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Tax Evasion and Inequality*

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Abstract

This paper attempts to estimate the size and distribution of tax evasion in rich countries. We combine random audits—the key source used to study tax evasion so far—with new micro-data leaked from large offshore financial institutions—HSBC Switzerland ("Swiss leaks") and Mossack Fonseca ("Panama Papers")—matched to population-wide wealth records in Norway, Sweden, and Denmark. We find that tax evasion rises sharply with wealth, a phenomenon random audits fail to capture. On average about 3% of personal taxes are evaded in Scandinavia, but this figure rises to close to 30% in the top 0.01% of the wealth distribution, a group that includes households with more than $45 million in net wealth. A simple model of the supply of tax evasion services can explain why evasion rises steeply with wealth. Taking tax evasion into account increases the rise in inequality seen in tax data since the 1970s markedly, highlighting the need to move beyond tax data to capture income and wealth at the top, even in countries where tax compliance is generally high. We also find that after reducing tax evasion—by using tax amnesties—tax evaders do not legally avoid taxes more. This result suggests that fighting tax evasion can be an effective way to collect more tax revenue from the very wealthy.

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1 Introduction

The size and distribution of tax evasion is a source of sustained interest and controversy among the public. Some believe that the bulk of tax evasion is done by the wealthy, a view fueled recently by high-profile leaks from offshore financial institutions such as the Panama Papers. Others stress that poorer individuals may be more likely to evade taxes, highlighting fraud by the self-employed or abuse of refundable tax credits.

Who evades taxes—and how much—matters for economists and policy-makers too. First, and most importantly, it matters for the study of inequality. Over the last fifteen years, scholars have increasingly relied on tax data to study distributional issues, especially trends in top income and wealth shares. This raises an obvious issue: since tax rates, tax evasion technologies, and tax enforcement strategies differ across countries and have changed dramatically over time, tax data may paint a distorted picture of the cross-country and time-series patterns in inequality. Second, tax evasion matters for analyzing the effects of governments intervention in the economy; it redistributes the tax burden and affects the costs of raising taxes, "bread-and-butter concerns of public economics" (Slemrod, 2016). Last, knowing how tax evasion is distributed would enable tax authorities—which face tight budget constraints—to better target their enforcement effort.

Tax evasion is fundamentally hard to study because there is no single source of information capturing all of it. The key source used so far in rich countries is stratified random audits. These audits are a powerful way to uncover unreported self-employment income, abuses of tax credits, and more broadly all relatively simple forms of tax evasion. Tax authorities rely on random audits to estimate the tax gap, that is, the total amont of unreported income and unpaid taxes (e.g., IRS 2016), and academics have fruitfully used them to gains insights on the determinants of tax evasion (e.g., Kleven et al., 2011). But, as discussed in Section 2 below, random audits do not allow to study tax evasion by the very wealthy satisfactorily, both because of insufficient sample sizes, and because they fail to capture sophisticated forms of evasion involving legal and financial intermediaries, the detection of which would require much more resources than available to tax authorities for their random audit programs. This limitation means that random audits need to be supplemented with other data sources to study tax evasion at the top of the distribution. Such data, however, have so far proven elusive.

In this paper, we analyze new micro-data that have recently become available and make it possible to study tax evasion by very rich individuals. These data come from massive leaks from offshore financial institutions—HSBC Switzerland ("Swiss Leaks") and Mossack Fonseca

(the "Panama Papers"). We combine these data with random audits and population-wide administrative income and wealth records in Norway, Sweden, and Denmark to estimate the size and distribution of total tax evasion. Factoring in this new data source reveals a sharp gradient in evasion by wealth group. We find that the top 0.01% of the wealth distribution—a group that includes households with more than $45 million in net wealth—evades about 30% of its personal income and wealth taxes (Figure 1). This is an order of magnitude more than the average evasion rate of about 3%.

The main leak used in this research is from HSBC Private Bank Switzerland, the Swiss subsidiary of the banking giant HSBC. In 2007, an HSBC employee extracted the complete internal records of the 30,412 clients of this bank, a large fraction of whom were evading taxes. We analyze the leaked HSBC files matched to individual tax data in Norway, Sweden, and Denmark. This leak has four key strengths. First, it is not the result of specific enforcement effort by tax authorities targeted at HSBC; it can be seen as a random event. Second, it involves a major—and, the available evidence suggests, representative—player in the offshore wealth management industry. Third, HSBC Switzerland recorded the name of the beneficial owners of the wealth it managed, even when this wealth was held, as is frequently the case, through intertwined shell companies incorporated in Panama and similar offshore havens. This makes it possible to link wealth to its actual owners. Fourth, while owning bank accounts in Switzerland is not illegal per se, the leaked file matched to tax returns offers a clear-cut way to identify illegal tax evasion: taxpayers who reported their HSBC accounts were not evading; those who did not were. In practice, about 90%–95% of all the individuals on the HSBC list that could be matched to a tax return did not report their Swiss bank account.

The second leak used in this research is what is known as the "Panama Papers". This leak revealed the identity of the shareholders of the shell companies created by the Panamanian firm Mossack Fonseca. Just like for HSBC, this leak is valuable as it can be seen as a random event and it involves a prominent provider of offshore financial services. It brings additional evidence on the extensive use of tax havens at the top of the distribution. The Panama papers, however, have one drawback: they do not allow us to estimate how much tax was evaded (if any) by the owners of the Mossack Fonseca shell companies. It is not illegal per se to own shell corporations in Panama or elsewhere.

We also analyze a third source of information, a large sample of Norwegian and Swedish households who voluntarily disclosed previously hidden wealth in the context of a tax amnesty.

The many data sets used in this article all paint the same picture: the probability to hide

assets offshore rises sharply with wealth, including within the very top groups of the wealth distribution. By our estimates, households who own around $10-12 million in net wealth are twice more likely to conceal assets abroad than households with around $5-6 million; households with more than $45 million are four times more likely. Conditional on hiding assets, the fraction of one's true wealth hidden abroad is high (around 40%) and does not vary much with wealth. As a result, the wealth in offshore tax havens turns out to be extremely concentrated. By our estimate, the top 0.01% of the distribution owns about 50% of it. When we apply this distribution to available estimates of the amount of wealth hidden in tax havens based on systematic exploitation of the available macroeconomic statistics (Zucman, 2013), we find that the top 0.01% evades a large fraction of its tax liability through offshore intermediaries, about 25% in our benchmark estimate—to which must be added a small amount of domestic tax evasion detected in random audits.

