

The deterrence effect of whistleblowing

An event study of leaked customer information from banks in tax havens^{*}

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Abstract

We document that the first leak of customer information from a tax haven bank caused a significant decrease in the market value of Swiss banks *known* to be assisting with tax evasion and that the decrease was largest for the banks most strongly involved. These findings suggest that markets expected the leak to increase the perceived risk of committing and assisting with tax evasion and thus to lower both demand and supply in the market for criminal offshore banking services. This interpretation finds support in further evidence that the leak caused a sharp drop in foreign-owned deposits in tax havens.

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). These views presume 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 22,000 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 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.

The key empirical challenge is that the criminal use of offshore banking services is not directly observable. Our main empirical approach is therefore indirect and amounts

¹Documents 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.

to estimating the effect of data leaks on the stock prices of banks that provide such services. 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. Conceptually, a decrease in expected bank 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). In either case, the equilibrium quantity of criminal offshore services would be lower than before the leak.²

For the purposes of the 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. Although its banking secrecy rules have recently been moderated, Switzerland dominates the global wealth management industry with a market share of around 30% (Zucman, 2013). Within this sample, we focus on a subsample of banks that have admitted to assisting U.S. taxpayers 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.

Our main analysis concerns the first data leak from a tax haven bank: customer files from *LGT Bank* in Liechtenstein were extracted by a former computer technician at the bank, Heinrich Kieber and distributed to tax authorities in several countries. 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

²Alstadsæter et al. (2017) 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.

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.

Employing a standard event study framework (Kothari and Warner, 2007), 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. The most plausible interpretation is that markets perceived the leak as an effective deterrent of offshore tax evasion. 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 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 earnings of offshore banks.⁴

A number of additional empirical tests support this 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. This reassures us

³Formal 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 (e.g., Dekel et al., 1998).

⁴From the perspective of a tax haven bank, the data leak may be seen as causing an inward shift of the demand curve and a

that our results are not driven by confounding shocks affecting the entire Swiss financial sector and is strongly suggestive 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 through a voluntarily disclosure of their cross-border activities (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 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.. Specifically, we find a larger decrease for banks with above-median penalties (abnormal return of -3.2% over four days) than for banks with below-median penalties (abnormal return of -1.4% over four days). This set of results further strengthens the causal link between the banks' losses in market value around the time of the LGT leak and their role in offshore tax evasion.

Third, we apply the same event study design to subsequent leaks from other tax haven banks. We manually searched all front pages of a major Swiss newspaper, *Neue Zürcher Zeitung*, between January 2008 and October 2016 and identified 13 instances where an article covered a newly leaked list of bank customers or a significant new dissemination of such a list, for example when a customer list previously leaked to foreign tax authorities was made publicly accessible. We generally find weak signs of stock market responses to major events, such as the leak from the Swiss wealth management branch of HSBC in 2009, but the effects are relatively modest in size and typically not statistically significant at conventional levels. Overall, these 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 not associated with a significant updating of the beliefs about this risk.

Fourth, we explore the alternative hypothesis that leaks do not themselves deter

offshore tax evasion, but drive down the expected earnings of murky offshore banks by exposing them to unwanted media attention, for instance, because exposure fosters public demand for political action. In an attempt to distinguish this exposure hypothesis from the deterrence hypothesis, we apply our model to an event that made offshore tax evasion feature prominently in international media, but contained no new information about its potential costs: the announcement that Uli Hoeness, president of the soccer club FC Bayern Munich, was under investigation for his use of Swiss bank accounts for tax evasion purposes. Consistent with the deterrence hypothesis, we find no significant stock market responses to this event.

Finally, we provide a complementary analysis of the deterrence effect of the LGT data leak using country-level data on foreign-owned bank deposits from the Bank for International Settlements. While foreign-owned deposit stocks evolved very similarly in tax havens and non-tax havens before the leak, we observe a sharp divergence during the first quarter of 2008 with deposits in tax havens decreasing by more than 10% relative to deposits in non-tax havens. This estimate is clearly consistent with a significant drop in the use of criminal offshore banking services following the leak and, under plausible assumptions, the magnitude is consistent with the estimated drop in the stock market value of Swiss banks.

While a number of studies have investigated which conditions are conducive to whistleblowing (Dyck et al., 2010), we are not aware of any existing quantitative evidence on the ability of whistleblowing to deter crime. A large related 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., 2017; 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.

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.

2 Background and data

2.1 Offshore tax evasion and Swiss banks

Recent studies estimate that household wealth hidden in tax havens amounts to at least \$6,000 billion (Zucman, 2013). The hidden wealth predominantly belongs to the very wealthiest households and largely escapes taxation (Alstadsæter et al., 2017).

