evasion, liable to criminal prosecution.[1] Hence, for many owners of tax haven accounts as well as for bankers in tax havens, leaks of customer files involve a risk of legal sanctions if the information is acquired by the tax authorities and public humiliation if posted online.

Our main results concern the first whistleblowing affair exposing tax evasion in tax havens: customer files from *LGT Bank* in Liechtenstein were extracted by a former

[1] Documents published in the context of a court case against the Swiss bank UBS show that around 90% of the bank's US customers were not tax compliant (US Senate, 2008). Besides hundreds of account holders, several UBS bankers were prosecuted for assisting with tax evasion including the whistleblower, Bradley Birkenfeld, and the head of the bank's global wealth management division, Raoul Weil.

computer technician at the bank, Heinrich Kieber, and distributed to tax authorities in several countries.[2] The leak became publicly known on 14 February 2008, when German police raided the premises of Klaus Zumwinkel, the chief executive of Deutsche Post, and detained him on charges of tax evasion. It soon became clear that the charges were based on leaked customer files that also contained incriminating information about hundreds of other German tax evaders. The affair attracted global attention and was prominently covered by media such as The New York Times, Le Monde, Die Welt and El Pais in the following days.

In the first part of the analysis, we use country-level data from the Bank for International Settlements (BIS) to document that the data leak from *LGT Bank* coincided with a significant decrease in foreign-owned bank deposits in tax havens compared to other international banking centers. While cross-border deposits evolved very similarly in havens and non-havens before the leak, we observe a sharp divergence during the first quarter of 2008 with deposits in havens decreasing by more than 10% relative to deposits in non-havens. The timing implies that this striking pattern cannot easily be explained by the tax enforcement efforts conducted by many governments in the wake of the financial crisis: the legal cases against Swiss banks in U.S. courts, most famously the case against UBS, began in August 2008 and the crucial event in compelling tax havens to exchange information about suspected tax evaders occurred in April 2009 (Johannesen and Zucman, 2014). Moreover, there is no similar decrease in interbank deposits, which reassures us that we are not picking up the effects of a confounding shock to banks in tax havens related to the global financial crisis in 2007-2008. Finally, because the data covers almost all cross-border deposits in the world, also when owned through shell companies or trusts, our results are unlikely to reflect shifting of assets to more secretive tax havens or more sophisticated evasion techniques.

These results are clearly consistent with a significant decrease in the use of criminal offshore banking services in response to the leak. Since offshore tax evasion had never previously been exposed in leaks, offshore account owners and bankers most likely did not account for this risk before the leak from LGT Bank.[3] Alternatively, they may have

[2]Banks in tax havens have been subject to other types of whistleblowing cases, for instance the leak of documents concerning Nazi accounts from the Swiss bank UBS in 1997.

[3]Formal models of choice under uncertainty typically assume that decision-makers are aware of all possible outcomes, but unawareness has been studied theoretically in the literature on bounded rationality

assigned a very small probability to the possibility of a leak and updated their beliefs about this probability the first time a leak occurred. In either case, an increase in the perceived probability of a leak should be expected to deter the demand and supply of criminal offshore banking services and reduce the stock of deposits related to evasion in tax havens.

One might still be concerned, however, that the results are driven by other shocks coinciding with the LGT leak but unrelated to offshore tax evasion. To improve identification, it would be useful to observe deposit stocks at a higher frequency, so as to zoom in on a narrower time window around the data leak, and, instead of comparing heterogeneous havens and non-havens, to compare banks in the same haven with differing levels of involvement in offshore tax evasion. Unfortunately, deposit information from the BIS is only available once per quarter and aggregated to the country-level.

In the second part of the analysis, we therefore turn to stock-market data, which are available at the daily frequency and at the level of individual banks. Employing a standard event study framework (Kothari and Warner, 2007), we estimate the effect of the LGT data leak on the stock prices of banks in tax havens. Stock prices reflect the net present value of expected future profits given all available information (Fama, 1991); hence, if we observe a drop in the stock prices of these banks precisely at the time when customer information is leaked, this is plausibly because financial markets expected the profits associated with criminal offshore services to decrease. A decrease in expected profits could derive either from the offshore banking market's demand side (an inward shift in the demand curve) or supply side (an outward shift of the cost curve), which in both cases would reflect a lower equilibrium quantity of offshore evasion.[4]

For the purposes of this analysis, we carefully select a sample of offshore banks that are *known* to have foreign tax evaders among their customers. We start from the full sample of banks in Switzerland, which dominated the global wealth management industry at the time of the LGT leak with a market share of around 35% (Zucman, 2013).[5] Within this sample, we focus on a subsample of banks that have admitted to assisting U.S. taxpayers

(e.g., Dekel et al., 1998).

[4] Alstadsæter et al. (2019) develop a formal model of the supply side of the market for offshore services where an exogenous shock to the risk of detection induces offshore banks to shed customers with relatively few assets under management.

[5] Since 2008, Swiss banks have lost market shares (Alstadsæter et al., 2018), presumably because of recent changes in the Swiss banking secrecy rules.

with tax evasion. Starting with the case against the Swiss bank UBS in 2008, the U.S. government has investigated 16 Swiss banks for their complicity in tax evasion leading to settlements with a combined value of more than $4 billion. Subsequently, another 80 Swiss banks have admitted to tax-related criminal activities in the U.S. under the *Swiss Bank Program*, which allows banks to resolve criminal liabilities through full disclosure of their cross-border activities and payment of appropriate penalties. From this gross sample of 96 Swiss banks with a known link to offshore tax evasion, our estimating sample includes the 46 banks that are listed on a stock exchange.

We find that the LGT leak caused a significant decrease in the market value of Swiss banks involved in offshore tax evasion. The banks in our sample tracked the normal return closely in the ten days preceding the leak, but earned an abnormal return of -1.1% over the first two days after the leak and -2.2% over the first four days following the leak. The estimated stock market responses are larger and sharper when returns are weighted by market capitalization; here, we find an abnormal return of -2.1% over two days and -3% over four days. In either case, the cumulative abnormal returns are statistically significant based on standard parametric tests as well as non-parametric tests comparing abnormal returns after the leak to the empirical distribution of abnormal returns in the pre-leak period.

These findings are suggestive that the leak from LGT Bank lowered market expectations about the future earnings of tax haven banks that assist foreign customers with tax evasion. Our preferred interpretation is that markets perceived the leak as an effective deterrent of offshore tax evasion, which is consistent with the flight of bank deposits from tax havens observed in the first quarter of 2008. By contrast, the loss of market value is unlikely to reflect the anticipation of penalties. Since the LGT Bank is not part of our estimating sample, any anticipation in the markets that this bank would face penalties because of the secrets exposed in the leak should not affect our estimates. Moreover, the penalties ultimately paid by Swiss banks in the U.S. were only a small fraction of the estimated loss of market value of around $27 billion.

A number of additional empirical tests support our interpretation of the main result and provide further evidence of the mechanisms at play. First, we show that other Swiss banks than those with known links to offshore tax evasion did not earn abnormal

returns in the days after the leak. These banks are smaller, presumably catering almost exclusively to domestic customers and therefore have little or no involvement in tax evasion. The finding reassures us that the main results are not driven by confounding shocks affecting the entire Swiss financial sector and supports the interpretation that the negative abnormal returns earned by banks in the baseline sample are related to their role in tax evasion. Second, we explore the heterogeneity of the stock market responses within the baseline sample and find a much larger decrease for the banks that were investigated by U.S. prosecutors (abnormal return of -6.1% over four days) than for the banks that subsequently resolved their criminal liabilities voluntarily (abnormal return of -1.2% over four days). Presumably, U.S. prosecutors selected Swiss banks for investigation based on *ex ante* information about their involvement in offshore tax evasion, so market participants with a similar information set would plausibly expect the same banks to be most adversely affected by an increase in the risk associated with offshore tax evasion. We obtain qualitatively similar results with an *ex post* measure of the involvement in offshore evasion based on the size of the penalties paid to the U.S. This set of results further strengthens the causal link between the banks' loss of market value around the time of the LGT leak and their role in offshore tax evasion.

The results concerning the LGT leak raise the question whether subsequent leaks from tax havens had a similar deterrence effect. We study this question by manually searching all front pages of a major Swiss newspaper, *Neue Zürcher Zeitung*, between January 2008 and October 2016 and employing our empirical framework to the 12 other instances where an article covered a newly leaked list of customers at offshore banks or service providers or a significant new dissemination of such a list. These events include the leak from the bank *HSBC Switzerland* (later known as *Swiss Leaks*) and from the law firm *Mosack Fonseca* (known as *Panama Papers*). We find some evidence of modestly sized deposit responses but only weak signs of stock market responses to these leaks. Overall, the results are suggestive that the very first leak led offshore account owners and bankers to incorporate the risk of whistleblowing into the calculus of tax evasion whereas subsequent leaks were associated with a much smaller, if any, updating of the beliefs about this risk.

While a number of studies have investigated which conditions are conducive to whistle-

blowing (Dyck et al., 2010), we are not aware of any existing quantitative evidence on the ability of whistleblowing to deter crime. Most relatedly, a large literature with contributions from scholars in law, economics and criminology explores the role of transparency and public information in deterring criminal behavior more broadly. For instance, legal scholars have argued that the public shaming of criminals is an efficient way to deter white-collar crime (Kahan and Posner, 1999) and economists have documented that publishing individual-level information about reported taxable income reduces tax evasion (Bo et al., 2015).

Our study also contributes to a small literature investigating the factors that shape offshore tax evasion, for instance, tax rates on capital income (Hanlon et al., 2015), tax enforcement (Johannesen and Zucman, 2014) and tax amnesties (Johannesen et al., 2018; Langenmayr, 2015). Our results suggest that the emergence of whistleblowers from the ranks of employees in tax haven banks has the potential to curb offshore tax evasion. To put the estimated magnitude of the deterrence effect into perspective, the estimated 10% decrease in offshore deposits following the LGT leak compares to a 15% decrease in offshore deposits following the signature of bilateral information exchange treaties (Johannesen and Zucman, 2014) and a decrease in unreported offshore wealth of around 12% in response to the U.S enforcement efforts in 2008-2009 (Johannesen et al., 2018).

Finally, our study adds to an emerging literature studying how stock prices respond to data leaks and other news about tax aggressive behavior. For instance, O'Donovan et al. (2017) document that firms whose offshore affiliates were exposed in the *Panama Papers* suffered significant losses in market value when the leak was published and Hanlon and Slemrod (2009) show a similar pattern around news stories documenting firms' use of domestic tax shelters. While these papers are suggestive that media exposure of firms' aggressive tax planning may limit these firm's ability to avoid taxes in the future, they do not provide evidence of a broader deterrence effect extending beyond the specific taxpayers exposed in the media.

The paper proceeds in the following way. Section 2 provides background information about the institutional setting and whistleblowing in tax havens. Sections 3 and 4 report the analysis of deposit data and stock market data respectively. Section 5 concludes.

2 Background

2.1 Offshore tax evasion

A recent study estimates, exploiting systematic inconsistencies in international investment positions, that household wealth in tax havens globally amounts to at least $6,000 billion or, equivalently, around 8% of households' total financial assets (Zucman, 2013). Most of this wealth is held in Switzerland but there are other tax havens with major wealth management industries including Luxembourg, Singapore, Hong Kong and the Bahamas. While holding assets in a tax haven is perfectly legal if the account is disclosed to the tax authorities, a recent study finds, using leaked customer data from the bank HSBC Switzerland combined with tax return data from Denmark, Norway and Sweden, that the vast majority of the offshore wealth is, in fact, not disclosed (Alstadsæter et al., 2019). Moreover, the same study finds that the assets hidden in HSBC are extremely concentrated among the wealthiest and that as many as 50% of the Scandinavian households at the very top of the wealth distribution hide assets on offshore accounts. This figure is likely to be even higher in most other countries since Scandinavians own little offshore wealth by international standards (Alstadsæter et al., 2018). Together these studies suggest that offshore tax evasion is a fairly widespread criminal activity, at least in the wealthiest segments of the population, and a major challenge for policy.

In response to this challenge, governments have recently enacted a number of enforcement initiatives: in May 2005, the European Union agreed with a number of tax havens to tax the interest income accruing to accounts owned by European residents and remit the revenue to the home country (Johannesen, 2014); in August 2008, the U.S. Department of Justice started a series of legal cases against Swiss banks, most famously the UBS, for their role in assisting U.S. citizens with tax fraud; in April 2009; the G20 compelled all tax havens in the world to accept a weak form of cooperation whereby they would lift the banking secrecy and provide information about account holders suspected of tax evasion when requested by foreign tax administrations (Johannesen and Zucman, 2014); and most recently, many tax havens have agreed to provide financial account information about foreign taxpayers on an automatic basis (Omartian, 2016; Stolper, 2017).[6] In

[6] Account information is provided to the U.S. under the Foreign Account Tax Compliance Act (FATCA) and to other countries under the Convention on Mutual Assistance in Tax Matters as amended

addition, many countries, including the U.S., now operate voluntary disclosure programs under which cooperating tax evaders benefit from reduced penalties and avoid criminal sanctions (Johannesen et al., 2017; Langenmayr, 2015).

2.2 Whistleblowing in tax havens

The offshore secrets of private individuals and multinational firms have been exposed numerous times in recent years by whistleblowers in banks (e.g. HSBC in Switzerland), accounting firms (e.g. PriceWaterHouseCoopers in Luxembourg), law firms (e.g. Mossack Fonsecka in Panama) and governments (e.g. corporate registry in the Bahamas). The secret documents leaked by the whistleblowers range from customer files related to offshore bank accounts and shell corporations to advance tax agreements between multinational firms and tax haven governments. A number of commentators and policy makers have argued that whistleblowing should be actively promoted by governments as a means to combat offshore crimes.