Of course, quantifying tax evasion faces challenges and by its very nature always will. Although we believe that leaks enable us to break new ground, it is worth mentioning at the outset the main limitations of our results. First, estimates of the macro stock of wealth hidden in tax havens have margins of errors, which add to the statistical noise due to us only observing samples of evaders. The available macro evidence enables us to construct a lower bound for the stock of wealth hidden abroad by Scandinavians; using it we find that the evasion rate for the top 0.01% is at least 15%—five times the macro average. Second, there are probably forms of tax evasion that neither random audits nor leaks can capture, hence that our estimates miss. At a modest level, our main finding is that combining random audits, leaks, and macroeconomic statistics makes it possible to obtain a more comprehensive picture of tax evasion than was available until now. Last, Scandinavia might not be representative of other rich countries. The most developed economies are, as in Scandinavia, likely to have low levels of evasion overall, because most economic activity takes place in the corporate and public sectors, where third-party reporting strongly limits tax evasion. But wealthy Scandinavians might be more (or less) likely to evade taxes than their counterparts in other rich countries. In our view, Scandinavian economies are an interesting laboratory, because they consistently rank among the countries with the highest social trust, lowest corruption, and strongest respect for the rule of law (Kauffmann and Kraay, 2017), suggesting that evasion among the wealthy may be even higher elshewere. In future work we plan to apply our methodology to estimate distributional tax gaps in as many countries as possible, as most tax authorities—including the United States'—have access to random audits and leaks similar to those we use in this research.

How can we explain the prevalence of tax evasion we estimate at the top of the distribution? Existing models focus on the rational behavior of a tax evader under uncertainty (Allingham and Sandmo, 1972), what can be seen as the demand side for tax evasion services. Evasion is high when the probability to be detected is low or when penalties are low, and the effect of tax rates is ambiguous. These models do not provide a direct explanation for the sharp gradient in evasion with wealth we find, because taxpayers with more than $50 million in wealth face the same marginal tax rates as those with $5 million, are more likely to be (non-randomly) audited, and yet seem to evade much more. We argue that to understand this gradient, it is necessary to consider the supply side of tax evasion services. We introduce such a model. Providers of tax evasion services (e.g., some Swiss banks) decide on the number of clients they serve by internalizing the cost of being caught, which rises with the number of clients served, for instance because the probability of a leak rises. We derive a closed-form expression for the fraction of the population served when wealth is Pareto distributed. The higher inequality, the lower the quantities of evasion services supplied. When inequality is very high, as is the case for wealth, it is optimal for banks to only supply tax evasion services to the super-rich.

We discuss two implications of our results.

First, we consider the implications of high-end evasion for public finances. Should tax evasion become impossible, would wealthy individuals pay significantly more taxes? The answer depends on how substitutable illegal tax evasion and legal tax avoidance are. To address this question, we analyze the behavior of a large sample of Norwegians who voluntarily disclosed previously hidden wealth in the context of a tax amnesty. In an event study design, we find that after voluntarily reducing tax evasion, tax evaders do not legally avoid taxes more, despite ample opportunities to do so. This finding suggests that fighting tax evasion can be an effective way to collect extra tax revenue from the wealthy.

Second, we analyze how accounting for offshore wealth affects measured wealth inequality. We illustrate this with the case of Norway where high quality, long-run time series of top wealth shares exist. Because offshore wealth appears to be extremely concentrated, taking it into account lifts top wealth shares significantly. It increases the top 0.1% wealth share from 8% to 10%. For the top 0.01%—the wealthiest 330 Norwegian households—taking tax evasion into account increases their wealth by a third. Our results highlight the need to move beyond tax records to capture the income and wealth of the very rich, even in countries where tax compliance is generally high. They also suggest that tax data may significantly under-estimate the rise of wealth concentration over the last four decades. As the world was less globalized in

the 1970s, it was harder to move assets across borders, and offshore tax havens played a less important role. Because most Latin American, and many Asian and European economies own much more wealth offshore than Norway, the results found in Scandinavia are likely to be lower bounds for these countries. Looking forward, our goal is to correct global inequality statistics in a systematic way so as to better capture the very rich.

The rest of this paper is organized as follows. In Section 2 we relate our work to the existing literature. Section 3 presents and analyzes the leaked HSBC and Panama Papers data. In Section 4 we combine the leaked data with macro estimates of the stock of wealth in tax havens and random audits to estimate the size and distribution of total tax evasion. Section 5 presents our supply-side model of tax evasion, and Section 6 our results on the interplay between tax avoidance and evasion. We discuss the implications of our results for the long-run trends in inequality in Section 7, and conclude in Section 8. This paper is supplemented by an extensive Online Appendix.[1]

2 Related Literature

2.1 Tax Evasion

Our paper first contributes to the empirical literature on tax evasion. The key data source in this literature is stratified random audits, such as the National Research Program (NRP) in the United States. Based on the NRP, the Internal Revenue Service (2016) estimates that the tax gap for all federal taxes amounts to 16.3% percent of actual (paid plus unpaid) tax liability in 2008–2010. Random audit studies consistently find large rates of tax evasion for self-employment and small business income, for which the absence of third-party reporting makes tax evasion relatively easy. The IRS (2016) estimates that half of the U.S. tax gap owes to unpaid self-employment Social Security and Medicare taxes plus unpaid taxes on small business profits. Also based on random audits, Kleven et al. (2011) find that 44.9% of Danish self-employed evade taxes.[2] Bishop, Formby, and Lambert (2000) and Johns and Slemrod (2010) use random audit micro-data to study how accounting for tax evasion affects U.S. income inequality.[3]

[1]The Appendix is available at `http://gabriel-zucman.eu/leaks`. All our code and data are posted online, excluding individual-level micro administrative data which cannot be publicly shared, but including a large number of tabulations of the raw data by bins of wealth which make our results fully replicable.

[2]A number of studies that are not based on randomized audits obtain similar results (e.g., Pissarides and Weber, 1989; Feldman and Slemrod, 2007; Artavanis et al., 2015). In these studies, the true income of the self-employed is found to be on average about 1.5 to 2 times their reported income, for instance 1.8 in Greece (Artavanis et al. 2015, footnote 5).

[3]Nygård, Slemrod and Thoresen (2016) study the distributional implications of tax evasion in Norway; see also Slemrod (2007, 2016) for surveys.