Governments wanting to tax the wealth hidden in tax havens have recently enacted a number of enforcement initiatives: in 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 2009, all tax havens in the world were compelled to accept a weak form of cooperation whereby they would lift the banking secrecy and provide information about specific account holders suspected of tax evasion when requested by foreign tax administrations (Johannesen and Zucman, 2014) and most recently, tax havens agreed to provide financial account information about foreign taxpayers on an automatic basis (Stolper, 2017).⁵

An enforcement initiative of particular interest to this study is the criminal cases in the U.S. against Swiss banks for assisting U.S. citizens with tax fraud involving anonymous shell companies and undeclared Swiss bank accounts. The first case, against UBS,

⁵Account information is provided to the US under the Foreign Account Tax Compliance Act (FATCA) and to other countries under the Convention on Mutual Assistance in Tax Matters as amended in 2014.

ended with a \$780 million settlement in February 2009 and another 15 Swiss banks were investigated on similar charges in the following years.⁶ 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.⁷ Finally, in August 2013, the U.S. Department of Justice and the Swiss government announced the *Swiss Bank Program* under which banks not already under criminal 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.⁸

These U.S. enforcement initiatives are useful for our purposes because they identify a group of banks that derived income from assisting U.S. customers with offshore tax evasion at the time of the data leak from LGT bank.⁹ Upon 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 that was at least partly observable by market participants at the time of the leak, we should expect market value losses to be larger for banks with higher penalties.

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

⁶There is no 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).

⁷The three banks that have dropped out of business are Wegelin, Neue Zürcher Bank, and Bank Frey.

⁸See <https://www.justice.gov/tax/swiss-bank-program> (last accessed on 15 February 2017).

⁹Of course, Swiss banks also assist taxpayers from other countries in evading taxes. In fact, most Swiss bank deposits are owned by Europeans (Zucman, 2013).

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*.¹⁰ 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.¹¹ Finally, as particularly smaller entities are not always being traded, we exclude entities 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 an office in Switzerland, we shall refer to the banks in our sample as “Swiss banks” for simplicity of the exposition.

Table A1 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.

2.2 Data leaks

The main focus of the analysis is to study banks’ stock market responses to 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 on the bank’s customers in Germany for around

¹⁰The 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.

¹¹Here, we drop American International Group Inc (insurance), Assicurazioni Generali SpA (insurance) and Italmobiliare SpA (construction & materials).

€4.2 million.

The data leak became publicly known in 2008. After months of secret investigations, on 14 February, the German police raided the premises of Klaus Zumwinkel, a prominent corporate executive and detained him on charges of tax evasion. 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* was first to report that BND had allegedly paid a whistleblower around €5 million for the information leading to the arrest of Klaus Zumwinkel.¹² On 18 February, the news reports contained regular references to the data leak in 2002. While we treat the arrest of Mr. Zumwinkel on 14 February as the event day, we should not expect to see the full effect on the stock prices until three to four days after the event, given the staggered dissemination of information.

The LGT leak in 2008 was, to our knowledge, the first data leak from a tax haven bank; however, several others followed in the subsequent years. We have systematically collected information about these leaks by manually searching all the front pages of a major Swiss newspaper, *Neue Zürcher Zeitung*, for the period 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.¹³ 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

¹²See <http://www.spiegel.de/wirtschaft/finanzskandal-bnd-zahlte-fuenf-millionen-fuer-geheimsteuerdaten-a-535687.html> (last accessed on 15 February 2017).

¹³We 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 US 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.

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

2.3 Stock market 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 index, which accounts for dividends as well as capital gains

$$Return_{n,t} = \frac{P_{n,t} - P_{n,t-1}}{P_{n,t-1}}, \quad (1)$$

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 from non-trading days in Switzerland to avoid a small group of banks which is traded outside of Switzerland from dominating the estimates on specific days, such as Israeli stocks which are traded on Sundays but not Fridays.¹⁴ 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

¹⁴We 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.

introduce a bias toward zero. Finally, we winsorize returns at the 0.1 and 99.9% level to reduce the influence of outliers.

Table 2 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*.¹⁵ 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*.¹⁶

Table 2 around here

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 and other unanticipated events. 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.¹⁷ The observation period includes the event window, consisting of the event date

¹⁵To 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.

¹⁶These results are not reported.

¹⁷The 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 private investor at the time of the event, it does not enter the event-specific sample.

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

$$Portfolio\ return_t = \frac{1}{N} \sum_{n=1}^N Return_{n,t}, \quad (2)$$

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. We use the portfolio return rather than bank individual returns as the dependent variable in the event study regressions to account for cross-sectional dependence in the returns of individual banks. We also compute a weighted variant of the portfolio return where the daily returns of individual banks are weighted by market capitalization.¹⁸

In a third step, we regress the portfolio return on the market return and dummies for the symmetric 21-day window around the event

$$Portfolio\ return_t = \alpha + \beta Market\ return_t + \sum_{s=-10}^{10} \delta_s D_s + \varepsilon_t, \quad (3)$$

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 and absent the leak. 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

¹⁸We 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 pre-event market capitalization (see Table A1 in the Appendix), and these banks are therefore not included in the weighted portfolio return.