The main focus of this paper is the first instance of whistleblowing involving an offshore bank: the leak of customer data from the Liechtenstein-based LGT Bank. According to journalistic accounts, the leak occurred in 2002 when a computer technician at the bank, Heinrich Kieber, extracted confidential customer information from the bank's IT systems. After leaving the bank, he approached the German intelligence agency in 2006 and ultimately sold them a CD-rom with information about the bank's customers in Germany for around €4.2 million. The data leak became publicly known on 14 February 2008 when the German policy raided the premises of Klaus Zumwinkel, a prominent corporate executive and detained him on charges of tax evasion after months of secret investigations. The case was immediately picked up by major media outlets, which also reported that the tax evasion scandal involved hundreds of further suspects. On 15 February, several news media reported that the German intelligence service, Bundesnachrichtendienst (BND), was involved in the case and, on 16 February, the German magazine *Der Spiegel* reported that BND had paid a whistleblower for the information leading to the arrest of Klaus Zumwinkel.[7]

in 2014.

[7] See http://www.spiegel.de/wirtschaft/finanzskandal-bnd-zahlte-fuenf-millionen-fuer-geheime-steuerdaten-a-535687.html (last accessed on 15 February 2017).

The LGT leak in 2008 was, to our knowledge, the first data leak from a tax haven to expose offshore tax evasion; however, several others followed in the subsequent years. We have systematically collected information about these leaks by manually searching all front pages of a major Swiss newspaper, *Neue Zürcher Zeitung*, published between January 2008 and October 2016. Concretely, we searched each front page for the keywords *Steuer* ("tax"), *Bank* ("bank"), *Info* ("information") and *Daten* ("data") and manually screened the headlines of all articles on the front pages. For every hit, we read the article to determine whether or not it referred to a data leak from a tax haven.[8] Finally, we searched the articles about data leaks for a reference to the date when the leaks became publicly known; when an article does not mention any date, we assume that the leak occurred one calendar day prior to the article's publication date. The implicit assumption underlying this approach is that data leaks with sufficient significance for Swiss banks to move their stock prices would be reported on the front pages of Swiss newspapers.

As detailed in Table 1, we identified 13 front page articles that concern new data leaks or significant new dissemination of information from existing leaks. Several of the articles reported the major leak from HSBC Private Bank in Switzerland. First, on 30 August 2009, the French budget minister Eric Woerth announced that his ministry was in possession of a list of 3,000 French taxpayers holding a total of €3 billion in Swiss bank accounts, but he did not disclose the source of the leak. Then, on 9 December 2009, French media reported an alleged data theft at HSBC, which was confirmed on 13 December 2009, when *Hervé Falciani* revealed himself as the HSBC whistleblower on French prime time television. Eventually, in February 2015, the *International Consortium for Investigative Journalists* (ICIJ) gained access to the HSBC customer lists and published them as the *Swiss Leaks*, thereby exposing hundreds of prominent tax evaders to public scrutiny.

Table 1 around here

[8] We excluded all articles about the Hildebrand affair. Philipp Hildebrand is a former president of the Swiss National Bank whose wife bought more than half a million U.S. dollars in August 2011, just one month before the Swiss National Bank capped the exchange rate of the Swiss franc. While the Hildebrand affair was triggered by a bank employee leaking information of this transaction, the data leak was limited to Philipp Hildebrand and was never intended to identify any foreign tax evaders. A list of all other articles can be requested from the authors.

3 Analysis of cross-border deposits

3.1 Data

In this section, we study the deterrence effect of the LGT whistleblowing affair by exploiting data from the Locational Banking Statistics of the Bank for International Settlements (BIS). This publicly available data source provides information on the stock of foreign-owned bank deposits in 47 international banking centers, including all major tax havens, at a quarterly frequency.[9] The deposit information in the Locational Banking Statistics is reliable because the primary source is the banks' own balance sheets. To our knowledge, this country-level measure of foreign-owned deposits is the only aggregate statistic that captures activities in the wealth management sector in a large number of tax havens and the measure is used extensively in the emerging literature on offshore wealth (e.g. Andersen, et al. 2017; Johannesen and Zucman, 2014; Johannesen, 2014; Zucman, 2013).

Conveniently, the BIS data distinguishes between cross-border deposits that are owned by banks and non-banks. Our main variable of interest is deposits owned by non-banks, which include deposits held by households for tax evasion purposes whether directly or through shell corporations. Deposits owned by banks reflect the global inter-bank market for funding and are presumably entirely unrelated to offshore tax evasion.

As shown in Table 2, cross-border deposits owned by non-banks amounted to around $7,700 billion globally at the time of the LGT leak and well-known tax havens such as the Cayman Islands, Switzerland, Singapore and Luxembourg were among the countries that attracted most foreign deposits.[10] The table also provides country-level information about the variation that ultimately drives our difference-in-difference estimates by indicating the growth in deposits between the observation immediately before the LGT leak (2007q4) and the last observation of the sample period (2008q3).

Table 2 around here

[9] An important property of the Locational Banking Statistics for our purposes is that it assigns deposits of multinational banks to the residence countries of the appropriate deposit-taking branches and subsidiaries. For instance, deposit accounts at HSBC Switzerland and HSBC London are assigned to Switzerland and the UK respectively.

[10] Note that assets such as bonds and shares are not included in the figures. The available evidence suggests that deposits account for around 25% of the total financial wealth managed in tax havens (Zucman, 2013)

3.2 Empirical strategy

Our goal is to investigate whether the LGT leak in February 2008 caused a decline in the use of secret offshore accounts. Our empirical strategy exploits that international banking centers, at least at the time of the leak, were highly heterogeneous with respect to their legal environment. One class of banking centers, havens, generally did not provide bank information to foreign tax administrations in cases of simple tax evasion, for instance with reference to banking secrecy rules, whereas another class of banking centers, non-havens, were committed to assisting foreign countries with tax enforcement through information exchange, both spontaneously and upon request. Under the assumption that banks in non-havens generally had few foreign tax evaders among their customers, deposits in these jurisdictions were plausibly unaffected by the LGT leak. Under the further assumption that other shocks to banks were uncorrelated with the legal environment, the evolution of deposit stocks in non-havens can be used to infer how deposit stocks in havens would have evolved in a counterfactual world without the LGT leak, and thus allow us to identify the effect of the leak on deposits in havens.[11]

Concretely, we define a list of 18 havens, corresponding roughly to the list of non-cooperative jurisdictions published by the OECD at the eve of the first global crackdown on havens in 2009 (Johannesen and Zucman, 2014; OECD, 2009) and define the remaining 29 countries that report to the BIS statistics as non-havens.[12] To be able to meaningfully compare deposit stocks across international banking centers of very different sizes, we define a country-level deposit index that expresses the stock of deposits in a given quarter relative to the stock at the end of 2007q4, the last observation before the data leak:

$$deposit\ index_{it} = \frac{deposits_{i,t}}{deposits_{i,t=2007q4}} \cdot 100 \tag{1}$$

[11] Our empirical strategy is not robust to differential shocks to owners of accounts in havens and non-havens. In principle, we cannot exclude that households with accounts in havens suffered a major differential liquidity shock at the time of the LGT leak, which induced them to repatriate deposits on offshore accounts.

[12] Our list of tax havens comprises the following countries: Austria, Bahamas, Bahrain, Belgium, Cayman Islands, Curacao, Cyprus, Guernsey, Hong Kong, Isle of Man, Jersey, Luxembourg, Macao, Malaysia, Netherlands Antilles, Panama, Singapore and Switzerland. These are all on the list of jurisdictions that had not implemented the global standard of international cooperation in tax matters published by the OECD prior to the G20 summit in April 2009 except for Macao and Hong Kong, which were omitted from the OECD list due to political pressure from China (see "G20 declares door shut on tax havens," *The Guardian*, 2 April 2009).

We compute the index separately for deposits owned by non-banks ("household deposit index") and by banks ("interbank deposit index").[13]

3.3 Results: The LGT leak

We first plot the average value of the household deposit index, for havens and non-havens respectively, over a two-year time window before and after the LGT leak.[14] As shown in Figure 1, deposits evolved very similarly in the two country groups before the data leak with steady quarterly increases. However, between the end of 2007q4 and the end of 2008q1, we observe a sharp divergence with a continued strong deposit growth in non-havens and close to zero growth in havens. This pattern suggests that the LGT leak deterred the use of offshore accounts for tax evasion purposes.[15]

Figure 1 around here

By contrast, as shown in Figure 2, interbank deposits evolved very similarly in havens and non-havens throughout the period with no signs of divergence at the time of the LGT leak. If anything, interbank deposits grew slightly faster in havens than in non-havens during 2008q1. This can be seen as a placebo test of the deterrence effect of the LGT leak: under the assumption that interbank deposits play no role in offshore tax evasion, we should not expect the leak to reduce interbank deposits in havens. It also suggests that the differential decrease in the household deposit index was not caused by a confounding shock to the financial sector in havens affecting all types of deposits.

Figure 2 around here

[13] Note that the term "household deposit index" is chosen for ease of reference; it also includes deposits owned by multinational firms.

[14] The index is only defined for the 41 countries that started reporting in 2007q4 or earlier (16 tax havens and 25 non-havens). We also exclude Malaysia, which started reporting in 2007q4 and therefore have no index values in the full pre-leak period. Finally, we exclude two very small banking centers, Mexico and Turkey, with foreign-owned deposits below $1 billion in 2007q4. Hence, our final sample comprises 38 banking centers (15 tax havens and 23 non-havens).

[15] We obtain qualitatively similar results when weighing the index with levels of deposits in 2007q4.

For the purposes of statistical inference, we run simple linear regressions for the same time period with the deposit indeces as dependent variables and a vector of time dummies (Ω_t), a tax haven dummy ($haven_i$) and their interactions as explanatory variables.

$$deposit\ index_{it} = \alpha + \gamma\Omega_t + \beta haven_i + \delta\Omega_t \times haven_i + \varepsilon_{it} \tag{2}$$

We illustrate the results by plotting the estimated coefficients on the interaction terms (the vector δ) and their confidence intervals based on standard errors clustered at the country-level. As shown in Figure 3, the divergence in the household deposit index in 2008q1 is strongly statistically significant. Under the identifying assumption that foreign-owned deposits would have evolved similarly in havens and non-haven countries absent the leak from LGT Bank, the results imply that the leak caused a sudden decrease in the deposits held in havens of more than 10 percentage points. The divergence in the interbank deposit index is much smaller and clearly not distinguishable from zero. Table A1 in the Appendix reports the detailed regression results.

Figure 3 around here

3.4 Results: Subsequent leaks

To investigate whether the subsequent data leaks from banks in havens were associated with similar decreases in deposits, we use a slightly modified regression framework :

$$\Delta deposit\ index_{it} = \alpha + \gamma\Omega_t + \beta haven_i + \delta haven_i \times leak_t + \varepsilon_{it} \tag{3}$$

Controlling flexibly for the general time trend in deposits (with Ω_t) and allowing for differential average deposit growth rates in havens and non-havens (with $haven_i$), we ask whether quarters with data leaks are associated with differential changes in deposits in havens relative to non-havens (the difference is captured by $leak_t \times haven_i$). Note that the main effect of the leaks ($leak_t$) is not identified due to the time fixed effects. To reduce

the impact of large outliers, we winsorize the outcomes at the 1^{st} and 99^{th} percentile.[16]

Table 3 first shows that the effects of the LGT leak estimated in the modified framework are consistent with our earlier findings: the household deposit index decreases by around 12 index points in havens relative to non-havens in the quarter of the leak (Column 1). Accounting for lagged effects of the leak has virtually no effect on this estimate and the lagged effects themselves are relatively small and statistically insignificant (Columns 2). Next, the table shows that later data leaks also coincided with differential decreases in deposits in havens, although smaller than in the case of the first leak (Columns 3-4). In both specifications, the point estimate is around -2.5 index points with a lower bound of the confidence interval around -5 index points.

Table 3 around here

These findings suggest that the first instance of whistleblowing acted as a strong deterrent of offshore tax evasion by increasing the risk of involuntary exposure as perceived by account holders and banks while later leaks were associated with much smaller behavioral responses. It seems intuitive that the first data leak had a larger effect on perceived risk than subsequent leaks since offshore account owners and bankers most likely assigned a very small - or even zero - probability to the possibility of a leak before this event.

3.5 Results: The role of salience

An alternative explanation for the finding that the LGT leak triggered larger responses than subsequent leaks relates to differences in salience; perhaps the first leak received the most news coverage and was therefore known by more owners of offshore accounts. By construction, all the leaks in our sample were covered on the front page of *Neue Zürcher Zeitung*, but even within this sample of relatively salient leaks, important differences may remain.

To explore this hypothesis, we use the volume of internet searches for four keywords, all relating to data leaks from tax havens, as a measure of salience. The assumption is that the volume of internet searches reflects the overall level of attention directed to

[16] Without winsorizing, the minimum and the maximum are -398 and 531 respectively. With winsorizing at the 1st and 99th percentiles, they become -30 and 44 respectively.

a leak and thus provides information about the salience of the leak.[17] Specifically, we use monthly indicators of global search volumes from Google Trends scaled to 100 in the sample month with the highest volume. As shown in Figure 4, searches for "Tax evasion" peaked in April 2016, when leaked files from Mossack Fonseca were published as the *Panama Papers* whereas the highest search volumes for the remaining three keywords coincided with events not directly related to data leaks from tax havens: "Data leak" with the leak from a website facilitating extramarital affairs in July 2015; "Tax havens" with the G20 Summit cracking down on tax havens in April 2009; and "Whistleblower" with the leak of NSA files by *Edward Snowden* in June 2013.