Although a key data source, random audits faces two main limitations. First, it is likely that they miss a large fraction of tax evasion. The IRS acknowledges this issue by multiplying the noncompliance found in its random audits by a factor of about three to calculate the U.S. tax gap. In doing so, it assumes that detected and undetected forms of tax evasion are similarly distributed across the income spectrum.[4] However—and this is the second, and main problem—they are likely to be distributed differently. Sophisticated forms of evasion involving legal and financial intermediaries—that are only accessible to wealthy taxpayers—are unlikely to be uncovered in random audits. Such audits consist of line-by-line information about what the taxpayer reported and what the examiner concluded was correct. As one moves up the wealth distribution, the share of capital in taxable income rises. Examiners can check that taxpayers duly report the capital income earned through domestic financial institutions, because these institutions automatically and truthfully report data to the tax authority, but they cannot check that they duly report income earned through offshore financial institutions, because they typically receive limited information from tax havens, and they cannot audit all the world's providers of offshore services.[5] In addition, the sample sizes in random audits are usually too small to analyze with precision tax evasion in top wealth groups.[6]

[4]The methodology used by the IRS to blow up detected tax evasion, known as detection controlled estimation, is based on Feinstein (1991). It models the detection process by positing that conditional on evasion occurring, only a fraction is detected depending on the characteristics of the return examined (presence of self-employment income, schedules filed, etc.) and of the examiner (experience, age, etc.). Feinstein (1991) estimates such a model by maximum likelihood and finds that about a third of tax evasion goes detected (i.e., if all examiners were as perceptive as those who uncover the most evasion, three times more evasion would be detected). To adjust for unreported income that examiners were unable to detect, the IRS applies DCE to the returns subject to audit, in effect multiplying the forms of evasion detected (mainly evasion by the self-employed) by about 3. This procedure is very sensitive to parametric assumptions (the correlation between the error terms in the evasion and detection equations), absolute detection rates are not point identified (we cannot know whether the best examiner captures 100% or less of total evasion), and it does not address the key issue that given the information available to the IRS, some forms of tax evasion cannot be detected in the context of random audits, no matter how talented the examiner. See Andreoni et al. (1998) and Johns and Slemrod (2010).

[5]As a matter of facts, random audits find little tax evasion on capital income. The NRP finds that about 4% of taxable interest and dividends are unreported (Johns and Slemrod, 2010, Table 1). The figure is greater for capital gains (12%), maybe because information reporting on capital gains was limited in the United States until recently, making tax evasion relatively easy. In Denmark, only 2.2.% of capital income earners are found to evade taxes, the smallest figure across all income categories (Kleven et al. 2011, p. 669). These low rates could reflect low actual evasion on capital income, but the results of this paper suggest they are more likely to reflect the limitations of random audits when it comes to uncovering high-end tax evasion. In addition to capital income, detecting sophisticated forms of business income tax evasion also raises formidable difficulties, as evidenced by the fact that in the United States, 30% of partnership income (which is highly concentrated) cannot be traced to any ultimate beneficiary, hence is essentially un-auditable (Cooper et al., 2016).

[6]Tax evasion at the top is important to study because wealthy taxpayers, although few in number, own a large share of total wealth and are liable for a large fraction of total taxes. In the United States, the top 0.1% owned about 22% of recorded household wealth in 2012, as much as the bottom 90%; the 0.01% owned 11% (Saez and Zucman, 2016). In the 2001 tax gap exercise conducted by the IRS, 2,060 taxpayers in the top 0.5% of the taxable income distribution were randomly audited (Johns and Slemrod, 2010, Table A1). This sample would in principle be large enough to study the top 0.1% or even the top 0.01%, but we have not been able to

Our main contribution is that we are able to document tax evasion by very wealthy taxpayers. Another advantage of our setting is that Scandinavian administrations maintain detailed, high-quality population-wide dataset on wealth, which allows us to study how evasion varies with wealth rather than taxable income as in the literature. While a useful indicator, taxable income can be quite far from permanent income and the actual capacity to pay taxes. This might especially be the case for wealthy tax evaders who in addition to evading taxes may reduce taxable income through various legal means, thus placing themselves in a low taxable income bin. This problem is largely alleviated (although not fully, as we discuss in Section 3 below) when ranking people by wealth.

2.2 Long-Run Trends in Inequality

Our paper also contributes to the literature on inequality. Over the last fifteen years, there has been renewed interest in the long-run evolution of the distribution of income and wealth. Following the pioneering work of Kuznets (1953) and Atkinson and Harrison (1978), a number of studies have used tax data to construct top income and wealth shares for many countries.[7] Two central findings have so far emerged from this research: inequality declined sharply in today's developed economies during the first half of the twentieth century, and it has increased much more in the Anglo-saxon world than in Continental Europe and Japan over the last thirty years. Much of our current attempts to understand inequality take these two facts seriously, and are based on how top shares vary across countries and over time.

A key concern raised by the use of tax returns to measure inequality, and indeed one of the main reasons why tax data have for a long time been viewed with skepticism, is tax evasion. Tax records only provide information about income (and wealth, when a wealth tax exists) reported to the tax authority, not true economic income and wealth. Due to tax progressivity, the rich have particularly strong incentives to understate their resources. This is a key issue for the inequality literature because most of the cross-country and historical variation in inequality comes from the very top of the distribution. In the United States, the share of wealth owned by the top 0.1% (with more then $20 million in net wealth today) has increased from about 7% in in the late 1970s to 22% today, while the wealth shares of the groups just below has

find any such study. In the Danish random audit data used by Kleven et al. (2011) and exploited in Section 4 below, 59 taxpayers in the top 0.1% were audited and only 7 in the top 0.01%, see Appendix Table H2.

[7]See, e.g., Piketty and Saez (2003) for U.S. top income shares, Saez and Zucman (2016) for U.S. top wealth shares, Atkinson et al. (2011) for a survey, and Piketty (2014) for a broad interpretative synthesis. Top income and wealth share series are collected in the World Wealth and Income Database, `http://wid.world` (Alvaredo et al., 2017).

remained mostly flat (Saez and Zucman 2016). Similarly, the decline in income concentration seen in France and most developed countries during the first half of the twentieth century owes to the fall of the top 1%, and not the next 9% (Piketty 2014).

The literature on inequality has discussed the potential problems raised by tax evasion (e.g., Atkinson, Piketty, Saez, 2011, pp. 36–40), but until recently there was little data that would allow to systematically quantify it.[8] Zucman (2013) estimates that 8% of the world's financial wealth is held in tax havens globally; a similar estimate if obtained by Pellegrini et al. (2016). But in the absence of micro data on who owns the wealth hidden offshore, none of these studies was able to assess the implications of tax havens for the measurement of inequality. Our contribution here is to study micro-data that provide the first direct evidence on the distribution of the wealth in tax havens.[9] Looking forward, our goal is to correct global inequality statistics by building on the results obtained here and constructing similar distributional tax gaps in as many countries as possible.