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 (3) as

$$CAR(T) = \sum_{s=0}^{T-1} \delta_s. \quad (4)$$

In practice, we estimate a slightly modified version of equation (3) that redefines the dummies to yield point estimates and standard errors of $CAR(T)$ directly (Salinger, 1992).

4 Results: Stock prices

4.1 Average effect

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 participated in the Swiss Bank Program.

As illustrated in Figure 1, 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 1 around here

While the confidence intervals plotted in Figure 1 are derived under the usual parametric assumptions, we also take a non-parametric approach to statistical inference. For instance, 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 2. 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 1st 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 2 around here

Table 3 reports additional results with Column (1) showing the baseline estimates from Figure 1 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 3 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. Assuming that Swiss banks earn an annual profit margin of 0.5% on assets under management and that stock market investors use a discount factor of 5%, these estimates suggests that the foreign-owned assets managed by Swiss banks in the portfolio were expected to

permanently decrease by around CHF 300 billion (around \$270 billion).¹⁹ This decrease corresponds to around 10% of the total foreign-owned wealth managed in Switzerland.²⁰

Having established an economically sizable and statistically significant 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 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.²¹ 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 (3), 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.

4.2 Heterogeneous effects

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

¹⁹Note that these figures only account for assets held in listed Swiss banks. Assuming that customers in unlisted Swiss banks were deterred to the same extent as customers in listed Swiss banks and that penalties were proportional to the value of foreign-owned assets under management, the implied decrease in assets under management is around CHF 380 billion (around \$340 billion) or around 14% of the total foreign-owned assets managed in Switzerland.

²⁰Zucman (2013, Table A.23 and A.24) puts the foreign-owned wealth held in Switzerland by the end of 2007 at US \$3.4 trillion.

²¹We 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.

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 3. The results are strikingly different: the cumulative abnormal return after four days was -6.1% for the prosecuted banks, but only -1.2% for the voluntary disclosers.

Figure 3 around here

Table 4 reports additional results with Columns (1)–(2) showing the estimates from Figure 3 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 4 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.

By showing that banks' loss in market value around the time of the LGT leak varies 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.

4.3 Other events

This section studies the stock market responses to events other than the leak from LGT Bank with the aim of gaining a deeper understanding of the mechanism through which whistleblowing affected the stock prices of Swiss banks involved in offshore tax evasion. The results are reported in Table 5.

We first apply the baseline model to three key dates associated with the leak of customer files from HSBC: 30 August 2009 when Éric Woerth, the French budget minister, announced that the French government had acquired a list of 3,000 French customers of three banks in Switzerland with assets worth \$3 billion (Column 1); 9 December 2009 when, for the first time, French media reported an alleged data theft at HSBC (Column 2); and 9 February 2015 when the *International Consortium of Investigative Journalists* (ICIJ) announced that they were in possession of the complete set of leaked documents from HSBC and published the identity of hundreds of prominent customers in a global wave of news stories (Column 3). We also estimate the average stock market response to the remaining nine leaks in our database with a modified version of the baseline model that includes multiple event windows (Column 4).²²

Table 5 around here

The results show that stocks of Swiss banks in the estimating sample generally earned negative abnormal returns in the days following news about a leak, however, the effects were relatively modest in size and typically not statistically significant at conventional levels. The results are suggestive that the data leaks occurring after the first leak from LGT Bank did not cause a significant reduction in the use of offshore bank accounts. Plausibly, the first leak made offshore account holders and banks aware of the risk that customer information may be leaked whereas subsequent leaks did not induce any significant upward adjustment in the probabilities assigned to such events. Prior to the first leak, they may have believed that data theft from Swiss banks was impossible; that bank employees had no incentive to blow the whistle or that intelligence services and

²²The 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.

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 too small to be statistically detectable.

Finally, we apply the baseline model to an event that is entirely unrelated to whistleblowing, but received enormous attention in international media: 20 April 2013 when it became apparent that Uli Hoeness, president of the soccer club FC Bayern Munich and a prominent public person with contacts to high-level politicians including the German chancellor Angela Merkel, was under investigation for tax evasion through accounts in Swiss banks.²³ As shown in Column (5), banks in the baseline sample earned very small and statistically insignificant abnormal returns in the days following the news.

This result suggests that media exposure in itself does not decrease the market value of offshore banks. This has important implications for the interpretation of the main findings: it is consistent with the notion that the LGT leak decreased the market value of Swiss banks through the deterrence of offshore tax evasion, but not consistent with the alternative hypothesis that stock markets responded adversely to offshore evasion having caught the attention of media, voters and, ultimately, policy makers.

5 Results: Bank deposits

In this section, we study the deterrence effect of the LGT leak by exploiting an entirely different data source: the Locational Banking Statistics from 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 major tax havens such as Switzerland, Luxembourg, Cayman Islands, Singapore and Hong Kong. The deposit information in the BIS statistics is reliable because the primary data 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 recent literature on hidden wealth (e.g. Andersen, et al. 2016; Johannesen and Zucman,

²³For summaries of the Uli Hoeness case, see "Uli, Uli, Uli: Secret Swiss bank accounts suddenly have a famous face," *The Economist*, 27 April 2013, and "Germany's Hoeness trial: Uli goes to jail," *The Economist*, 13 March 2014.