Figure 4 around here

For each of the four keywords, Table 4 reports raw values from Google Trends and, to account for time trends in search volumes, also residuals from regressions of the raw values on year dummies. Specifically, the table reports averages for the months where no leak occured (first row), the months where one of the 13 leaks in the sample occurred (second row), the month where the LGT leak occurred (third row) and the months were one of the other 12 leaks occurred (fourth row). Two patterns stand out. First, search levels for the four keywords were generally higher around the data leaks in our sample. The residualized indeces were on average 4 percentage higher in months where data leaks occurred than in months where they did not. The difference, which is statistically significant with a t-value of 3.3, provides some reassurance that internet search volumes are a suitable measure of salience in this context. Second, there is virtually no difference in search volumes between the first leak and those that followed suggesting that the larger responses to the LGT leak was not driven by higher salience.

Table 4 around here

Further regression results reported in Table 3 suggests that differences in salience does not play a significant role in shaping the heterogeneous responses across the leaks in our

[17] Several papers in finance use internet search volumes to measure the attention of investors, for instance Da et al (2011).

sample. Whether we interact the leak dummy with our preferred measure of salience, the average of the residualized indeces across the four keywords, (Column 6) or with a dummy indicating an above-median value of this salience measure (Column 7), the interaction terms are close to zero and statistically insignificant and the main effect of leaks is virtually unchanged relative to the baseline specification without the interaction (Column 5). If anything, more salient leaks appear to be associated with marginally smaller decreases in deposits in havens.

3.6 Discussion

A potential identification problem with the empirical framework employed in this section is that data leaks from tax havens may correlate with unobserved determinants of cross-border deposits. Most importantly, we study a period with prolific policy activity to combat offshore tax evasion both at the national and international levels, ranging from the start of the U.S. case against UBS in August 2008 to the signing of bilateral tax treaties with tax havens in 2009-2010 and the gradual extension of automatic information exchange to tax havens in the most recent years. Data leaks may coincide with enforcement initiatives either by chance or if whistleblowing is triggered by the increased public interest in offshore tax evasion created by enhanced enforcement. While we cannot generally rule out that our estimates are influenced by new enforcement policies targeting offshore evasion, it should be noted that the first leak from LGT Bank in February 2008 occurred 6 months *before* the first major policy event. This essentially rules out this source of endogeneity in the case of the LGT leak, which is our most important event, whereas some concern remains about the subsequent leaks.

Relatedly, the financial crisis in 2007-2008 may confound our results if, for some reason, it induced households to withdraw deposits from havens to a larger extent than from non-havens precisely in the quarters where the leaks occurred. The placebo tests with interbank deposits go some way toward addressing this concern. If a financial shock to banks in havens were driving the decrease in household deposits in havens, we should expect to see a similar decrease in interbank deposits. The fact that we do not is suggestive that the decrease in household deposits is driven by a shock to the perceived risk associated with offshore tax evasion rather than a financial shock to haven banks.

Identification of the deterrence effects of the data leaks can be improved in at least two ways. First, analyzing data at a higher frequency makes it more plausible that no other important events coincided with the leaks. Second, analyzing data for individual banks makes it possible to formulate and test predictions about the incidence of the leaks across heterogeneous banks, which is interesting in its own right and makes identification of the average effect more credible. Since no data source offers high-frequency information on foreign-owned wealth under management at the bank-level, the next section turns to another type of outcome that can be observed for each individual bank on a daily basis: stock-market returns.

4 Analysis of stock-market data

In this section, we study the deterrence effect of whistleblowing by testing whether banks, known to be assisting with offshore tax evasion, suffered negative excess returns in the days following the LGT leak as well as the subsequent data leaks from tax havens. If the leaks caused a significant decrease in the use of secret bank accounts, as suggested by the analysis in the previous section, and if financial markets anticipated these behavioral responses, we should expect an immediate increase in the market value of banks deriving income from offshore tax evasion. In a first step, we discuss how the legal action against Swiss banks in the U.S. is helpful in delimiting a set of banks that were assisting with offshore tax evasion at the time of the LGT leak. In the next steps, we present the stock-market data, develop the empirical methodology and present the results.

4.1 Bank sample

Not all banks in tax havens are actively managing the wealth of foreign tax evaders. Notably tax havens like Switzerland and Hong Kong with a sizable domestic economy also have important banks that mainly provide standard financial services to domestic customers. For the purposes of assessing how leaks of customer data affect the profitability of the wealth management industry, it is therefore necessary to zoom in on a sample of banks with known links to tax evasion.

To identify such a sample, we exploit the measures taken by the U.S. Department of

Justice against Swiss banks suspected of assisting U.S. citizens with tax fraud involving anonymous shell companies and undeclared Swiss bank accounts. The first case, against UBS, ended with a $780 million settlement in February 2009 and another 15 Swiss banks were investigated on similar charges in the following years.[18] At the time of writing, six of these cases have been settled with combined penalties of $4.29 billion while seven are still pending; three of the investigated banks have ceased their operations.[19] Subsequently, in August 2013, the U.S. Department of Justice and the Swiss government announced the *Swiss Bank Program* under which banks not already under investigation could resolve potential criminal liabilities related to undeclared U.S.-owned accounts in Switzerland by satisfying a list of requirements, including full disclosure of their cross-border activities, cooperation with future information requests under the U.S.-Swiss double tax treaty and the payment of appropriate penalties. The program resulted in non-prosecution agreements with an additional 80 banks with combined penalties of around $1.36 billion.[20]

These U.S. enforcement initiatives are useful for our purposes because they identify a group of banks that derived income from assisting foreign customers with offshore tax evasion at the time of the data leak from LGT Bank.[21] Following an increase in the risks associated with offshore tax evasion, we should expect precisely these banks to suffer a decrease in profits. Moreover, the outcomes of the enforcement initiatives allow us to make predictions about the heterogeneity in stock market responses *within* this sample of banks. First, if U.S. prosecutors chose to investigate the Swiss banks, which they believed *ex ante* were the most likely to be involved in offshore tax evasion and if market participants had similar beliefs, we should expect investigated banks to suffer larger market value losses than banks subsequently admitting to criminal offences under the Swiss Bank Program. Second, if *ex post* penalties contain a signal about the degree of involvement in offshore tax evasion and if that signal was at least partly observable to market participants at the time of the leak, we should expect market value losses to be larger for banks with higher penalties.

[18] We are not aware of an official list of all 16 banks under investigation, but they are mentioned in numerous news articles. One article that lists all the banks can be found on the Swiss public service news and information platform Swissinfo, see http://www.swissinfo.ch/eng/credit-suisse-fallout_remaining–hit-list–banks-sweat-over-us-verdicts/38637818 (last accessed on 15 February 2017).

[19] The three banks that have dropped out of business are Wegelin, Neue Zürcher Bank, and Bank Frey.

[20] See https://www.justice.gov/tax/swiss-bank-program (last accessed on 15 February 2017).

[21] Of course, Swiss banks also assist taxpayers from other countries in evading taxes. In fact, most Swiss bank deposits are owned by Europeans (Zucman, 2013).

Starting from the gross sample of 96 Swiss banks that have been subject to criminal investigations in the U.S. or have participated in the Swiss Bank Program, we arrive at the estimating sample in the following steps. First, our empirical approach requires daily publicly available stock prices, so we disregard banks that are not listed on a stock exchange. However, when a Swiss bank in our sample belongs to a multinational banking group, we include the parent company if listed; for instance, the Swiss entity *HSBC Private Bank* is owned by the UK-based holding company *HSBC Holdings PLC*.[22] This procedure yields 49 Swiss entities. Second, we exclude three entities that are classified neither as a bank nor as a financial services company under the Industry Classification Benchmark (ICB) as we do not expect the data leaks to be relevant for these firms.[23] Finally, we exclude a few entities, typically small banks whose stock is not traded every day, for which no stock return can be identified in the week after the event under consideration. This yields an estimating sample of 38 Swiss entities for the data leak from LGT Bank in February 2008 and a similar number of entities for other events. While the sample varies slightly across events and, strictly speaking, includes both Swiss banks and multinational banking groups with operations in Switzerland, we shall refer to the banks in our sample as "Swiss banks" for simplicity of the exposition.

Table A2 in the Appendix contains detailed information about all 46 banks that appear in the estimating sample at some point between 1 January 2007 and 31 October 2016 including an indication of whether banks were subject to criminal investigations or participated in the Swiss Bank Program as well as the size of the resulting penalty.

4.2 Data

We use Bloomberg to collect financial information about the 46 Swiss banks in our estimating sample for the period 1 January 2007 to 31 October 2016. We calculate the daily return on each stock as the simple rate of return of the stock's total return

[22] The current parent companies of Swiss banks are identified in Bloomberg and any changes to the parent-subsidiary links are identified in an extensive online research using the banks' own homepages, Wikipedia, and http://www.schweizer-banken.info/ (last accessed on 15 February 2017). In case of multiple listed parent companies on different hierarchy levels in the company tree, we selected the lowest ranked listed parent company in order to include as few unaffected entities as possible.

[23] Here, we drop American International Group Inc (insurance), Assicurazioni Generali SpA (insurance) and Italmobiliare SpA (construction & materials).

index, which accounts for dividends as well as capital gains:

$$Return_{n,t} = \frac{P_{n,t} - P_{n,t-1}}{P_{n,t-1}} \cdot 100, \tag{4}$$

where $P_{n,t}$ is the value of the total return index of bank n at time t. All prices are denoted in Swiss francs to avoid any confounding effects of exchange rate movements.

We exclude observations for non-trading days in Switzerland to avoid that a small group of banks traded on stock exchanges outside of Switzerland dominates the estimates on specific days, for instance Israeli stocks traded on Sundays but not Fridays.[24] Moreover, we exclude observations if the end-of-day stock price remained constant or was missing for at least five consecutive Swiss trading days because such stale stocks could otherwise introduce a bias toward zero. Finally, we winsorize returns at the 0.1 and 99.9% level to reduce the influence of outliers.

Table 5 provides summary statistics on the resulting sample of stock returns: the mean daily return across all banks over the entire sample period is 0.0% with a minimum return of -19.9%, a maximum return of 25% and a standard deviation of 2.3%. We also provide summary statistics on the returns of the portfolios including all banks, unweighted and weighted by market capitalization, as well as a major European broad stock market index, *Stoxx Europe 600*.[25] In the event studies, we choose this index to proxy for the general market return because almost all the banks in our sample are listed in Europe and because it explains more of the variation in stock returns outside of the event windows than the blue chip index *Stoxx Europe 50* or leading Swiss market indices such as the *Swiss Market Index* or the *Swiss Performance Index*.[26]

Table 5 around here

[24] We define Swiss trading days as days when the Swiss Market Index is traded. Non-trading days in Switzerland are typically Saturdays, Sundays, and bank holidays.

[25] To be precise, Table 2 uses an unbalanced portfolio accounting for the trading day specific company structures and ownership links, which sometimes change over time. The event study regressions use event-specific balanced portfolios of those listed companies that are a Swiss bank or own subsidiaries that are Swiss banks for the entire week following the event.

[26] These results are not reported.

4.3 Empirical methodology

The aim of the empirical analysis is to estimate how the market values of Swiss banks with ties to offshore tax evasion responded to leaks of customer files. For this purpose, we employ a standard event study framework (e.g. Kothari and Warner, 2007).

In a first step, for each event to be considered, we identify an event-specific bank sample and observation period. The bank sample contains those of the 46 banks in the estimating sample for which stock market data are available for the entire week after the event.[27] The observation period includes the event window, consisting of the event date and 10 trading days before and after the event date, and an estimation window consisting of 250 trading days before the event window, which is roughly one calendar year. So for every analysis, we consider 271 trading days $t \in [-260, 10]$ and the event is normalized to take place on $t = 0$.

In a second step, we calculate the daily portfolio return as the average daily stock return across all Swiss banks in the event-specific sample:

$$Portfolio\ return_t = \frac{1}{N} \sum_{n=1}^{N} Return_{n,t}, \tag{5}$$

where $Return_{n,t}$ is the return of bank n on day t and N is the number of banks in the event-specific sample. As the dependent variable, we use the portfolio return rather than the returns of individual banks to account for cross-sectional dependence. We also compute a weighted variant of the portfolio return where the daily returns of individual banks are weighted by market capitalization.[28]

In a third step, we regress the portfolio return on the market return and dummies for

[27] The most common reason why stock market data are not available is that the bank went out of business. For multinational banking groups, we also require that the link to the Swiss bank with criminal liabilities in the U.S. is *active* in the week after the event; hence, if a U.K banking group has closed its Swiss branch or sold it to a unlisted investor by the time of the event, it does not enter the event-specific sample.

[28] We use the latest available pre-event information on banks' market capitalization so that the weights are unaffected by the leak. For four banks there is no available information on market capitalization before the leak from LGT Bank (see Table A1 in the Appendix) and these banks are therefore not included in the weighted portfolio return.

the symmetric 21-day window around the event:

$$Portfolio\ return_t = \alpha + \beta\ Market\ return_t + \sum_{s=-10}^{10} \delta_s D_s + \varepsilon_t, \tag{6}$$

where $Market\ return_t$ is the return of the Stoxx Europe 600 on day t and D_s is a dummy indicating day s relative to the event.