3 Tax Evasion by the Wealthy: Evidence from Leaks

Our main goal in this paper is to estimate how much each group of the wealth distribution evades in taxes as a fraction as their true tax liability. There are three main steps in the analysis. First we analyze samples of wealthy individuals found evading taxes through offshore financial institutions. Second, we combine these samples with statistics on the macro amount of wealth hidden offshore to estimate the size and distribution of tax evasion through offshore intermediaries. Third, we add information about other forms of tax evasion, coming from stratified random audits. In this Section we present and analyze our samples of wealthy individuals using offshore financial institutions (the HBSC leak, the Panama Papers, and amnesty partic-

[8] A closely related problem raised by tax data is tax avoidance. Not all income is taxable: many forms of capital income, in particular, are usually tax-exempt, for instance imputed rents for homeowners and corporate retained earnings. The frontier between what is taxable or not varies over time and across countries, and so do the incentives to avoid taxes; tax avoidance can thus bias the cross-country and time series comparisons of top shares. Alstadsæter et al. (2016) show that business income reported on individual income tax returns is responsive to tax changes. A wave of recent studies attempts to compute more comprehensive inequality statistics by distributing all of the national income recorded in the national accounts (including corporate retained earnings, and all other legally tax-exempt income); see, e.g., Piketty, Saez and Zucman (2016), Garbinti, Goupille-Lebret and Piketty (2017), and Piketty, Yang and Zucman (2017). These "distributional national accounts" attempt to take into account tax avoidance, but not yet tax evasion (as national income itself is under-estimated when households hide assets abroad; see Zucman, 2013).

[9] Larudee (2016) investigates the extent to which capital flight to Switzerland can explain the decline in the French top 1% income share between the two world wars. Roine and Waldenström (2008) is the only paper that focuses on the distributional implications of hidden wealth for the recent period. They use an indirect method—residual flows in the balance of payments and financial accounts—to estimate the amount of wealth hidden by Swedish residents, and assume that this wealth primarily belongs to the top.

ipants), before attempting in the next Section to combine these samples with macro statistics and random audits.

3.1 Micro-Data on Households With Assets in Tax Havens

3.1.1 HSBC Switzerland Leak

The first sample used in this research is the leak from HSBC Private Bank Switzerland, the Swiss subsidiary of HSBC. In 2007 a systems engineer employed by HSBC, Hervé Falciani, extracted the internal records of this Swiss bank. Falciani turned the data over to the French government in 2008 who shared it with foreign administrations when Christine Lagarde was Finance Minister in France (thus the "Falciani list" became known as the "Lagarde list"). The newspaper *Le Monde* obtained a version of the tax authority data and shared it with the International Consortium of Investigative Journalists. ICIJ assembled a global team of journalists and in January 2015 published the results of its investigation, called "Swiss leaks." A number of high-profile names appearing in the leak were disclosed by ICIJ, but the complete list of HSBC account-holders is not publicly available. In Denmark and Norway, the anonymized data we use are from the version of the HSBC list shared by the French tax authority with foreign administrations. In Sweden, they are from the list obtained by ICIJ-affiliated journalists.[10]

The HSBC leak has a number of key strengths for our purposes. First, it was not the result of specific enforcement effort by tax authorities and can be seen as a random event. The documents leaked by Falciani include the complete internal records—including the names and in the majority of cases account values—of the 30,412 clients (who controlled about 112,000 accounts) of this Swiss bank in 2007. Importantly, HSBC Switzerland recorded the name of the beneficial owners of the wealth it managed, even when this wealth was held, as is frequently the case, through shell companies. Identifying beneficial owners is a requirement for banks under anti-money laundering regulations and it appears that HSBC complied with it.

At the time of the leak, HSBC Switzerland was a major player in the offshore wealth management industry. It managed 4.4% of all the foreign wealth in Swiss banks, $118.4 billion out of $2,667 billion. The $118.4 billion figure is the official value for 2007 published by HSBC (2015); the amount of offshore wealth managed by all Swiss banks is from the official statistics published annually by the Swiss central bank. Throughout this article, offshore wealth is defined as the sum of the bank deposits and portfolio securities (equities, bonds, mutual fund shares) managed by banks on behalf of non-resident investors. Since more than 200 banks operated in

[10]Online Appendix E provides detailed background information about HSBC Switzerland, the leak, the information made publicly available by ICIJ, and the samples we were able to study in this research.

Switzerland at the time of the leak, the market share of HSBC Private Bank was significant; it was likely to be among the top 10 largest Swiss banks.[11] Around $5.6 trillion of wealth was held in tax havens globally at the time of the Falciani leak; HSBC Switzerland alone accounted for 2.1% of that total.[12]

The available evidence suggests that HSBC was fairly representative of the Swiss banking industry. A country-by-country breakdown of the wealth managed by HSBC Switzerland in 2007 is published by the ICIJ, based on an exhaustive exploitation of the file leaked by Falciani. An annual country-by-country breakdown of the amount of offshore wealth in all Swiss banks is similarly published by the Swiss central bank. Figure 2 compares the two distributions. Some countries are slightly over-represented in the HSBC leak, most notably Venezuela, the United States, and Brazil. This can be explained as follows. In 1999, HSBC Switzerland merged with the Republic National Bank of New York and Safra Republic Holdings, two private banks with a large customer base in the United States and Brazil respectively. In addition, according to the ICIJ, the biggest account at HSBC Switzerland was a US$ 11.9 billion account registered in the name of Venezuela's National Treasurer. Despite these idiosyncrasies, the share of HSBC's wealth owned by each country i (s_i^H) is overall tightly linked to its share of all Swiss banks' wealth s_i. A regression of s_i^H on s_i has a slope of 1.00 and R^2 of 0.80. We have not found evidence that HSBC was catering to very wealthy clients more than its peers. In fact, in the years before the leak it was advertising its wealth management services in most of the world's airports, so it is possible that its clientele was actually less wealthy than that of its more discrete competitors.

Another strength of the HSBC leak is that it provides a clear-cut way to assess whether tax evasion is involved. In most countries it is legal to own offshore accounts, as long as such accounts are reported to tax authorities (in the United States, using the electronic Foreign Bank and Financial Account form if the account value is $10,000 or more). In Denmark and Norway, the tax authorities found that only 5% to 10% of all HSBC accounts belonging to resident

[11] Rankings of the world's largest private banks (or private banking divisions of large bank holding companies) are regularly published in trade magazines (e.g., Scorpio partnership). At the time of the leak, other major players in this market included UBS, Credit Suisse, Julius Baer, Pictet, Royal Bank of Scotland, BNP Paribas, etc. To our knowledge, however, there are no reliable rankings for the Swiss wealth management industry alone (i.e., available rankings aggregate assets managed by banks in all their subsidiaries across the world, with no country-by-country breakdowns).