2014; Johannesen, 2014; Zucman, 2013).

Our main variable of interest in this analysis is the stock of bank deposits owned by foreign non-bank residents. This variable excludes inter-bank deposits, which is presumably entirely unrelated to tax evasion and thus captures deposits held by households and firms. The main weakness of the measure in this context is the fact that only deposits are covered whereas other types of assets under management, e.g. bonds and shares, are not. Recent estimates suggest that deposits account for around 25% of the total financial wealth managed in tax havens (Zucman, 2013).

We investigate whether the LGT leak caused a detectable decline in the use of secret offshore accounts by comparing the evolution of deposits in tax havens and non-haven countries around the time of the leak. Concretely, we define a list of 17 tax havens, corresponding roughly to the list of non-cooperative jurisdictions published by the OECD at the eve of the first global crackdown on tax havens in 2009 (Johannesen and Zucman, 2014; OECD, 2009) and define the remaining 30 countries that report to the BIS statistics as non-tax havens.²⁴ To be able to meaningfully compare countries with very different deposit stocks, we base the analysis on a country-level deposit index expressing the stock of deposits in a given quarter relative to the stock at the end of 2007q4, the last observation before the data leak.

We first plot the average index value for tax havens and non-tax havens in a narrow window around the data leak. As shown in Figure 4, deposit stocks evolved very similarly in the two groups before the data leak with steady quarterly increases. Between the end of 2007q4 and the end of 2008q1, however, we observe a sharp divergence with a continued strong deposit growth in non-haven countries and close to zero growth in tax havens. The level difference of between 10 and 15 index points remains roughly constant through the bust of Lehman Brothers in September 2008 and the onset of the global financial crisis in 2008q3.

Figure 4 around here

²⁴Our list comprises the following countries: Austria, Bahamas, Bahrain, Belgium, Cayman Islands, Curacao, Cyprus, Guernsey, Hong Kong, Isle of Man, Jersey, Luxembourg, Macao, 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).

For the purposes of statistical inference, we run a simple linear regression with the deposit index as dependent variable and a tax haven dummy, a full set of time dummies and their interactions as explanatory variables. Figure 5 plots the estimated coefficients on the interaction terms as well as their confidence intervals based on standard errors clustered at the country-level. The divergence in 2008q1 and 2008q2 is strongly statistically significant. Table A2 in the Appendix shows the detailed regression output.

Figure 5 around here

Under the identifying assumption that foreign-owned deposits would have evolved similarly in tax havens and non-haven countries in the absence of the leak of customer information from LGT Bank, the results suggest that the leak caused a sudden decrease in the deposits held in tax havens by around 10 to 15%. The decrease is consistent with the notion that the first data leak reduced the use of offshore bank accounts by increasing the risk of involuntary exposure as perceived by account holders and banks. Note that the magnitude of the estimate is similar to what is implied by the estimated drop in market value of the Swiss sample banks, as shown above, under plausible assumptions about discount rates on financial markets and profit margins in the wealth management industry.

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

We address other possible interpretations, for instance, that the negative stock market responses were driven solely by the media attention to the business model of offshore banks. However, such interpretations are less plausible given that we find no stock market responses to other events directly related to offshore tax evasion and covered intensively in international media, but carrying no new information about the risk of exposure for offshore account owners and banks.

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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: 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 a major European stock market index. All statistics are for the period between 1 January 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 3: Main regression results

	Unweighted portfolio (1)	Weighted portfolio (2)	Other Swiss banks (3)
CAR 1	-0.5 (0.4)	-1.1* (0.6)	-0.3 (0.7)
CAR 2	-1.1** (0.5)	-2.1** (0.8)	0.7 (1.1)
CAR 3	-1.5** (0.6)	-2.2** (1.0)	-0.6 (1.3)
CAR 4	-2.2*** (0.7)	-3.0** (1.2)	0.1 (1.5)
CAR 5	-2.1** (0.8)	-2.9** (1.3)	-0.3 (1.7)
Stoxx Europe 600	66.5*** (1.7)	108.2*** (2.7)	65.0*** (3.5)
Constant	-0.0 (0.0)	-0.0 (0.0)	0.1 (0.0)
Observations	271	271	271
R-squared	0.9	0.9	0.6
Portfolio size	38	38	7
Market capitalization	980,402	980,402	26,977

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. Column (1) indicates the results with the unweighted portfolio return, Columns (2) indicates the results with the portfolio return weighted by market capitalization; Column (3) indicates 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 4: Regression results, heterogeneity