The parameter β captures the correlation between the portfolio return and the market return in the period before the event window and the term $\alpha + \beta\ Market\ return_t$ thus expresses the normal portfolio return on day t conditional on the market return. The parameter δ_t captures the abnormal return of the portfolio on day t, $AR(t)$, which is simply the difference between the actual and the normal portfolio return.

The main parameter of interest is the cumulative abnormal return over the first T days after the event, $CAR(T)$, where $T = 1, 2, 3, 4, 5$. The point estimate can be obtained directly from the coefficients estimated in equation (6) as:

$$CAR(T) = \sum_{s=0}^{T-1} \delta_s. \tag{7}$$

In practice, we estimate a slightly modified version of equation (6) that redefines the dummies to yield point estimates and standard errors of $CAR(T)$ directly (Salinger, 1992).

4.4 Results: Average effect of the LGT leak

We start the empirical analysis by estimating the event study model on the baseline sample of Swiss banks that have either been under criminal investigation for their role in offshore tax evasion or have admitted to such a role by participating in the Swiss Bank Program.

As illustrated in Figure 5, these banks earned abnormal returns of around -0.5% on the first day of the LGT leak and on each of the subsequent three trading days. The cumulative abnormal return of around -2% over four trading days is statistically significant and remained roughly constant in the remainder of the event window. By contrast, abnormal returns were small and not systematically positive or negative in the

ten days before the leak. This reassures us that the negative abnormal returns observed after the leak are not driven by a differential underlying trend.

Figure 5 around here

While the confidence intervals plotted in Figure 5 are derived under the usual parametric assumptions, we also take a non-parametric approach to statistical inference. To test the statistical significance of $CAR\,(5)$, we compute the cumulative abnormal return for each five-day window in the estimation period (outside of the event window) and plot the empirical distribution as illustrated in Figure 6. Intuitively, this distribution provides a sense of the variability of abnormal returns in normal times and thus allows us to assess whether the abnormal return observed at the time of the leak is statistically significant. Specifically, as illustrated with a vertical line in the figure, our estimate of $CAR\,(5)$ is around -2.1%, which corresponds roughly to the 1^{st} percentile in the distribution. It follows that the probability of observing a more extreme outcome than $CAR\,(5)$ under the pre-event distribution of returns is around 2%. Or in other words, the p-value associated with a two-sided test of the null hypothesis that $CAR\,(5) = 0$ is around 0.02. Applying the same non-parametric test, we find that $CAR\,(1)$ is significantly different from zero with a p-value of 0.14, $CAR\,(2)$ with a p-value of 0.06, $CAR\,(3)$ with a p-value of 0.02 and $CAR\,(4)$ with a p-value of 0.00.

Figure 6 around here

Table 6 reports additional results with Column (1) showing the baseline estimates from Figure 5 for ease of comparison. While the baseline specification defines the portfolio return as the simple average of the individual banks' stock returns, we re-estimate the model with a portfolio return that weighs the individual bank returns by market capitalization and report the results in Column (2). The estimated stock market responses are both larger and sharper than in the baseline model with the cumulative abnormal return reaching -2% already after two days and stabilizing at roughly -3% after four days.

Table 6 around here

These results are instructive by providing a sense of the economic significance of the stock market responses: the combined market value of the 37 banks in the portfolio was almost CHF 1,000 billion (around $900 billion) immediately prior to the leak, so the 3% decrease corresponds to a loss in market value of around CHF 30 billion (around $27 billion). Taken at face value, this measures the net present value of the income losses suffered by listed Swiss banks due to the deterrence effect of the data leak. Recall that the estimate from the regression analysis of cross-border deposits concluded that the leak was associated with a 10% decrease in foreign-owned wealth managed in tax havens, which is equivalent to around CHF 300 billion (around $270 billion) in the case of Switzerland.[29] It follows that the two estimates are fully consistent if, for instance, Swiss banks earn an annual profit margin of 0.5% on assets under management and stock market investors use a discount factor of 5%. Under these assumptions, a permanent loss of deposits of CHF 300 billion implies an annual loss of profits of CHF 1.5 billion with a net present value of CHF 30 billion.

In a next step, we test whether the event study results are robust to adding a second factor to the model of the normal return. While the gain from employing multiple factors is typically marginal in event studies with daily stock-market returns and a short horizon, some scholars recommend that the market model is augmented with an industry index in cases where all the firms in the sample belong to the same industry (Campbell, Lo and MacKinlay, 1997). As shown in Columns (3)-(4), both point estimates and standard errors tend to decrease somewhat when we add the major index for the European financial industry, *Stoxx Europe 600 Financials*, to the model. Note that the Swiss banks in our sample make up a non-negligible share of the European financial industry, which implies that part of the stock market response to the data leak may be absorbed by the financial index. For that reason, we continue the analysis with the one-factor model.

Having documented an economically sizable, statistically significant and robust decrease in the market value of Swiss banks associated with offshore tax evasion precisely at the time of the LGT leak, one may still be concerned that the stock market response

[29] Zucman (2013) puts the foreign-owned wealth held in Switzerland by the end of 2007 at US $3.4 trillion.

was in fact not caused by the leak itself but by an unrelated shock coinciding with the leak. We address this concern by applying the baseline model to a sample of Swiss banks *not* associated with offshore evasion.[30] For most types of shocks unrelated to offshore evasion, for instance, monetary policy changes, macroeconomic news and exchange rate fluctuations, we should expect the two groups of banks to be similarly affected and, thus, stock prices to follow similar patterns. However, as shown in Column (5), there is no clear trend in the abnormal returns earned by banks not associated with offshore evasion after the leak: the cumulative abnormal return in this group was 0.7% after two days and 0.1% after four days. These results are strongly suggestive that the responses identified in the main sample are in fact caused by the leak.

We also address the possibility of a confounding shock with a reading of the Swiss newspaper, *Neue Zürcher Zeitung,* for a 2-week period starting at the LGT leak. We identify nine front-page articles about Swiss banks; however, none of them concern events that could conceivably have caused a general decrease in the market value of Swiss banks. Table A3 in the Appendix provides a short description of each article.

4.5 Results: Heterogeneous effects of the LGT leak

This section explores how stock market responses to the leak from LGT Bank varied *within* the estimating sample across Swiss banks with different involvement in offshore tax evasion. We exploit two distinct measures of involvement.

Most importantly, we distinguish between the eight banks that were investigated by U.S. authorities for complicity in tax crimes and the 30 banks that subsequently disclosed their cross-border activities under the Swiss Bank Program. Assuming that U.S. authorities selected Swiss banks for prosecution based on *ex ante* information about their involvement in offshore tax evasion and further assuming that market participants had access to a similar information set, we should expect the stock prices of prosecuted banks to be most adversely affected. We estimate the baseline model for the two subsamples separately and plot the results in Figure 7. The results are strikingly different: the cumulative abnormal return after four days was -6.1% for the prosecuted banks, but only

[30] We identified this set of placebo banks in the equity screen of Bloomberg. Specifically, we searched for all actively traded banks and asset managers in Switzerland, and excluded all banks that were investigated in the US for assisting in offshore tax evasion or participated in the Swiss Bank Program.

-1.2% for the voluntary disclosers.

Figure 7 around here

Table 7 reports additional results with Columns (1)–(2) showing the estimates from Figure 7 for ease of comparison. Columns (3)–(4) show that a similar pattern prevails if bank returns are weighted by market capitalization in the portfolio return, although the difference between the two groups of banks is less stark: the cumulative abnormal return after four days was -4.6% for the prosecuted banks and -2.1% for the voluntary disclosers.

Table 7 around here

Ultimately, the involvement of Swiss banks in offshore tax evasion should be reflected in the size of the penalties paid in the U.S. We thus split the sample of banks on the size of the penalties and estimate the baseline model for the two subsamples separately. As shown in Columns (5)–(6), the stock market responses to the first leak are stronger for banks with larger *ex post* penalties: the cumulative abnormal return after four days was -3.2% for banks with above-median penalties and -1.4% for those with below-median penalties. As shown in Columns (7)–(8), a similar pattern emerges when bank returns are weighted by market capitalization in the portfolio return.

We test whether the heterogeneity in 5-day CARs is robust to controlling for bank characteristics in a simple cross-sectional model and report the results in Table 8. As shown in Columns (1)-(2), the difference in abnormal returns between banks subject to criminal investigations and banks disclosing tax-related offences under the Swiss Bank Program is robust to a number of controls: an indicator for being headquartered in Switzerland, the banks' market value and the size of the banks' balance sheet. While standard errors increase slightly as the characteristics are added, the point estimate remains virtually unchanged. As shown in Columns (3)-(4), when we estimate how abnormal returns vary with penalties paid in the U.S., standard errors increase as the model is saturated with controls, but the point estimate also becomes more negative.

Table 8 around here

By showing that banks' loss of market value around the time of the LGT leak varied systematically with the intensity of their involvement in offshore tax evasion, these results further establish the causal link between the leak and the observed decrease in stock prices; it seems unlikely that heterogeneity in this particular dimension would have emerged if the correlation were spurious and stock markets really responded to a simultaneous shock unrelated to offshore evasion.

4.6 Results: Subsequent leaks

This section studies the stock market responses to events other than the leak from LGT Bank. We first apply the baseline model to all dates associated with news about data leaks from tax havens. Figure 8 plots the estimated CARs for the LGT leak (red line) as well as for each of the other 12 data leaks identified in our news search individually (gray lines) and pooled (blue line). The latter estimates are derived from a modified version of the baseline model that includes multiple event windows.[31] The output from each of the underlying regressions is reported in Table A4 in the Appendix.

Figure 8 around here

On average, across all the data leaks following the LGT leak, stocks of Swiss banks with known ties to tax evasion earned negative abnormal returns in the days after the news, however, the magnitude of the effects is relatively modest. The accumulated stock market response is largest on the third trading day (CAR3 = -0.7%) where the effect is also statistically significant, but then declines again (CAR5 = -0.4%). Three leaks are associated with relatively large negative stock market responses, in particular the news on 3 November 2009 that the Netherlands joins Germany in buying customer data from tax havens (leak #3); the news on 16 July 2012 that the German state Nord-Rhine-Westphalia acquires customer data from Switzerland despite an agreement between the

[31] The observation period of this modified event study model includes all trading days from one year prior to the event window of the first leak until the event window of the last leak. The sample includes all banks that satisfy the requirements outlined above for all leaks under consideration.

German and Swiss federal governments that should put an end to purchases of leaked data (leak #8); and the news on 4 April 2016 about a massive data leak from the Panamanian law firm Mossack Fonseca (leak #12). The other leaks were associated with very small negative or even positive stock market developments. In accordance with the deposit analysis, we find no systematic relation between the size of the stock market response and the salience of the leaks (results not reported).

The results are suggestive that the data leaks occurring after the first leak from LGT Bank were generally associated with much smaller, if any, reductions in the use of offshore banks. Plausibly, the first leak made offshore account holders and banks aware of the risk that customer information may be leaked whereas subsequent leaks only induced a small, or none at all, upward adjustment in the probabilities assigned to such events. Prior to the first leak, they may have believed that data theft from providers of offshore banking and corporate service was impossible; that employees had no incentive to blow the whistle or that intelligence services and tax authorities were not able or willing to use leaked data to prosecute tax evaders and bankers. While the first leak changed these priors, any effect of subsequent leaks on the perceived risk appears to be quite small and in most cases not statistically detectable.

5 Concluding remarks

While whistleblowing has become the order of the day in politics, business, sports and many other domains of society, we know little about its consequences. Some argue that it deters criminal activity by increasing the risk of exposure, but, to our knowledge, there is no systematic evidence documenting such an effect.

This paper studies whistleblowing in the context of offshore tax evasion and an environment in which data leaks were thought to be impossible or at least very unlikely. It documents that the first leak of customer files from a tax haven bank caused a significant decrease in foreign-owned deposits on accounts in tax havens and a decrease in the market value of Swiss banks *known* to derive revenues from offshore tax evasion. Our preferred interpretation is that the leak induced a shock to the detection risk as perceived by offshore account holders and banks, which curbed the use of offshore bank accounts

and lowered the expected future profits of banks providing access to such tax evasion technologies.

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Table 1: Events related to data leaks from tax havens

Event number	Date of event	Date of front page article	Headline
#1	14/02/2008	16/02/2008	Head of Deutsche Post trips over tax affair: eyeing further hundred suspects
#2	30/08/2009	31/08/2009	France wants to collect the evaded taxes: 3,000 client data received from Switzerland
#3	-	03/11/2009	Also the Netherlands buy bank data: a blow against tax evasion
#4	-	10/12/2009	Data theft at the HSBC in Geneva: part of the tax evaders list?
#5	01/02/2010	02/02/2010	All set to buy data: Germany risks new tax dispute
#6	-	08/02/2010	The data theft affair draws circles: new data CDs surfaced
#7	17/01/2011	18/01/2011	Elmer appears with Julian Assange: whistleblower delivers bank information
#8	14/07/2012	16/07/2012	Blow against the tax agreement: North-Rhine-Westphalia acquired bank-data-CD from Switzerland
#9	04/04/2013	05/04/2013	The expulsion from the tax paradise: revelations about tax havens have further large repercussions
#10	-	17/04/2013	Germany acquires another CD with bank data: raids against clients
#11	-	10/02/2015	“Swissleaks” hitting massive headlines: HSBC client information evaluated
#12	03/04/2016	04/04/2016	Network of offshore companies revealed: allegedly, around two billion dollars from the vicinity of the Russian president
#13	14/04/2016	15/04/2016	Stolen bank data distributed across the EU: North Rhine-Westphalia passes on financial account information from Switzerland

Note: The table provides information about all new data leaks from banks in tax havens, and significant new disseminations of such data, mentioned on the front page of the Swiss newspaper *Neue Zürcher Zeitung* between January 2008 and November 2016. The date of the event is either the date mentioned in the article or, in the absence of such information, the calendar day before the article was published. The headline is in the author's own translation from German. The front page article about event #8 states that it happened during the weekend 14/15 July 2012, but not the precise date; however, as the event studies are only concerned with trading days, this has no bearing on the estimations.