[12] The $5.6 trillion estimate for the world's offshore wealth in the middle of 2007 is from Zucman (2013). We return to the computation of the global amount of wealth in tax havens—and discuss the uncertainties involved—in Section 4.1.1 when we try to estimate the size and distribution of total offshore tax evasion (i.e., at HSBC and other offshore banks).

taxable individuals were properly declared; 90% to 95% were not.[13] This result is consistent with a body of evidence suggesting that more than 90% of Swiss accounts were undeclared around 2007; this includes two US Senate (2008, 2014) reports finding that 85–95% of US-owned accounts at UBS and Credit Suisse were undeclared in 2007–2008, Roussille (2015) who estimates that more than 90% of the wealth held by Europeans in Switzerland was undeclared before 2010, and Johannesen and Zucman (2014, section V) who obtain a similar estimate.

The leaked HSBC data, however, face a few limitations. First, and as detailed in Appendix E, about 100 accounts cannot be matched to individual owners, for instance accounts owned by corporations other than the shell corporations whose beneficial owners were identified by HSBC in its internal system. Some of these accounts could belong to tax evaders (e.g., accounts owned by shell companies whose beneficial owners were not known or recorded by HSBC) or to legitimate organizations (e.g., financial institutions or non-profit organizations). If these untraceable accounts are used by the wealthiest tax evaders, we under-estimate the concentration of tax evasion. Second, some accounts are matched to taxpayers who claim to be non-residents, hence not taxable in Scandinavia; these accounts are systematically excluded from our analysis.[14] Yet some of them might in actual facts be taxable in Scandinavia: claiming to be non-resident is a form of tax evasion sometimes practiced by wealthy individuals, which we cannot detect with the data at our disposal. If true, we would again under-estimate tax evasion at the top. Last, in our analysis we are able to exclude the Norwegian accounts that were properly declared, but not the few (maybe around 20–30) Danish or Swedish accounts that were too. This is, however, unlikely to bias our findings significantly, since we know that close to 95% of the matched Danish and Norwegian accounts were undeclared.[15] To simplify the exposition, in the rest of

[13]Note, however, that this does not imply that all taxpayers with undeclared HSBC accounts have been convicted of tax evasion. In prosecuting the cases, the tax authorities face a number of constraints. In particular, the nature of the evidence (a leaked file) raises legal issues and can be insufficient to prove in court the existence of a hidden account. To circumvent this issue, tax authorities can ask for information to the Swiss tax authority and to HSBC. We know that in Denmark, in many instances neither the taxpayers, nor the Swiss authorities or HSBC cooperated, forcing the tax authority to drop cases. Note that it is optimal for the tax authority to focus its resources on investigating and prosecuting the largest cases; analyzing the sub-sample of cases that eventually led to conviction would thus introduce a selection bias and would lead us to over-estimate the concentration of tax evasion. We therefore do not base our assessment of whether tax evasion occurred on what was the legal outcome of the case, but instead on whether the account was declared. This is similar to what is done in random audit studies where non-compliance is estimated based on the examiner's assessment, not a court decision.

[14]There is some evidence that a fraction of the very wealthiest Scandinavian (especially Swedish) households lived abroad at the time of the leak. According to Forbes magazine data, 3 out of the 14 billionaires with Scandinavian citizenship lived outside of Scandinavia in 2007. We always exclude non-residents from our analysis.

[15]The available evidence suggests that declared accounts may belong to less wealthy evaders than hidden accounts. As shown by Appendix Figure E.5, the wealth held by Norwegians at HSBC—which excludes accounts properly declared—is more concentrated than than held by Swedish and Danish households—which includes properly declared accounts. The inclusion of the duly reported Danish and Swedish accounts may thus lead us to slightly under-estimate the actual concentration of hidden wealth. The small size of the sample of declared

the analysis we consider that all matched Swedish and Danish households evade taxes. Our working sample includes 520 households who owned at least one account at HSBC Switzerland, declared themselves as being taxable in Scandinavia in 2006, could be matched to a tax return (and, for the Norwegian portion of the list, did not duly declare their account).[16]

3.1.2 Panama Papers Leak

The second leak we use in this research is the Panama Papers. In the Spring of 2016, the ICIJ published the names and addresses of the owners of shell companies created by the Panamanian firm Mossack Fonseca.[17] The leak provides information on shell corporations that were created over two decades, many of which were still active at the time of the leak in 2015. We matched the names of the shareholders of these shell companies to individual wealth data in Norway and Sweden (but were not able to do so in Denmark). Although Mossack Fonseca—like HSBC Switzerland—is a major provider of offshore services, the sample of matched households is smaller than for the HSBC leak (165 vs. 520). Beyond the exclusion of Denmark, one other factor contributes to the smaller sample size: a large number of shell companies cannot be linked to their ultimate owner. A company created by Mossack Fonseca can be owned by another shell created by another incorporation agent, in which case ultimate owners remain untraceable—while they are usually identifiable at HSBC. A last limitation of the Panama Papers is that we don't know whether the Scandinavian individuals appearing in the leak evaded taxes. There are legal uses of shell companies, and the investigations conducted by the tax authorities are still ongoing. Despite these limitations, the Panama Papers provide valuable information, as we shall see.

3.1.3 Samples of Amnesty Participants

Our third sample of households with offshore wealth is a large sample of individuals who voluntarily declared previously hidden assets in the context of tax amnesties. In recent years, governments have encouraged tax evaders to declare hidden wealth in exchange for reduced penalties. In Norway and Sweden we have access to all the voluntary disclosures made since

accounts, however, does not give us enough power to reject the hypothesis that duly reported and undeclared accounts are distributed similarly.

[16] Appendix Table E.1 provides a detailed reconciliation of the number of households in our sample and the number of HSBC customers connected to Scandinavia published by the ICIJ.

[17] Online Appendix F provides background information about the Panama Papers and analyzes the data made public by the ICIJ. In contrast to the HSBC leak, all the names and corporate structures appearing in the Mossack Fonseca files have been disclosed by the ICIJ.

2006.[18] The number of amnesty participants picked up significantly in 2009, when G20 countries compelled tax havens to exchange bank information upon request with foreign authorities (Johannesen and Zucman, 2014); it was negligible before.