	Unweighted portfolio		Weighted portfolio		Unweighted portfolio		Weighted portfolio	
	Criminal	Swiss Bank	Criminal	Swiss Bank	High penalty	Low penalty	High penalty	Low penalty
	investigations	Program	investigations	Program	High penalty	Low penalty	High penalty	Low penalty
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CAR 1	-1.0 (0.7)	-0.4 (0.4)	-1.9*** (0.7)	-0.6 (0.6)	-0.5 (0.5)	-0.6* (0.4)	-1.7** (0.8)	-0.3 (0.6)
CAR 2	-2.3** (0.9)	-0.8 (0.5)	-3.1*** (0.9)	-1.5 (0.9)	-1.3* (0.8)	-0.9* (0.5)	-2.6** (1.1)	-1.2 (0.8)
CAR 3	-4.3*** (1.2)	-0.8 (0.7)	-3.1*** (1.1)	-1.7 (1.1)	-2.4** (0.9)	-0.7 (0.6)	-3.5*** (1.3)	-0.5 (1.0)
CAR 4	-6.1*** (1.3)	-1.2 (0.8)	-4.6*** (1.3)	-2.1 (1.3)	-3.2*** (1.1)	-1.4* (0.7)	-4.4*** (1.5)	-1.5 (1.2)
CAR 5	-6.2*** (1.5)	-1.0 (0.9)	-4.1*** (1.5)	-2.2 (1.4)	-3.2*** (1.2)	-0.9 (0.8)	-4.2** (1.7)	-1.4 (1.3)
Stoxx Europe 600	69.7*** (3.1)	65.7*** (1.8)	92.0*** (3.0)	117.9*** (3.0)	85.1*** (2.5)	49.4*** (1.7)	116.8*** (3.5)	109.6*** (2.7)
Constant	-0.0 (0.0)	-0.0 (0.0)	-0.1* (0.0)	-0.0 (0.0)	-0.0 (0.0)	0.0 (0.0)	-0.1 (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
Market capitalization	366,045	614,358	366,045	614,358	578,949	197,055	578,949	197,055

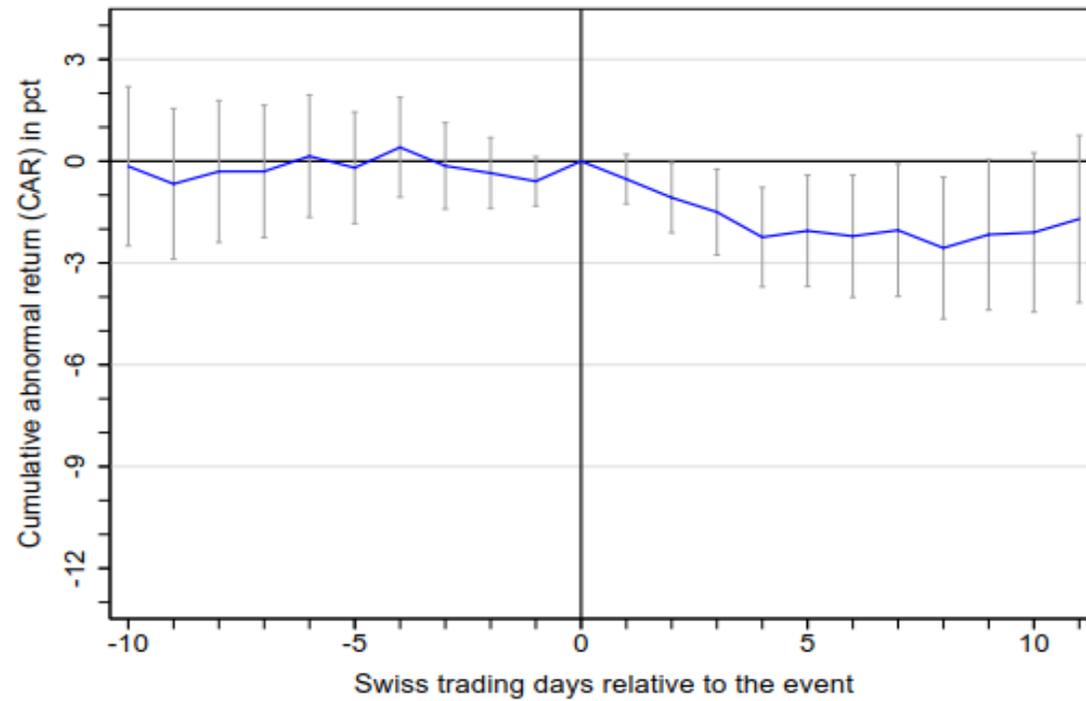
Note: The table shows the results from the main event study specification applied to the first event, the leak from LGT bank on 14 February 2008. Columns (1)-(2) and (5)-(6) show results for the unweighted portfolio return while Columns (3)-(4) and (7)-(8) show results for the portfolio return weighted 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 5: Regression results, other events