Table 2: Cross-border deposits by bank country

Country	Deposits in 2007q4 ($billion)	Deposit growth 2007q4-2008q3	Country	Deposits in 2007q4 ($billion)	Deposit growth 2007q4-2008q3
United Kingdom	1,686	-16%	Greece	62	-4%
United States	1,078	-7%	*Isle of Man*	58	-15%
Cayman Islands	771	21%	Canada	50	3%
Switzerland	548	-7%	Italy	46	25%
Germany	445	-11%	Denmark	42	-17%
Belgium	324	9%	Portugal	35	-16%
Ireland	303	-41%	Taiwan	35	14%
Netherlands	286	-13%	Sweden	34	-1%
Singapore	231	-7%	*Antilles*	12	-6%
Jersey	220	-39%	Norway	12	53%
Luxembourg	208	-18%	*Malaysia*	12	-17%
France	176	-16%	*Panama*	10	19%
Bahamas	171	5%	*Macao*	9.4	3%
Japan	169	51%	Brazil	4.5	-1%
Hong Kong	162	1%	Finland	4.4	23%
Australia	142	-11%	South Korea	4.2	2%
Spain	103	-2%	Chile	4.0	32%
India	70	-30%	Bermuda	2.1	-22%
Guernsey	69	-9%	Mexico	0.7	-2%
Bahrain	65	-5%	Turkey	0.4	48%
Austria	65	-1%	**Total**	**7,729**	

Note: The table lists all international banking centers that were contributing to the Locational Banking Statistics on 31 December 2007 and for each banking center reports the value of deposits held in its banks by non-bank foreigners. Countries that are tax havens are printed in italics (see definition in the main text).

Source: Bank For International Settlements, Locational Banking Statistics, Table A2

Table 3: The effect of data leaks on deposits in tax havens belonging to non-banks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	LGT leak		Other leaks		All leaks		
	(2006:q4-2008:q3)		(2008:q4-2016:q3)		(2006:q4-2016:q3)		
Tax haven	1.40	1.41	1.07	1.55	1.14	1.14	1.14
	(0.99)	(1.11)	(2.27)	(2.62)	(1.81)	(1.81)	(1.81)
Tax haven × Leak	-12.06***	-12.06***	-2.53**	-2.81**	-3.62***	-3.79**	-3.65***
	(3.87)	(3.81)	(1.09)	(1.16)	(1.13)	(1.69)	(1.25)
Tax haven × Leak, 1 lag		-3.50		0.22			
		(3.98)		(1.09)			
Tax haven × Leak, 2 lags		3.44		-2.04			
		(3.63)		(1.69)			
Tax haven × Leak × High salience						0.30	
						(2.37)	
Tax haven × Leak × Salience							0.01
							(0.13)
Observations	304	304	1,327	1,327	1,631	1,631	1,631
R-squared	0.18	0.18	0.45	0.45	0.42	0.42	0.42
Time FE	YES	YES	YES	YES	YES	YES	YES

Note: The table reports the results from ordinary least square regressions where the dependent variable is the first difference in the index of deposits owned by non-banks (see the main text for the precise definition). The explanatory variables are a dummy indicating a tax haven (*Tax haven*); a set of dummies indicating that a leak occurred in the current quarter (*Leak*), a leak occurred in the previous quarter (*Leak, 1 lag*) and a leak occurred two quarters ago (*Leak, 2 lags*); a continuous measure of the leaks' salience (*Salience)* and a dummy variable indicating that salience is higher than the median across all leaks (*High salience*). In Columns (1)-(2), the sample period is 2006:q4-2008:q3, which includes only the leak from LGT Bank. In Columns (3)-(4), the sample period is 2008:q4-2016:q3, which includes all the leaks in our sample except the leak from LGT bank. In Columns (5)-(7), the sample period is 2006:q4-2016:q3, which includes all the leaks in our sample. Standard errors are robust and clustered at the country-level.

Table 4: Google searches for keywords related to data leaks in tax haven banks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	"Data leak"		"Tax evasion"		"Tax havens"		"Whistleblowing"		Average	
	raw	residuals	raw	residuals	raw	residuals	raw	residuals	raw	residuals
No leaks	19.1	-0.4	39.3	-0.5	17.4	-0.6	20.5	0.1	24.1	-0.4
All leaks	23.7	4.4	45.3	5.5	28.5	6.9	17.0	-0.9	28.6	4.0
- LGT leak	17.0	0.3	41.0	8.1	26.0	7.8	10.0	-0.4	23.5	4.0
- Other leaks	24.4	4.9	45.8	5.2	28.8	6.8	17.8	-0.9	29.2	4.0

Note: The table summarizes trends in the global number of Google searches for four keywords, "Data leak" (Columns 1-2), "Tax evasion" (Columns 3-4), "Tax Havens" (Columns 5-6), "Whistleblowing" (Columns 7-8) and the average over the four keywords (Columns 9-10) over the 10-year period 2007m1-2016m12. For each keyword, the month with the highest number of searches takes the value 100 and the number of searches in other months is measured relative to this index. The reported statistics are raw index numbers (Columns 1, 3, 5, 7, 9) and the residuals from regressions where raw index numbers are regressed on year dummies (Columns 2, 4, 6, 8, 10). The table reports averages for the months where no leak occured (first row), the months where one of the 13 leaks in the sample occurred (second row), the month where the LGT leak occurred (third row) and the months were one of the other 12 leaks occurred (fourth row).
Source: Google Trends and own computations

Table 5: Summary statistics on stock returns

	Mean	Standard deviation	Minimum	Maximum
Individual banks	0.0	2.3	-19.9	25.0
Portfolio of banks, unweighted	0.0	1.2	-8.2	8.9
Portfolio of banks, weighted by market capitalization	0.0	2.1	-12.1	18.7
Stoxx Europe 600	0.0	1.6	-11.7	11.3

Note: The table provides summary statistics for the stock market returns of the 46 Swiss banks in our estimating sample and for the return of the major European stock market index. All statistics are for the period between 1 January 2007 and 31 October 2016. The first line refers to the sample of individual banks; the second line to the portfolio return computed as the simple average of individual bank returns; the third line to the portfolio return computed as the average of individual bank returns weighted by their market capitalization; the fourth line to the stock market index Stoxx Europe 600.

Table 6: Main event-study results

	One-factor model		Two-factor model		
	Unweighted portfolio	Weighted portfolio	Unweighted portfolio	Weighted portfolio	Other Swiss banks
	(1)	(2)	(3)	(4)	(5)
CAR 1	-0.5	-1.1*	-0.2	-0.2	-0.3
	(0.4)	(0.6)	(0.3)	(0.3)	(0.7)
CAR 2	-1.1**	-2.1**	-0.6	-0.9**	0.7
	(0.5)	(0.8)	(0.4)	(0.4)	(1.1)
CAR 3	-1.5**	-2.2**	-1.2**	-1.4***	-0.6
	(0.6)	(1.0)	(0.5)	(0.5)	(1.3)
CAR 4	-2.2***	-3.0**	-1.9***	-2.2***	0.1
	(0.7)	(1.2)	(0.6)	(0.5)	(1.5)
CAR 5	-2.1**	-2.9**	-2.0***	-2.7***	-0.3
	(0.8)	(1.3)	(0.7)	(0.6)	(1.7)
Stoxx Europe 600	66.5***	108.2***	11.8**	-28.1***	65.0***
	(1.7)	(2.7)	(5.2)	(4.5)	(3.5)
Stoxx Europe 600 Financials			48.1***	120.2***	
			(4.4)	(3.8)	
Constant	-0.0	-0.0	0.0	0.0	0.1
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Observations	271	271	271	271	271
R-squared	0.9	0.9	0.9	1.0	0.6
Portfolio size	38	38	38	38	7

Note: The table shows the results from the main event study specification applied to the first event, the leak from LGT bank on 14 February 2008. Columns (1) and (3) show the results with the unweighted portfolio return, Columns (2) and (4) show the results with the portfolio return weighted by market capitalization; Column (5) shows the results for an unweighted portfolio of Swiss banks with no known link to offshore tax evasion. All regressions include a set of event time dummies as described in the main text.

Table 7: Event-study results, heterogeneity

	Unweighted portfolio		Weighted portfolio		Unweighted portfolio		Weighted portfolio	
	Criminal investigations	Swiss Bank Program	Criminal investigations	Swiss Bank Program	High penalty	Low penalty	High penalty	Low penalty
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CAR 1	-1.0	-0.4	-1.9***	-0.6	-0.5	-0.6*	-1.7**	-0.3
	(0.7)	(0.4)	(0.7)	(0.6)	(0.5)	(0.4)	(0.8)	(0.6)
CAR 2	-2.3**	-0.8	-3.1***	-1.5	-1.3*	-0.9*	-2.6**	-1.2
	(0.9)	(0.5)	(0.9)	(0.9)	(0.8)	(0.5)	(1.1)	(0.8)
CAR 3	-4.3***	-0.8	-3.1***	-1.7	-2.4**	-0.7	-3.5***	-0.5
	(1.2)	(0.7)	(1.1)	(1.1)	(0.9)	(0.6)	(1.3)	(1.0)
CAR 4	-6.1***	-1.2	-4.6***	-2.1	-3.2***	-1.4*	-4.4***	-1.5
	(1.3)	(0.8)	(1.3)	(1.3)	(1.1)	(0.7)	(1.5)	(1.2)
CAR 5	-6.2***	-1.0	-4.1***	-2.2	-3.2***	-0.9	-4.2**	-1.4
	(1.5)	(0.9)	(1.5)	(1.4)	(1.2)	(0.8)	(1.7)	(1.3)
Stoxx Europe 600	69.7***	65.7***	92.0***	117.9***	85.1***	49.4***	116.8***	109.6***
	(3.1)	(1.8)	(3.0)	(3.0)	(2.5)	(1.7)	(3.5)	(2.7)
Constant	-0.0	-0.0	-0.1*	-0.0	-0.0	0.0	-0.1	0.0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Observations	271	271	271	271	271	271	271	271
R-squared	0.7	0.9	0.8	0.9	0.8	0.8	0.8	0.9
Portfolio size	8	30	8	30	17	17	17	17

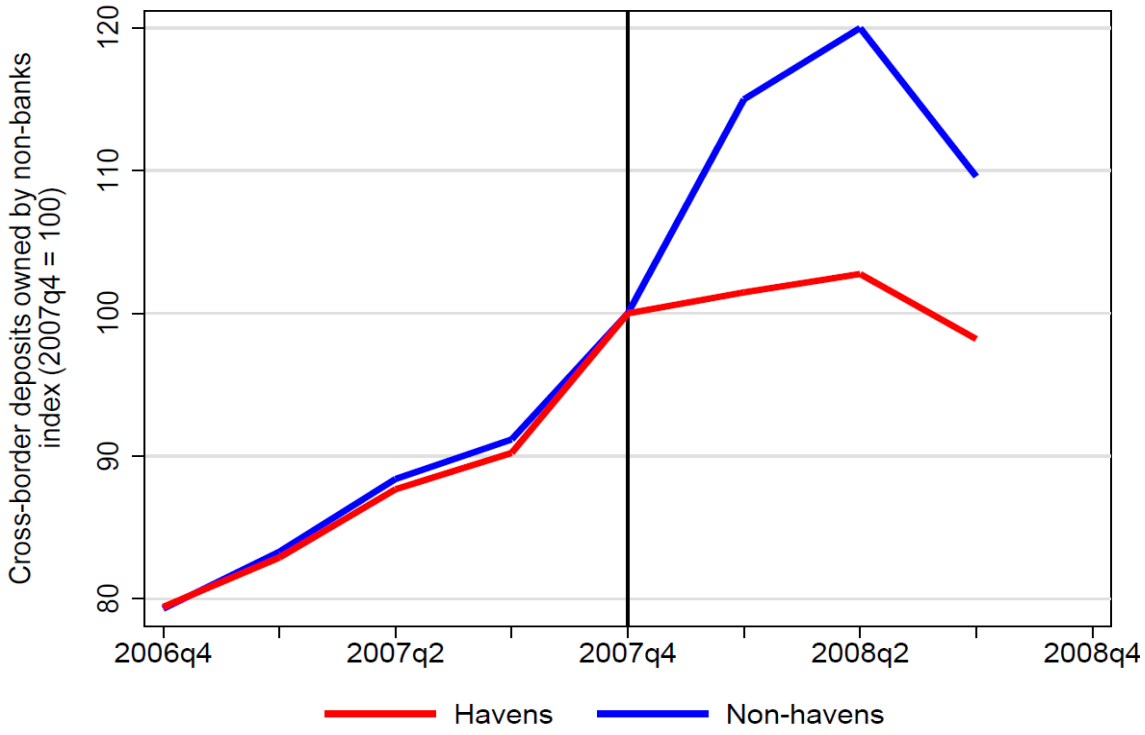
Note: The table shows the results from the main event study specification applied to the first event, the leak from LGT bank on 14 February 2008. Columns (1)-(2) and (5)-(6) show results for the unweighted portfolio return while Columns (3)-(4) and (7)-(8) show results for the portfolio return weighted by market capitalization. In Columns (1) and (3), the portfolio only includes Swiss banks that have been subject to criminal investigations in the U.S. for their role in offshore tax evasion. In Columns (2) and (4), the portfolio only includes Swiss banks that have admitted to criminal tax-related offences under the Swiss Bank Program. In Columns (5) and (7), the portfolio only includes Swiss banks that have paid penalties above the sample median. In Columns (6) and (8), the portfolio only includes Swiss banks that have paid penalties below the sample median. All regressions include a set of event time dummies as described in the main text.