A key advantage of the amnesty dataset is the large sample size: 1,422 taxpayers in Norway and 6,811 in Sweden. Another key strength is that we know that tax evasion is, by definition, involved.[19] This data source suffers from one limitation, however: there may be selection into the amnesty based on wealth. According to the canonical Allingham and Sandmo (1972) model of tax evasion, tax evaders should continue evading as long as τ, the marginal tax rate they face, is greater than $p \times \theta$, the probability to be detected times the penalty if detected. In 2009, when the number of households participating in amnesties starts rising, the only parameters that changes is the perceived probability to get caught, which increases. The increase may depend on wealth—and the effect could go either way. Only unsophisticated, moderately rich individuals with inherited offshore accounts might have perceived an increase in p in 2009, while very rich evaders may have considered they would always be able to conceal their wealth by using sophisticated combinations of shell companies and trusts. Conversely, the richest evaders might have feared that governments would strengthen their monitoring of the very wealthy in the aftermath of the financial crisis; or liquidity constraints may have prevented less wealthy individuals from using tax amnesties that require them to pay back taxes. In the end, whether richer evaders self-select into amnesties is an empirical issue. The results discussed below suggest that less wealthy evaders are slightly more likely to self-select.

3.2 Scandinavian Wealth Data

To rank HSBC account holders, Panama Papers individuals, and amnesty participants in the wealth distribution, we construct the full distribution of household wealth in Norway, Denmark, and Sweden following a common methodology. All wealth series, computations, and results are described in a detailed manner in Online Appendix A (for Scandinavia as whole), B (for computations and issues specific to Norway), C (Sweden), and D (Denmark); here we discuss the main data sources and conceptual issues.

We compute wealth at the micro level for the entire population by distributing 100% of the macroeconomic amount of household wealth at market value recorded in the national accounts.

[18] Appendix G discusses the specifics of the Norwegian and Swedish amnesties.

[19] In a small number of cases, the tax authority deems the disclosures made by amnesty participants not worth investigating—either because it considers the amounts involved negligible or because it concludes that no tax evasion was actually committed. We exclude these cases from the analysis.

This enables us to estimate wealth levels and shares for Scandinavia that are directly comparable to those estimated in the United States by Saez and Zucman (2016) and in a growing number of countries where similar methods are followed; see the series published on the World Wealth and Income Database at `http://WID.world` (Alvaredo et al., 2017). In keeping with standard national account concepts, our definition of wealth includes all the non-financial and financial assets that belong to Scandinavian residents, minus debts. It includes in particular all funded pension wealth, and excludes the present value of future government transfers, as well as consumer durables and valuables.

Our starting point is the population-wide administrative wealth micro-data maintained by Scandinavian authorities. Although these data are generally of high quality,[20] they suffer from two main limitations. First, and most importantly, they disregard funded pension assets. Second, they do not accurately capture forms of wealth that are not reported by third parties, namely unlisted corporate equities and non-corporate business assets. We deal with these issues as follows. First, we impute pension wealth by assuming that 40% belongs to wage-earners and 60% to retirees; pension wealth allocated to wage-earners is then distributed proportionally to wage income and pension wealth allocated to retirees proportionally to the income derived from pension funds. We chose the 40/60 split based on the available survey evidence about the distribution of pension wealth across age groups. Since 2012, pension wealth has been recorded in the administrative Danish data, and we were able to check that our imputation delivers very accurate results. Saez and Zucman (2016) impute pension wealth similarly in the United States.

Second, we impute unlisted equities by capitalizing dividends earned from unlisted corporations. The capitalization rate is the ratio of the market value of unlisted firms (as recorded in the national accounts) by the flow of unlisted dividends reported on tax returns. Third, we impute non-corporate business assets by capitalizing business income in the same way. The imputations introduce a small noise at the micro-level. This noise, however, is second-order for our purposes, because the largest form of wealth missed by the administrative data is pension wealth, which only accounts for a small fraction of wealth at the top of the distribution, the main focus of our analysis. For instance, pension wealth only accounts for 1% of the wealth of the top 0.1% in Denmark, the Scandinavian country with the largest amount of private funded pension wealth (178% of national income in 2014). Throughout the paper, our unit of analysis is the tax unit, defined as either a single person aged 20 or above or a married couple, with

[20] They have been fruitfully used to study, e.g., retirement saving (Chetty et al., 2014), intergenerational wealth mobility (e.g., Boserup, Kopczuk and Kreiner, 2016) and the accuracy of survey responses (Kreiner, Lassen and Leth-Petersen, 2015).

dependent children if any.[21]

Next, we combine Denmark, Norway, and Sweden into a single Scandinavian "country" as follows. We collapse each country's population-wide data into small bins (of as few as 10 tax units at the top), compute average, minimum, and maximum wealth in each bin, using current market exchange rates to convert local currencies into US$,[22] and interpolate the distribution of wealth within each bin using the generalized Pareto interpolation methods recently developed by Blanchet et al. (2017). This makes it possible to study the distribution of wealth and tax evasion in Scandinavia as a whole, in a dataset that is virtually identical to the one that would exist if the population-wide files of the three Scandinavian countries could be appended (which is not currently possible).

Detailed results on Scandinavia's wealth distribution are reported in Appendix A. The top 1% owns about 20% of total (non-hidden) wealth, the top 0.1% around 9%, and the top 0.01% around 4-5%. Wealth appears to be similarly distributed in the three Scandinavian countries, Norway, Sweden, and Denmark. Scandinavia is much more equal than the United States: strikingly, although both economies have the same average wealth per adult ($290,000 in 2014), the bottom 90% is twice richer in Scandinavia, while the top 0.1% appears twice poorer.

3.3 Patterns of Tax Evasion in Leaks and Amnesties

We start the analysis by computing how the probability to own offshore assets varies with wealth in each of our three samples—HSBC account holders, Panama Papers individuals, and tax amnesty participants. The results are presented in Table 1 and Figures 3 and 4. The probability to own offshore wealth rises steeply with wealth at the top, although there are interesting differences across samples.

[21] Summing the wealth of married spouses addresses the fact that jointly-owned assets are typically allocated to only one individual in the registry data. Another possibility would be to split the wealth of married spouses 50/50; we prefer to conduct all our analysis at the tax unit level, as spouses are typically liable for the taxes owed by their partner. We disregard children below 20 who own negligible wealth.

[22] In the context of our study that focuses on top-end wealth, using market exchange rates seems slightly preferable to using PPP exchange rates, because very wealthy Scandinavians all have access to the same basket of goods and global assets. In Appendix A, we report detailed results on Scandinavian income and wealth using both market and PPP-adjusted exchange rates. PPP-adjusted rates slightly reduce the weight of Norway (where the price level is relatively high) in the Scandinavian aggregate (e.g., Norway accounts for 24% of total Scandinavian wealth using market exchange rates, vs. 22% using PPP-adjusted rates in 2014, see Appendix Tables A1d and A1e), but using PPP vs. market exchange rates does not significantly affect any of the main results of the paper. All dollar figures given in this paper are at current-year prices and using current-year market exchange rates (for instance, $44.5 million is the threshold to be part of the top 0.01% of the Scandinavian wealth distribution in 2006, using 2006 prices and 2006 exchange rates to convert Scandinavian currencies into US$).