	Leak #2: Woerth (1)	Leak #4: Falciani (2)	Leak #11: Swiss Leaks (3)	Other leaks (4)	Hoeness (5)
CAR 1	-0.7 (1.0)	-0.1 (0.8)	-0.2 (0.3)	-0.3 (0.2)	-0.2 (0.5)
CAR 2	-1.1 (1.4)	0.3 (1.1)	-0.7 (0.5)	-0.3 (0.3)	-0.6 (0.7)
CAR 3	-2.1 (1.7)	-0.7 (1.3)	-1.1* (0.6)	-0.5 (0.4)	-0.5 (0.9)
CAR 4	-0.9 (1.9)	-0.5 (1.6)	-0.8 (0.7)	-0.5 (0.5)	-0.6 (1.0)
CAR 5	-0.8 (2.2)	-0.7 (1.7)	-0.1 (0.7)	-0.2 (0.5)	-0.3 (1.1)
Stoxx Europe 600	73.5*** (2.2)	81.2*** (2.6)	62.4*** (1.6)	78.7*** (1.0)	71.4*** (3.2)
Constant	0.1 (0.1)	0.1** (0.0)	-0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Observations	271	271	271	1,890	271
R-squared	0.8	0.8	0.9	0.8	0.7
Portfolio size	38	40	36	30	36
Market capitalization	842,491	813,818	668,437	759,968	622,445

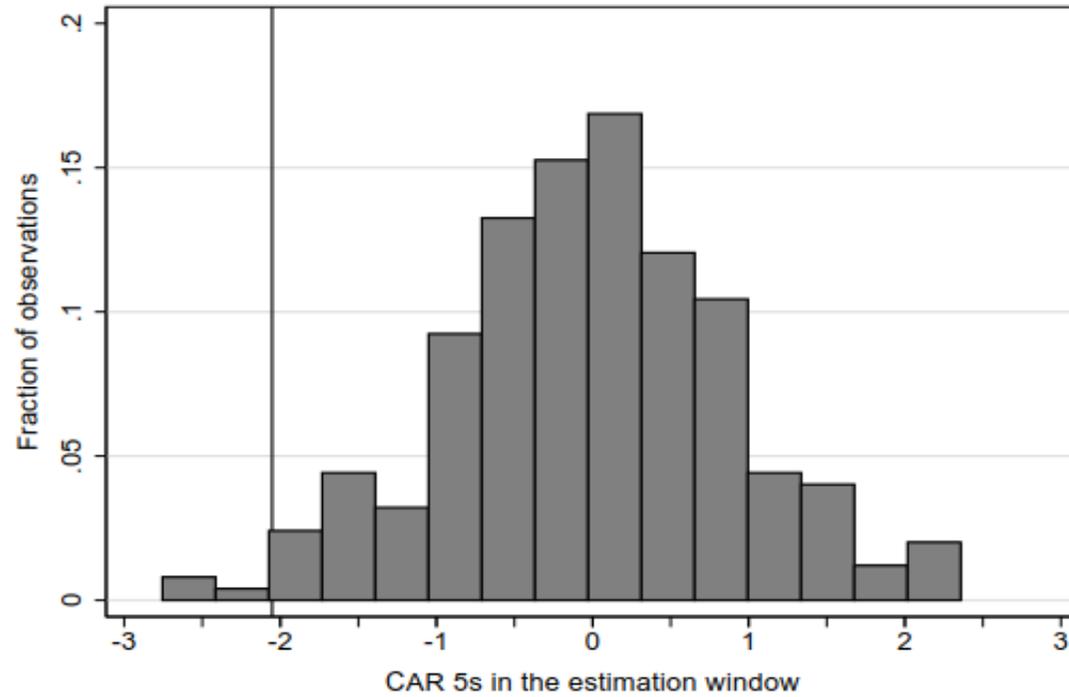
Note: The table shows the results from the main event study specification applied to various leaks. Column (1) concerns leak #2 where the French Budget Minister announced the acquisition of a list with French owners of undeclared Swiss accounts; Column (2) concerns leak #4 when Hervé Falciani revealed himself as the source of the data leak from HSBC; Column (3) concerns leak #11 where ICIJ published the HSBC customer lists as the Swiss Leaks; Column (4) concerns leaks #3, #5-#10 and #12-#13; Column (5) concerns the date at which it became publicly known that Uli Hoeness was under investigation for offshore tax evasion. All regressions include a set of event time dummies as described in the main text.