Table 8: Cross-sectional results, determinants of the 5-day CAR

	(1)	(2)	(3)	(4)
Criminal investigation	-5.1***	-4.9***		
	(1.6)	(1.6)		
Penalty (in logs)			-0.8*	-1.4**
			(0.4)	(0.6)
Swiss bank		2.4		4.7**
		(1.5)		(2.1)
Market capitalization (in logs)		0.1		1.5
		(1.2)		(1.7)
Total assets (in logs)		-0.1		-0.4
		(0.9)		(1.1)
Constant	-1.0	-2.2	0.0	-9.2
	(0.7)	(4.1)	(1.3)	(6.4)
Observations	38	37	33	32
R-squared	0.2	0.3	0.1	0.2

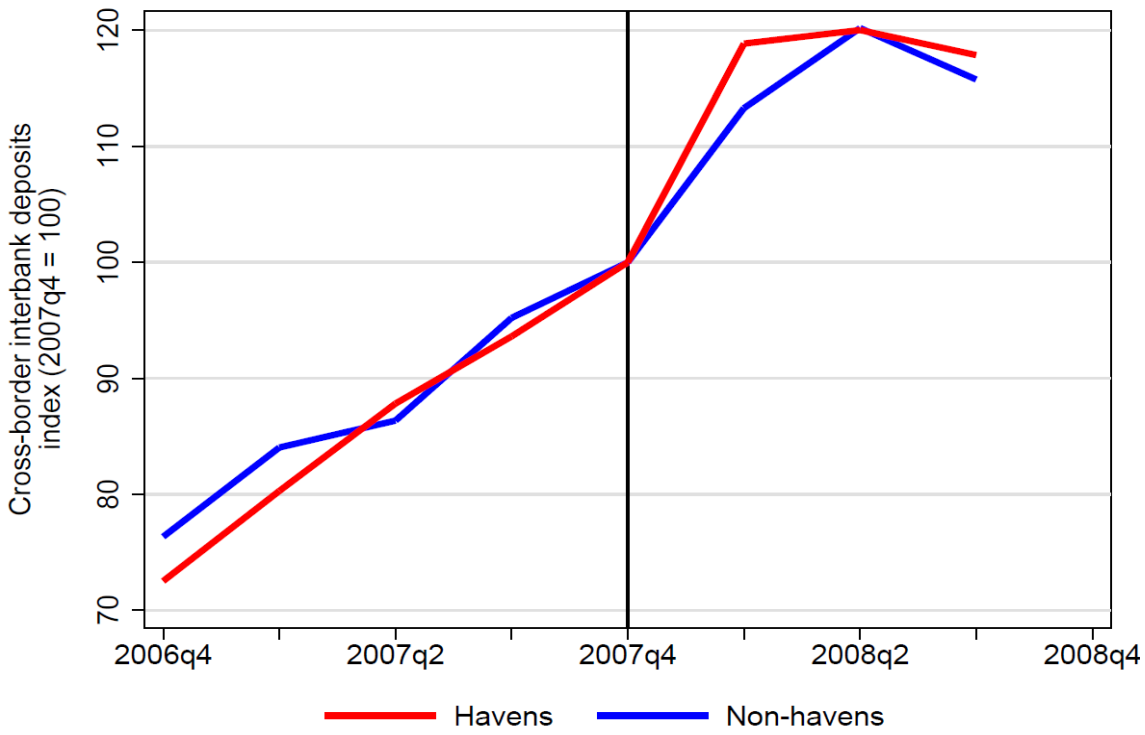
Note: The table shows the results from a cross-sectional regression where the dependent variable is the 5-day CAR after the LGT leak at the level of individual banks. The sample is the 38 Swiss banks that have been investigated for their role in offshore tax evasion in the U.S. or have admitted to tax-related criminal activities in the U.S. under the Swiss Bank Program. The explanatory variables are: a dummy for having been under criminal investigation in the U.S. (*Criminal investigation*); the penalty paid in relation to assistance with offshore tax evasion (*Penalty*); an indicator for being headquartered in Switzerland (*Swiss Bank*); the total market capitalization of the bank (*Market Capitalization*); the total assets of the bank (*Total assets*).

Figure 1: Cross-border deposits belonging to non-banks, in havens vs non-havens



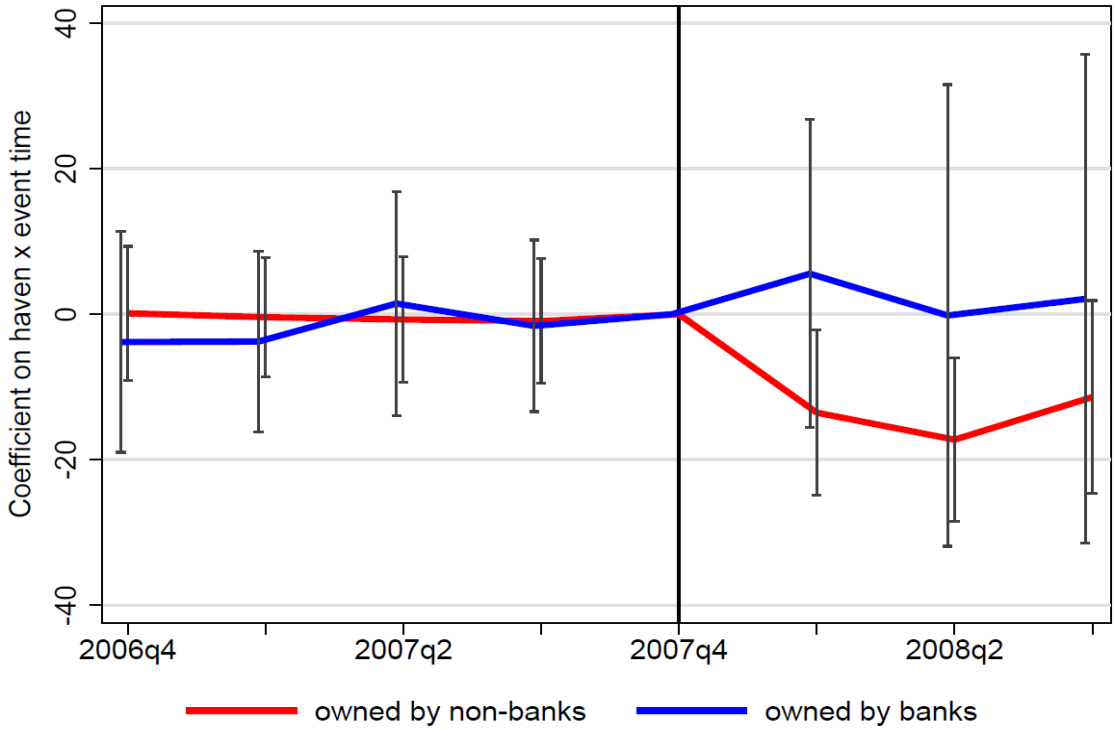
Note: The figure shows the trend in cross-border deposits owned by non-banks, in havens (red line) and non-havens (blue line) respectively. For each country reporting to the BIS Locational Banking Statistics, we have computed a country-level index expressing the stock of deposits in a given quarter relative to the stock at the end of 2007:q4. The figure shows the average index value for havens and non-havens over the 2-year period 2006:q4 - 2008:q3. The vertical line indicates the last observation before the LGT leak. Two countries with very small stocks of foreign deposits (below $1 billion) are excluded from the analysis (Mexico and Turkey).

Figure 2: Cross-border deposits owned by banks, in havens vs non-havens



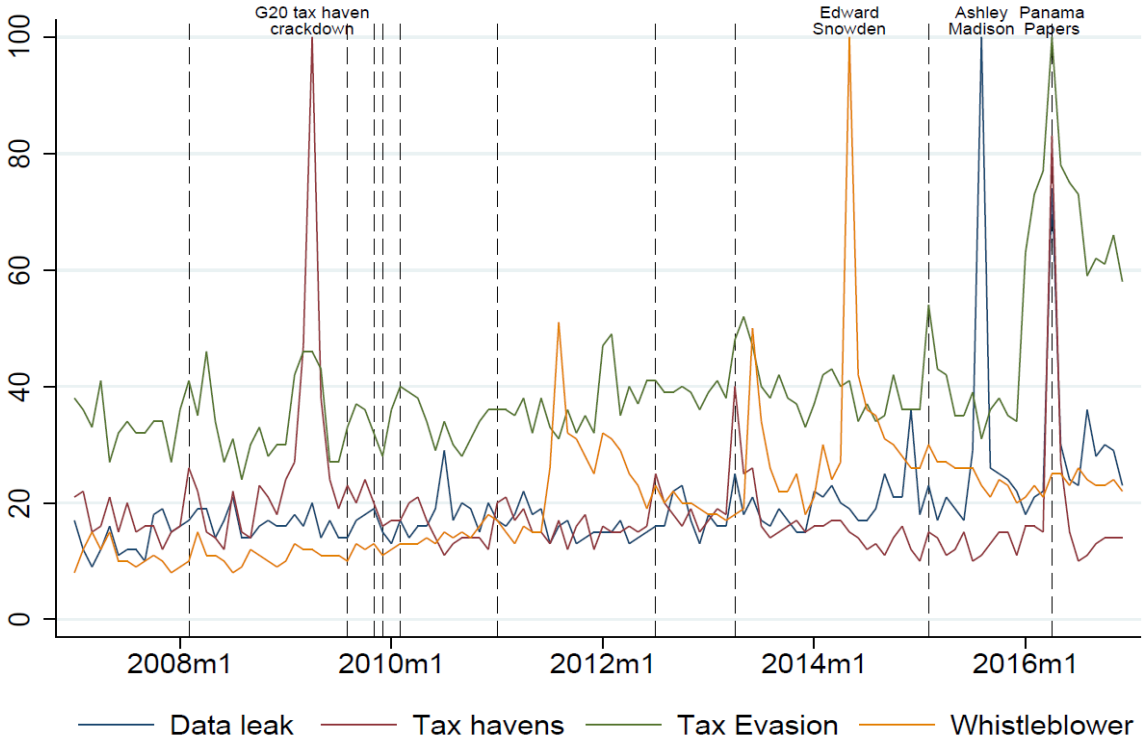
Note: The figure shows the trend in cross-border deposits owned by banks, in havens (red line) and non-havens (blue line) respectively. For each country reporting to the BIS Locational Banking Statistics, we have computed a country-level index expressing the stock of deposits in a given quarter relative to the stock at the end of 2007:q4. The figure shows the average index value for havens and non-havens over the 2-year period 2006:q4 - 2008:q3. The vertical line indicates the last observation before the LGT leak. Two countries with very small stocks of foreign deposits (below $1 billion) are excluded from the analysis (Mexico and Turkey).

Figure 3: DiD-estimates of the effect of the LGT leak on deposits in tax havens



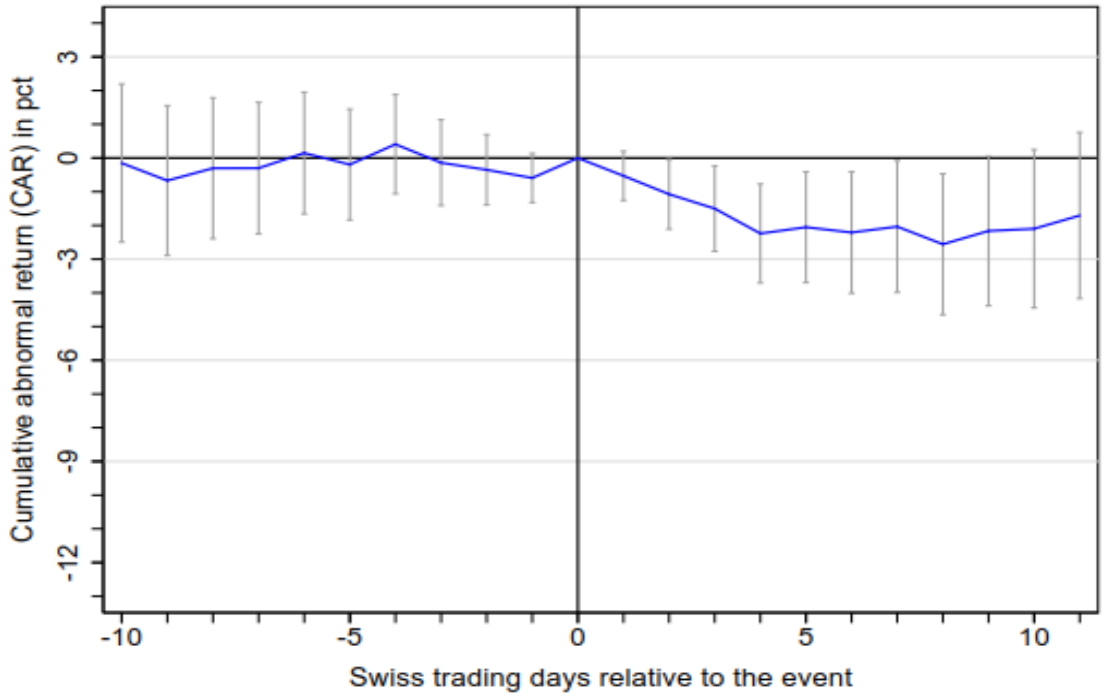
Note: The figure shows the difference-in-differences estimates of the effect of the LGT leak on cross-border deposits held in tax havens, for deposits owned by banks (blue line) and non-banks (red line) respectively. For each country reporting to the BIS Locational Banking Statistics,we have first computed country-level indeces expressing the stock of deposits, owned by banks and non-banks respectively, in a given quarter relative to the stock at the end of 2007:q4. We have then estimated separate linear regressions with the relevant index as dependent variable and time dummies, a haven dummy and the interactions between them as explanatory variables. The sample period is the 2-year period 2006:q4 -2008:q3 and the omitted time category is 2007:q4. The vertical line indicates the last observation before the LGT leak. The figure shows the estimated cofficients on the interaction terms and their 95% confidence bounds based on standard errors clustered at the country level.