3.3.1 Tax Evasion in Leaks

Starting with HSBC, the top panel of Figure 3 shows that the probability to hide assets in that Swiss bank is negligible up to the top 1% threshold, and then rises to reach close to 1% for the 0.01% richest Scandinavians, who own more than $44.5 million in net wealth at the end of 2006. Remember that HSBC Switzerland is just one bank in one tax haven, a bank that managed around 2% of the wealth held offshore globally at the time of the leak, so the high absolute level of the probabilities at the very top of the wealth distribution is notable. The gradient is notable too: top 0.01% households are 13 times more likely to hide assets at HSBC than households in the bottom half of the top 1%, i.e., in between percentile 99 ($2 million in net wealth) and 99.5 ($3 million). The differences in the probabilities across wealth group are statistically significant. The first column of Table 1 reports bootstrapped standard errors for these probabilities and the second column shows pairwise comparisons across wealth bins. The probabilities to hide assets at HSBC differ from each other at the 5% level. The only exception is for the very top bin—the top 0.01%—where the small sample size does not allow us to reject the null hypothesis that the probability to evade taxes is the same as in the rest of the top 0.1%.[23]

Two remarks are in order here. First, for the purpose of ranking HSBC customers in the Scandinavian wealth distribution, we added the hidden HSBC wealth to non-hidden wealth.[24] This mechanically moves HSBC evaders up the wealth ladder. However, this re-ranking does not drive the sharp gradient in the probability to evade taxes by wealth group reported in the top panel of Figure 3. In Appendix Figure E.2, we re-produce this figure but ranking households by their wealth *excluding* that held at HSBC; the patterns are very similar.[25] Second, 50 households

[23]Appendix Table E.7 reports a version of Table 1 where the top 0.01% is lumped together with the next 0.04%, i.e., the top 0.1% is split in two equal-size groups, P99.9–99.95 (tax units with between $9.1 million and $14.6 million in net wealth) and P99.95–100 (tax units with more than $14.6 million). The probabilities to own an HSBC account are statistically different in these two groups at the 10% level.

[24]The amount hidden at HSBC is observable for 300 households out of 520. As discussed in Appendix E, the main explanation for the gap is that a number of accounts initially held by households directly in their own name were over time transferred to shell corporations, following which the identity of the beneficial remains observable in the files leaked by Falciani, but not the account details. As shown in Appendix Figure E.1, excluding accounts with no know values does not change the gradient reported in the top panel of Figure 3.

[25]Including hidden wealth when ranking households seems slightly preferable, because doing so delivers the best estimate of the amount of wealth the HBSC evaders actually own given observable data. Note that if HSBC account-holders hide assets in other banks too, then we under-estimate their true wealth. In the extreme case where all offshore wealth belongs to the HSBC sample (i.e., these are the same households who have unreported accounts at HSBC, UBS, Credit Suisse, etc.), then many HSBC account-holders ranked below the top 0.01% actually belong to the top 0.01%. Conversely, if all the non-HSBC offshore wealth belongs to other tax evaders (i.e., HSBC account holders do not hide assets elsewhere), then we over-estimate the rank of HSBC account-holders in the true Scandinavian wealth distribution. Our computations that add observable hidden wealth to non-hidden assets to rank households attempt to reach a middle ground between these two polar cases. With the data at our disposal, we cannot tell whether tax evaders tend to have accounts in numerous or just one bank.

(around 10% of the sample) have less than $100,000 in net wealth (including that hidden at HSBC); half of them have negative net wealth. It is unlikely that poor households hide wealth offshore; this result is more likely to reflect limitations of our data. These "poor" households probably own assets that we don't capture properly, such as closely-held businesses that don't pay dividends or assets hidden in other offshore banks. Whatever the reason, the implication is that we probably under-estimate the true probability to evade taxes at HSBC in the top wealth groups.

The households who evaded taxes through HSBC hid a large fraction of their total wealth in that Swiss bank. The bottom panel of Figure 3 shows the ratio of the wealth held at HSBC over total observable wealth in the sample of HSBC account-holders with available account values—the intensive margin of evasion, in contrast to the extensive margin studied in the top panel. HSBC customers owned around 40% of their wealth there, with no trend across the wealth distribution.

The Panama Papers confirm that the use of offshore financial institutions steeply rises with wealth. As shown in the top panel of Figure 4, the probability to own a Mossack Fonseca offshore shell company reaches 1.2% in the top 0.01% of the (Norwegian plus Swedish) wealth distribution, against less than 0.2% for all groups below the top 0.01%. The difference between the top 0.01% and all other groups is highly significant (Table 1, col. 5). The use of tax havens appears more concentrated in the Panama Papers than in the HSBC leak: in both Norway and Sweden, as shown by Appendix Figure F.1, one finds very few households who own Mossack Fonseca shell companies in the bottom 99.9% of the wealth distribution. One interpretation of this finding is that wealth concealment using shell corporations is a more sophisticated form of tax avoidance than owning offshore bank accounts. Both techniques are often combined, but the wealthiest tax evaders might be more likely to combine offshore accounts with shell companies, when less wealthy tax evaders may be relatively more likely to own offshore accounts directly in their own names.

3.3.2 Tax Evasion Among Amnesty Participants

Turning to our third sample—amnesty participants—the bottom panel of Figure 4 shows that the probability to disclose previously hidden offshore wealth also rises sharply with wealth. There are three additional notable findings. First, the use of tax amnesties is widespread among the very rich: 14% of all top 0.01% Norwegian and Swedish households have used one over the 2009-2015 period. Second, by contrasting the probabilities to appear in the HSBC

leak to the probability to voluntarily disclose hidden assets, we can study whether self-selection into amnesties correlates with wealth. We find that the poorest evaders are slightly more likely to self-select. Households between the 95^{th} and the 99.5^{th} percentile—i.e., with net wealth between about $1 and $3 million—are relatively over-represented in the amnesty sample. For that group, the odds of using the amnesty are 32.8 higher than the odds of evading taxes at HSBC. For the top 0.1% the odds ratio drops to 20.4. The self-selection is not massive, but it is statistically significant.[26] Third, as reported in cols. 9 and 10 of Table 1, we find that amnesty participants used to hide close to a third of their wealth on average, with no trend across the distribution. The fraction of wealth hidden is lower than in the HSBC sample (where it reaches 40%), consistent with the view that the most agressive tax evaders are relatively less likely to self-select into amnesties.