Figure 1: Cummulative abnormal return of Swiss banks around the leak from LGT Bank



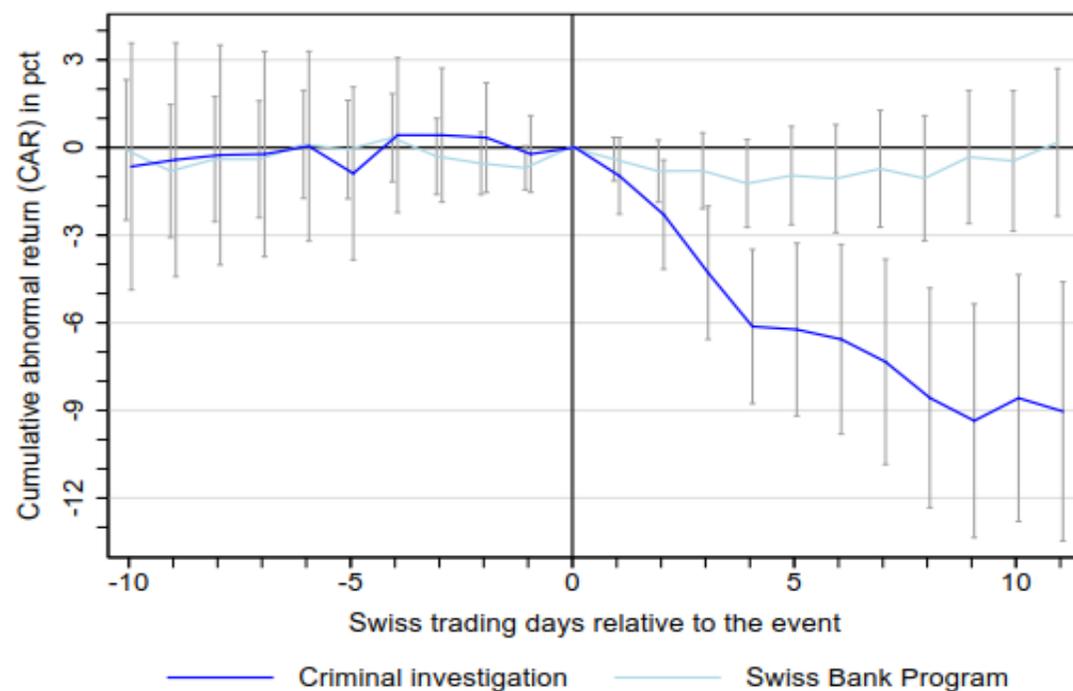
Note: The figure illustrates the results from the main event study specification applied to the first event, the leak from LGT bank on 14 February 2008. The blue line shows the estimates of the cumulative abnormal return. The gray bars indicate 95% confidence intervals of the estimates.

Figure 2: Distribution of 5-day cumulative abnormal returns before leak from LGT Bank



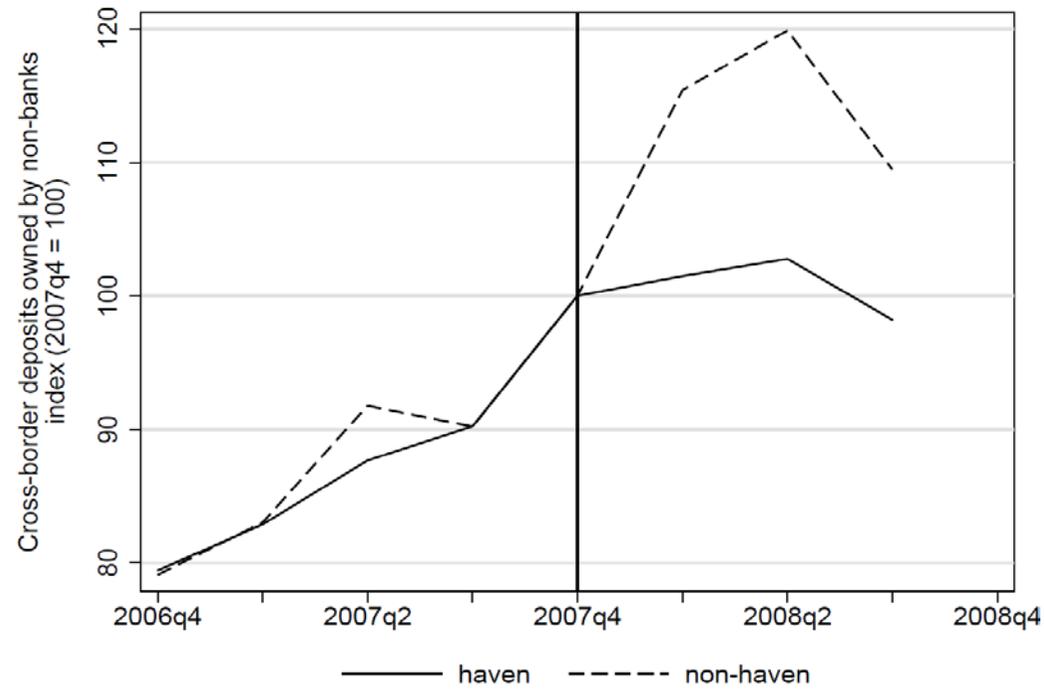
Note: The table shows the distribution of cumulative abnormal returns for all 5-day windows in the estimation period (outside of the event window) of the first leak. The vertical line indicates the estimated cumulative abnormal return in a 5-day window starting at the event, that is CAR(5).