Figure 4: Google searches for keywords related to data leaks in tax haven banks



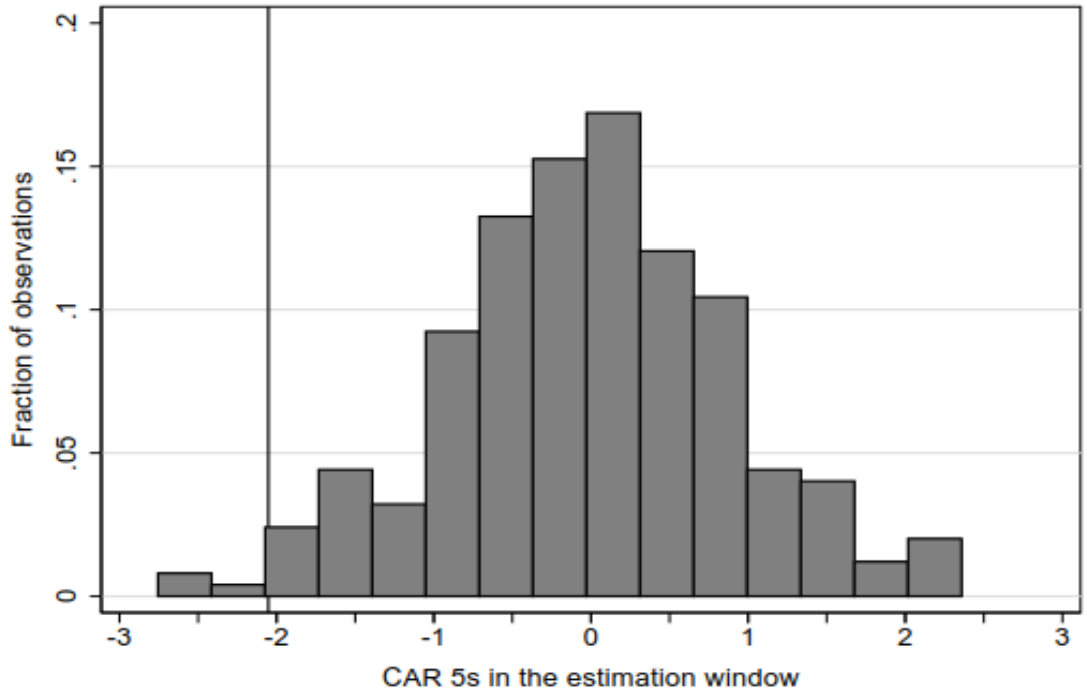
Note: The table shows the trends in the global number of Google searches for five keywords, "LGT bank", "Data leak" , "Tax evasion", "Tax Havens", "Whistleblowing" over the 10-year period 2007m1-2016m12. For each keyword, the month with the highest number of searches takes the value 100 and the number of searches in other months is measured relative to this value. The label "G20 tax haven crackdown" refers to the G20 summit in London in April 2009; "Edward Snowden" to the leak of NSA files in June 2013; "Ashley Madison" to the leak of customer data from a website facilitating extra-marital affairs in July 2015; "Panama Papers" to the leak from the law firm Mossack Fonseca in April 2016.
Source: Google Trends

Figure 5: Cummulative abnormal return of Swiss banks around the leak from LGT Bank



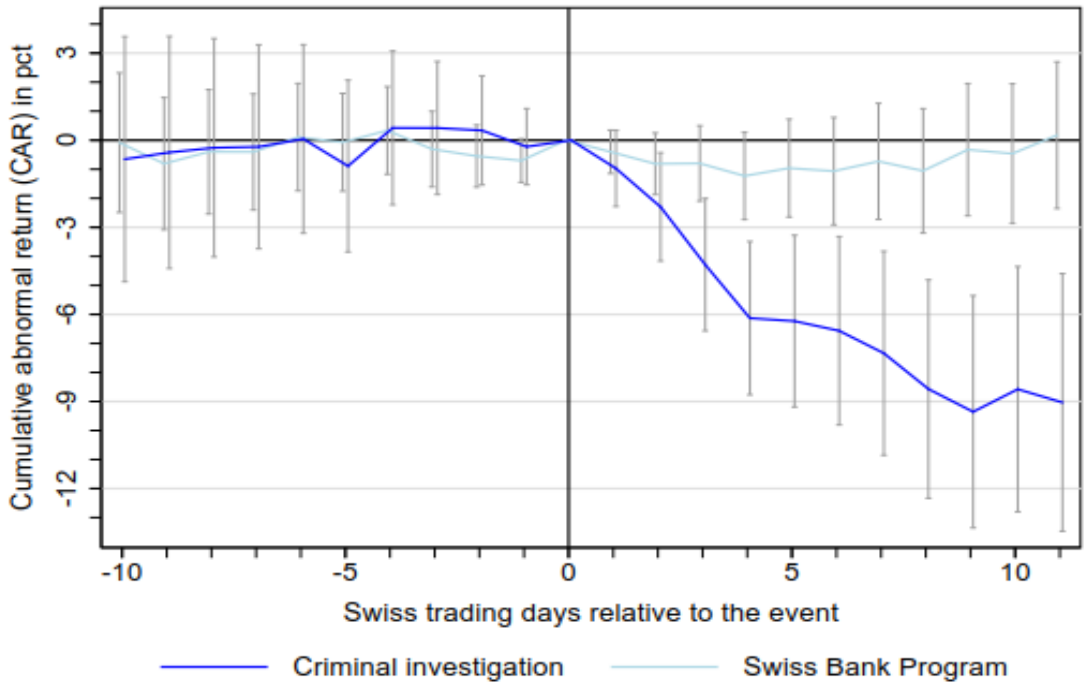
Note: The figure illustrates the results from the main event study specification applied to the first event, the leak from LGT bank on 14 February 2008. The blue line shows the estimates of the cumulative abnormal return. The gray bars indicate 95% confidence intervals of the estimates.

Figure 6: Distribution of 5-day cumulative abnormal returns before leak from LGT Bank



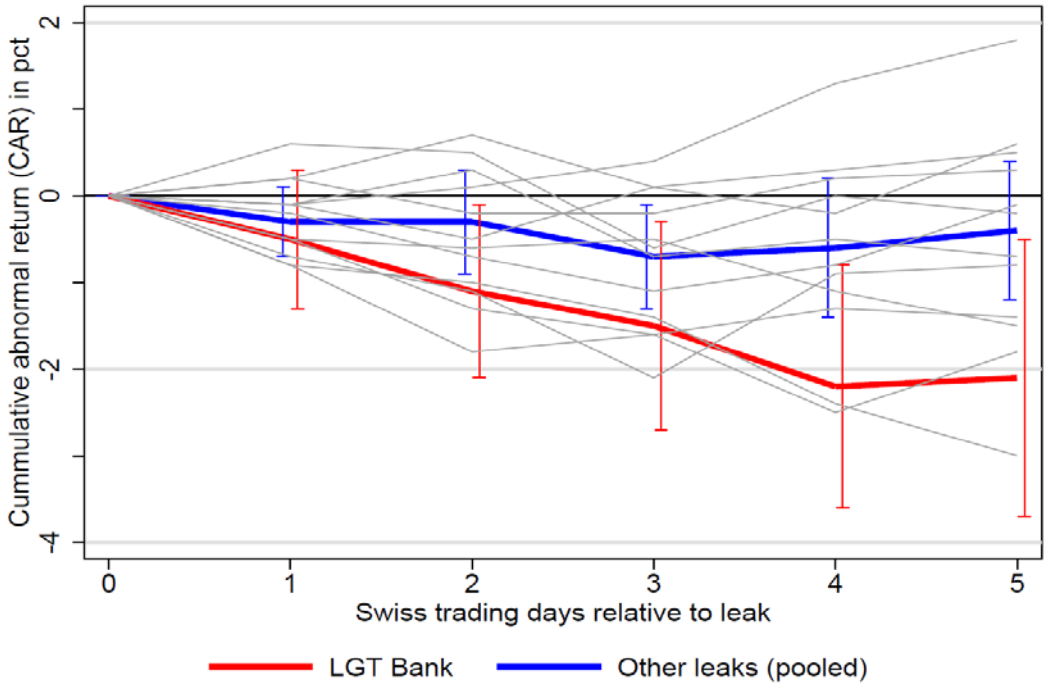
Note: The table shows the distribution of cumulative abnormal returns for all 5-day windows in the estimation period (outside of the event window) of the first leak. The vertical line indicates the estimated cumulative abnormal return in a 5-day window starting at the event, that is CAR(5).

Figure 7: Heterogeneity in the CARs of Swiss banks around the leak from LGT Bank



Note: The figure illustrates the results from the main event study specification applied to the first event, the leak from LGT bank on 14 February 2008. The two blue lines show the estimates of the cumulative abnormal return for the sample of Swiss banks that have been subject to criminal investigations in the U.S. for their role in offshore tax evasion (dark blue) and the sample of Swiss banks that have admitted to criminal tax-related offences under the Swiss Bank Program (light blue) respectively. The gray bars indicate 95% confidence intervals of the estimates.

Figure 8: Estimated CARs around all data leaks



Note: The figure illustrates the estimated CARs around the leak from LGT Bank (red line), around each of the other 12 data leaks (gray lines) and the average around the other leaks estimated in a single regression using the entire sample period and pooling all the leaks (blue line).

Appendix

Table A1: Deposit regressions

	(1)	(2)	(3)	(4)
	owned by non-banks		owned by banks	
	deposit index	deposit index	deposit index	deposit index
Tax Haven	-0.39		-1.58	
	(2.95)		(4.83)	
Post 2007q4	26.43***		27.31***	
	(6.35)		(4.23)	
Tax Haven × Post 2007q4	-13.66*		4.08	
	(6.76)		(15.68)	
2006q4		-20.70***		-23.65***
		(4.32)		(3.45)
2007q1		-16.70***		-15.96***
		(3.75)		(2.21)
2007q2		-11.60***		-13.64***
		(3.88)		(2.84)
2007q3		-8.83***		-4.78*
		(3.00)		(2.40)
2008q1		15.00***		13.29***
		(5.14)		(1.40)
2008q2		20.00***		20.19***
		(4.80)		(5.98)
2008q3		9.59		15.76***
		(5.74)		(5.33)
Tax Haven × 2006q4		0.13		-3.82
		(4.60)		(7.58)
Tax Haven × 2007q1		-0.41		-3.75
		(4.12)		(6.21)
Tax Haven × 2007q2		-0.72		1.47
		(4.31)		(7.70)
Tax Haven × 2007q3		-0.94		-1.60
		(4.28)		(5.89)
Tax Haven × 2008q1		-13.53**		5.57
		(5.66)		(10.59)
Tax Haven × 2008q2		-17.24***		-0.17
		(5.63)		(15.85)
Tax Haven × 2008q3		-11.39*		2.11
		(6.64)		(16.79)
Observations	324	324	270	270
R-squared	0.27	0.36	0.25	0.31

Note: The sample period is 2006q4-2008q3. The sample is 41 countries reporting deposit information to the BIS in at least part of the sample period. *Deposit index* measures the level of deposits relative to 2007q4 (100 in 2007q4). *Owned by non-banks* indicates that deposits belong to the non-bank sector whereas *Owned by banks* indicates that deposits are interbank. *Tax haven* is a dummy indicating that the country belongs is Austria, Bahamas, Bahrain, Belgium, Cayman Islands, Curacao, Cyprus, Guernsey, Hong Kong, Isle of Man, Jersey, Luxembourg, Macao, Netherlands Antilles, Panama, Singapore or Switzerland. *Post* is a dummy indicating that the period is after 2004q4. Robust standard errors clustered at the country-level are repoerted in parenthesis. Sigificance levels are indicated as: *** p<0.01, ** p<0.05, * p<0.1