Figure 3: Heterogeneity in cumulative abnormal returns of Swiss banks around the leak from LGT Bank



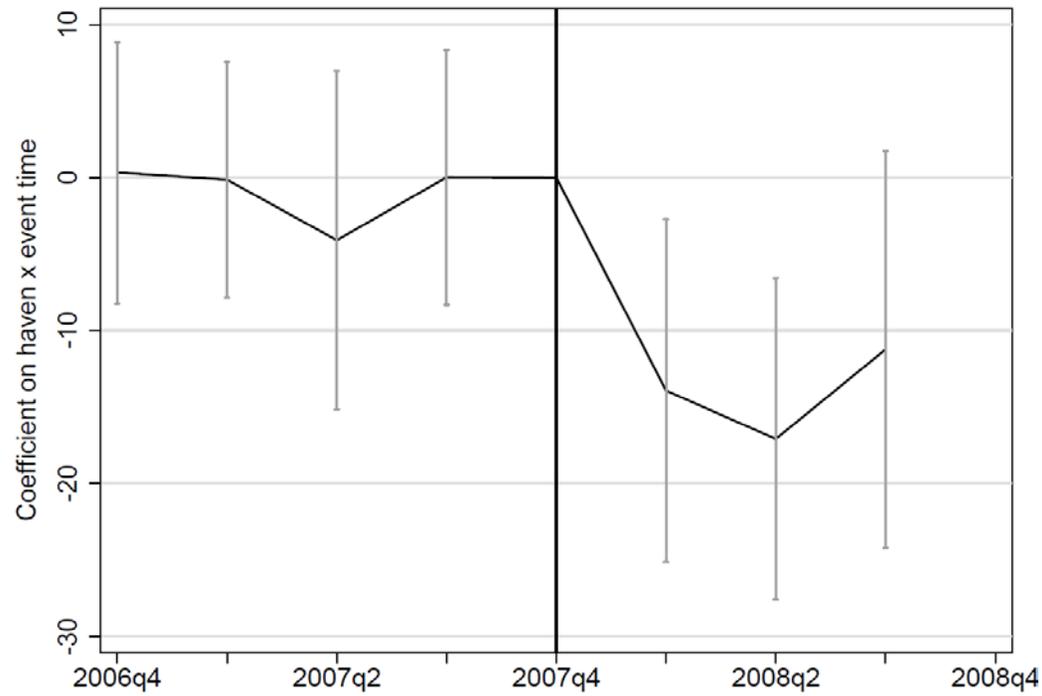
Note: The figure illustrates the results from the main event study specification applied to the first event, the leak from LGT bank on 14 February 2008. The two blue lines show the estimates of the cumulative abnormal return for the sample of Swiss banks that have been subject to criminal investigations 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 4: Foreign-owned deposits in tax havens and non-tax havens



Note: The figure shows the trend in foreign-owned bank deposits in tax havens and non-tax havens respectively. For each country reporting to the BIS Locational Banking Statistics, we have computed a country-level deposit index expressing the stock of deposits in a given quarter relative to the stock at the end of the fourth quarter of 2007. The figure shows the average index value for tax havens and non-tax havens over the period 2006:q4 - 2008:q3.

Figure 5: Estimated effect of LGT leak on deposits in tax havens



Note: The figure shows the difference-in-differences estimate of the effect of the LGT leak on foreign-owned bank deposits in tax havens. For each country reporting to the BIS Locational Banking Statistics, we have first computed a country-level deposit index expressing the stock of deposits in a given quarter relative to the stock at the end of the fourth quarter of 2007. We have estimated a linear regression with the index as dependent variable and time dummies, a haven dummy and the interactions between them as explanatory variables. The figure shows the estimated coefficients on the interaction terms and their 95% confidence bounds based on standard errors clustered at the country level.

Appendix

Table A1: 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
Graubündner 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 Cantonale 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 A2: Deposit regressions

VARIABLES	(1) deposit index	(2) deposit index
Tax Haven	-0.87 (2.81)	
Post 2007q4	25.99*** (5.82)	
Tax Haven × Post 2007q4	-13.22** (6.26)	
2006q4		-20.89*** (3.98)
2007q1		-16.97*** (3.46)
2007q2		-8.22 (5.21)
2007q3		-9.79*** (2.84)
2008q1		15.40*** (5.07)
2008q2		19.86*** (4.37)
2008q3		9.45* (5.57)
Tax Haven × 2006q4		0.32 (4.27)
Tax Haven × 2007q1		-0.14 (3.85)
Tax Haven × 2007q2		-4.10 (5.54)
Tax Haven × 2007q3		0.02 (4.17)
Tax Haven × 2008q1		-13.93** (5.60)
Tax Haven × 2008q2		-17.10*** (5.27)
Tax Haven × 2008q3		-11.24* (6.49)
Constant	88.91*** (2.51)	100.00*** (0.00)
Observations	324	324
R-squared	0.27	0.36

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). *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 reported in parenthesis. Significance levels are indicated as: *** p<0.01, ** p<0.05, * p<0.1