Table A2: Swiss banks in the estimating sample

Name of listed Swiss bank or its listed parent	Source	Penalty ($ million)	Market capitalization ($ million)	Name of Swiss entity in the Swiss Bank Program	Start of holding period	End of holding period	Country	Sector
Credit Suisse Group AG	Criminal investigation	2,600	66,248	-	-	-	CH	Bank
UBS Group AG	Criminal investigation	780	84,725	-	-	-	CH	Bank
Julius Baer Group Ltd	Criminal investigation	547	-	-	-	-	CH	Bank
Bank Leumi Le-Israel BM	Criminal investigation	270	7,576	-	-	-	IL	Bank
Liechtensteinische Landesbank AG	Criminal investigation	24	3,098	-	-	-	LI	Bank
Bank Hapoalim BM	Criminal investigation	pending	6,380	-	-	-	IL	Bank
Basler Kantonalbank	Criminal investigation	pending	3,453	-	-	-	CH	Bank
HSBC Holdings PLC	Criminal investigation	pending	192,547	-	-	-	UK	Bank
Mizrahi Tefahot Bank Ltd	Criminal investigation	pending	2,016	-	-	-	IL	Bank
BTG Pactual Group	Swiss Bank Program	211	-	BSI SA	14/07/2014	22/02/2016	BR	Financial services
Credit Agricole SA	Swiss Bank Program	99.2	50,893	Crédit Agricole (Suisse) SA	-	-	FR	Bank
Bank J Safra Sarasin AG	Swiss Bank Program	85.8	2,930	Bank J. Safra Sarasin AG	-	31/07/2012	CH	Bank
Royal Bank of Scotland Group PLC	Swiss Bank Program	78.5	80,371	Coutts & Co Ltd	-	-	UK	Bank
St Galler Kantonalbank AG	Swiss Bank Program	60.3	2,770	Multiple	14/12/2007	27/06/2013	CH	Bank
BNP Paribas SA	Swiss Bank Program	59.8	89,516	BNP Paribas (Suisse) SA	-	-	FR	Bank
Edmond de Rothschild Suisse SA	Swiss Bank Program	45.2	3,555	Edmond de Rothschild (Suisse)	-	-	CH	Financial services
Banque Cantonale Vaudoise	Swiss Bank Program	41.7	4,381	Banque Cantonale Vaudoise	-	-	CH	Bank
Deutsche Bank AG	Swiss Bank Program	31.0	66,499	Deutsche Bank (Suisse) SA	-	-	DE	Bank
EFG International AG	Swiss Bank Program	30.0	4,840	EFG Bank European Financial Group	-	-	CH	Bank
Societe Generale SA	Swiss Bank Program	19.2	59,832	Multiple	-	-	FR	Bank
KBC Group NV	Swiss Bank Program	18.8	48,165	KBL (Switzerland) Ltd.	-	10/10/2011	BE	Bank
Rothschild & Co	Swiss Bank Program	11.5	1,318	Rothschild Bank AG	-	-	FR	Financial services
Luzerner Kantonalbank AG	Swiss Bank Program	11.0	2,233	Luzerner Kantonalbank AG	-	-	CH	Bank
CIC	Swiss Bank Program	10.5	12,004	Multiple	-	-	FR	Bank
Banco Bilbao Vizcaya Argentaria SA	Swiss Bank Program	10.4	83,604	BBVA Suiza S.A.	-	-	ES	Bank
Schroders PLC	Swiss Bank Program	10.4	6,252	Schroder & Co. Bank AG	-	-	UK	Financial services
Dexia SA	Swiss Bank Program	9.7	30,516	Banque Internationale à Luxembourg	-	20/12/2011	BE	Bank
Standard Chartered PLC	Swiss Bank Program	6.3	49,060	Standard Chartered Bank (Switzerland)	-	-	UK	Bank
Vontobel Holding AG	Swiss Bank Program	5.4	2,763	Finter Bank Zurich AG	04/09/2015	-	CH	Bank
Berner Kantonalbank AG	Swiss Bank Program	4.6	2,122	Berner Kantonalbank AG	-	-	CH	Bank
Bank Linth LLB AG	Swiss Bank Program	4.2	399	Bank Linth LLB AG	-	-	CH	Bank
Zuger Kantonalbank AG	Swiss Bank Program	3.8	1,067	Zuger Kantonalbank	-	-	CH	Bank
Graubuendner Kantonalbank	Swiss Bank Program	3.6	2,550	Graubündner Kantonalbank	-	-	CH	Bank
Valiant Holding AG	Swiss Bank Program	3.3	3,057	Valiant Bank AG	-	-	CH	Bank
Bank Coop AG	Swiss Bank Program	3.2	1,347	Bank Coop AG	-	-	CH	Bank
Walliser Kantonalbank	Swiss Bank Program	2.3	-	Banque Cantonal du Valais	-	-	CH	Bank
Aabar Investments PJSC	Swiss Bank Program	1.8	1,285	Falcon Private Bank AG	01/12/2008	12/07/2010	AE	Financial services
BHF Kleinwort Benson Group	Swiss Bank Program	1.8	1,165	BHF-Bank (Schweiz) AG	07/07/2011	27/11/2015	BE	Financial services
SB Saanen Bank AG	Swiss Bank Program	1.4	-	SB Saanen Bank AG	-	-	CH	Bank
Mercantil Servicios Financieros CA	Swiss Bank Program	1.2	1,637	Mercantil Bank (Schweiz) AG	-	-	VE	Bank
Irish Bank Resolution Corp Ltd/Old	Swiss Bank Program	1.1	11,747	Hyposwiss Private Bank Genève	-	14/12/2007	IE	Bank
Banque Cantonale du Jura SA	Swiss Bank Program	1.0	192	Banque Cantonale du Jura SA	-	-	CH	Bank
Medibank	Swiss Bank Program	0.8	76	MediBank AG	-	-	CH	Bank
Hypothekarbank Lenzburg AG	Swiss Bank Program	0.6	359	Hypothekarbank Lenzburg AG	-	-	CH	Bank
Banco di Desio e della Brianza SpA	Swiss Bank Program	0.3	1,458	Credito Privato Commerciale	-	08/06/2012	IT	Bank
Banca Intermobiliare SpA	Swiss Bank Program	-	1,433	Banca Intermobiliare di Investi	-	-	IT	Financial services

Note: This table provides information about all the banks in the estimating sample. Except for the name of the entity in the Swiss Bank Program and the source of identification, all information may vary over time as ownership links sometimes change. This table states the latest information for each bank before the first leak from *LGT bank* .

Table A3: News stories concerning banks on the front page of Neue Zürcher Zeitung

Date	Headline
14 February 2008	Jerker Johannsson takes over the investment banking at UBS
15 February 2008	UBS struggles with crisis of confidence: Another drop in the stock price
16 February 2008	The subprime crises approaches its bottom: the CEO of Credit Suisse Brady Dougan interviewed
19 February 2008	Northern Rock nationalized reluctantly
20 February 2008	Credit Suisse in the subprime vortex: billions written-off in the first quarter
21 February 2008	Convertible loan of UBS was valued fairly
22 February 2008	UBS stands by Marcel Ospel
25 February 2008	Yes for the business tax reform II
27 February 2008	Petition against excessive management compensation filed: much support from the left

Table A4: Regression results, other events

	Leak #1	Leak #2	Leak #3	Leak #4	Leak #5	Leak #6	Leak #7
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CAR 1	-0.5	-0.7	-0.8	-0.1	0.2	-0.5	-0.1
	(0.4)	(1.0)	(0.9)	(0.8)	(0.7)	(0.7)	(0.4)
CAR 2	-1.1**	-1.1	-1.8	0.3	-0.2	-0.6	0.1
	(0.5)	(1.4)	(1.3)	(1.1)	(1.0)	(0.9)	(0.5)
CAR 3	-1.5**	-2.1	-1.6	-0.7	-0.2	-0.5	0.4
	(0.6)	(1.7)	(1.6)	(1.3)	(1.2)	(1.1)	(0.7)
CAR 4	-2.2***	-0.9	-2.5	-0.5	0.2	-1.1	1.3*
	(0.7)	(1.9)	(1.9)	(1.6)	(1.4)	(1.3)	(0.8)
CAR 5	-2.1**	-0.8	-1.8	-0.7	0.3	-1.5	1.8**
	(0.8)	(2.2)	(2.1)	(1.7)	(1.6)	(1.5)	(0.9)
Stoxx Europe 600	66.5***	73.5***	73.4***	81.2***	89.8***	84.1***	71.7***
	(1.7)	(2.2)	(2.6)	(2.6)	(2.7)	(2.5)	(1.7)
Constant	-0.0	0.1	0.1	0.1**	0.1**	0.1**	0.0
	(0.0)	(0.1)	(0.1)	(0.0)	(0.0)	(0.0)	(0.0)
Observations	271	271	271	271	271	271	271
R-squared	0.9	0.8	0.8	0.8	0.8	0.8	0.9
Portfolio size	38	38	39	40	37	40	39

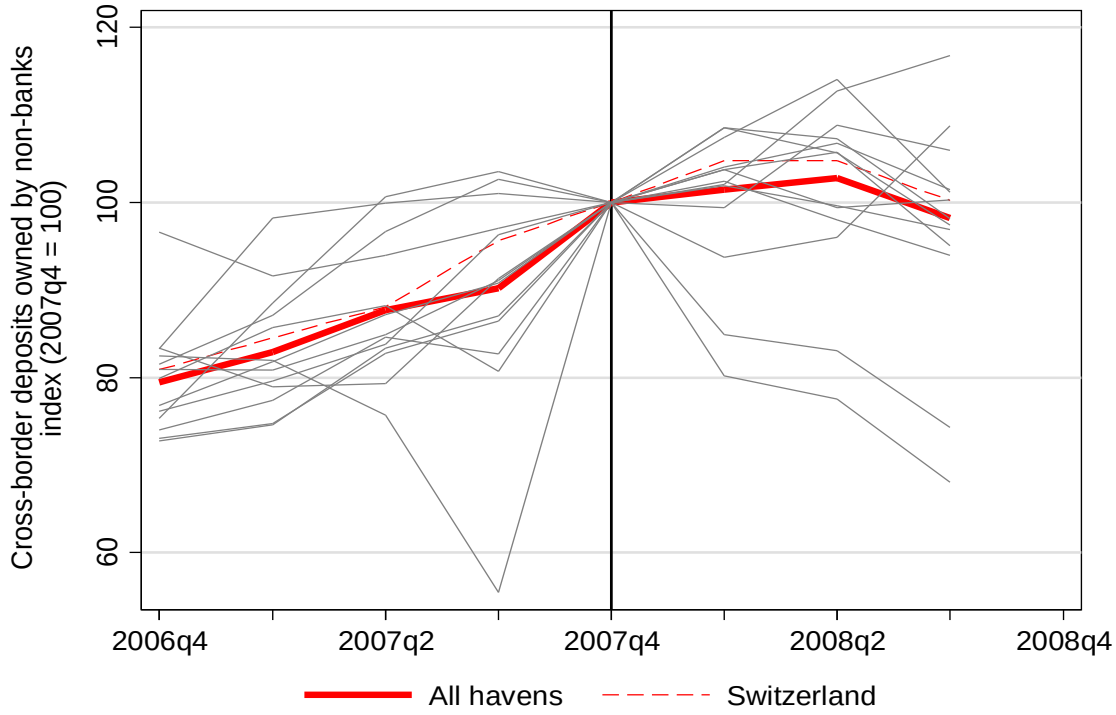
Note: The table shows the results from the main event study specification applied to each of the data leaks from banks in tax havens individually (Columns 1-13); to all of the data leaks at once (Column 14).

Table A4: Regression results, other events (continued)

Leak #8	Leak #9	Leak #10	Leak #11	Leak #12	Leak #13	All leaks pooled
(8)	(9)	(10)	(11)	(12)	(13)	(14)
-0.8	0.2	0.6	-0.2	-0.5	-0.1	-0.3
(0.6)	(0.5)	(0.5)	(0.3)	(0.4)	(0.4)	(0.2)
-1.0	0.7	0.5	-0.7	-1.3**	-0.5	-0.3
(0.8)	(0.7)	(0.7)	(0.5)	(0.6)	(0.6)	(0.3)
-1.4	0.1	-0.6	-1.1*	-1.6**	0.1	-0.7**
(1.0)	(0.9)	(0.9)	(0.6)	(0.7)	(0.7)	(0.3)
-2.4**	0.3	-0.0	-0.8	-1.3	-0.2	-0.6
(1.2)	(1.0)	(1.0)	(0.7)	(0.8)	(0.8)	(0.4)
-3.0**	0.5	-0.2	-0.1	-1.4	0.6	-0.4
(1.3)	(1.1)	(1.1)	(0.7)	(0.9)	(0.9)	(0.4)
74.5***	70.7***	71.3***	62.4***	58.1***	58.6***	78.6***
(2.0)	(3.2)	(3.3)	(1.6)	(1.8)	(1.8)	(0.8)
-0.0	0.0	0.0	-0.0	0.0	0.0	0.0
(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
271	271	271	271	271	271	2,321
0.9	0.7	0.7	0.9	0.8	0.8	0.8
36	36	36	36	36	36	29

Note: The table shows the results from the main event study specification applied to each of the data leaks from banks in tax havens individually (Columns 1-13); to all of the data leaks at once (Column 14).

Figure 4: Cross-border deposits held by non-banks in tax havens around the LGT leak



Note: The figure shows the trend in cross-border deposits held in tax havens by non-banks. For each tax haven reporting to the BIS Locational Banking Statistics, we have computed a country-level index expressing the stock of deposits held by non-banks in a given quarter relative to the stock at the end of 2007:q4. The figure shows the average index value for all tax havens (full red line), the index value for Switzerland (dashed red line) and the index value for each of the other tax havens (gray lines) over the 2-year period 2006:q4 - 2008:q3.