Finally, we pool HSBC evaders and amnesty participants, excluding the small overlap between the two samples. As reported in cols. 11 and 12 of Table 1, 14.8% of the top 0.01% richest Norwegians and Swedish households revealed hiding wealth or were caught in the HSBC leak, a probability statistically greater than that of the the next 0.04% (11.8%), which is itself statistically greater than than of the next 0.05%, etc. Overall, the three samples we analyze paint a consistent and robust picture: the probability to conceal assets and the amounts hidden rise sharply, continuously, and significantly from $3 million in net wealth to $10, $20, and $50 million plus.[27]

4 The Size and Distribution of Tax Evasion

The samples analyzed above are drawn from the universe of individuals who use tax havens. These draws are random in the HSBC and Panama Papers leaks, and involve self-selection slightly negatively correlated with wealth in the case of amnesty participants. In this Section we combine these samples with macro statistics on the stock of wealth held in tax havens to estimate how much taxes are evaded through offshore intermediaries by the different groups of the wealth distribution. We then combine the results with random audit data to produce distributional tax gaps that include domestic and foreign evasion.

[26] See Appendix Table E.8.

[27] Data limitation, however, does not allow us to zoom further within the top 0.01% to see whether evasion continues to rise (say, between $50 million and $100 million, $100 million and $500 million, etc.). One would need larger leaked datasets, in a large, unequal, and wealthy country (say, the United States) to shed light on this important question.

4.1 Offshore Tax Evasion

4.1.1 Methodology

To estimate the size and distribution of offshore tax evasion, we need three ingredients: (i) the total amount of wealth held by Scandinavians in tax havens; (ii) how this wealth is distributed; (iii) the extra amount of taxes that would be paid if all this wealth—and the income it generates—was duly declared to tax authorities. We discuss each issue in turn.

Macro stock of offshore wealth. Regarding the total amount of offshore assets, the available evidence suggests that Scandinavians own around 1.7% of their wealth in tax havens. This is a relatively modest amount compared to other countries; at the opposite end of the spectrum, in Russia, about half of financial wealth is held offshore (see Zucman, 2014; and Novokmet, Piketty and Zucman, 2017). Although quantifying the macro stock of wealth held offshore by Scandinavians involves a margin of error, our result is likely to be robust: we obtain similar orders of magnitude using two different methodologies, presented in Table 2.

Our first strategy is a bottom-up approach that scales up the wealth held by Scandinavians at HSBC Switzerland. We know that this bank managed $118.4 million in wealth in 2007. Based on a systematic investigation of the international statistics and the anomalies therein, Zucman (2013) estimates that $5.6 trillion was held in tax havens globally at the time of the leak, i.e., 47.5 times the wealth held at HSBC. We apply this 47.5 multiplicative factor to the amount of wealth owned at HSBC by customers who were taxable in Scandinavia, could be matched to a tax return, and for whom we are able to observe account values, namely $1,013 million. By this estimate, Scandinavians owned $48 billion in tax havens globally in 2007, 1.5% of their total wealth. Because it disregards the HSBC accounts that could not be matched to any individual income tax return and those where no balance information is available, this method is likely to under-estimate the total amont of offshore assets owned by Scandinavians.

Our second strategy is a top-down approach. Starting from the $5.6 trillion in global offshore wealth, we allocate this total across countries by using statistics disclosed by tax havens on which countries' residents own deposits in their banks. The Swiss central bank has published such statistics since the 1970s; a number of prominent tax havens—including Luxembourg, the Channel Islands, and Hong Kong—have started publishing similar, retrospective information through the Bank for International Settlements in 2016. The main limitation of these statistics is that they only cover bank deposits, not the portfolios of equities, bonds, and mutual fund shares that households entrust to offshore banks. The distribution of offshore bank deposits

across countries, however, is likely to be strongly correlated with that of total offshore wealth. In a companion paper (Alstadsæter, Johannesen and Zucman, 2017) we use this new information to allocate the global amount of offshore wealth to each of the world's country, and provide a comprehensive discussion of the data and methodology involved. By this estimate, Scandinavians owned 1.7% of their wealth in tax havens in 2007. We use this top-down approach as our benchmark estimate.

Both the bottom-up and top-down approaches are likely to deliver conservative results. They both rely on Zucman's (2013) estimate that $5.6 trillion was held in tax havens globally in 2007, which is at the low-end of the scale of available estimates. The OECD calculates that households owned a total of $5 to $7 trillion offshore in 2007 (Owens, 2007); based on interviews with wealth managers, the Boston Consulting Group (2008) finds $7.3 trillion that same year; Cap Gemini and Merrill Lynch (2002) have a $8.5 trillion figure for 2002; Palan, Murphy, and Chavagneux (2010) write that "the global rich held in 2007 approximately $12 trillion of their wealth in tax havens;" and Henry (2012) finds $21 to $32 trillion as of 2010. One limitation of Zucman's (2013) methodology is that it only captures financial wealth, disregarding valuables, works of art, real estate, and other non-financial assets.[28] Moreover, due to the lack of official statistics on the wealth held offshore, all the above studies rely on indirect methods and therefore involve a margin of error. Only one country publishes direct, official data on the stock of wealth owned by foreigners in its banks: Switzerland.[29]

The official Swiss data allow us to construct a lower bound for Scandinavians' offshore wealth. This lower bound (reported in Table 2, line 2) only includes the—directly observable—wealth owned by Scandinavian households in Swiss banks; it excludes any holdings in Luxembourg, Singapore, and other tax havens. Swiss banks have historically played a large role in the business of cross-border private banking; they managed close to $2.7 trillion in offshore wealth in 2007, close to half of the of the $5.6 trillion global total estimated by Zucman (2013). Accordingly, the offshore wealth owned by Scandinavians is more than halved in our lower-bound scenario. Because our benchmark estimate is likely to be on the low-end, we also report an alternative, higher estimate, where we allocate Zucman's (2013) global offshore wealth proportionally to each country's share of world wealth (see line "proportional allocation" in Table 2). Compared to our benchmark scenario, this multiplies the share of their wealth that Scandinavians own

[28] Since his estimate of offshore wealth only includes financial assets, Zucman (2013) chose to scale it by global financial wealth. In this article where we focus on the distribution of total household wealth—including all financial and non-financial assets—we scale offshore wealth by total wealth. $5.6 trillion amounts to 8% of global net financial wealth in 2007 (as reported in Zucman, 2013) and to about 3.3% of global wealth.

[29] See Zucman (2013, Section III; 2015, chapter 1) for a detailed analysis of this unique, high-quality dataset.

offshore by about two, from 1.7% to 3.3%.

Distribution of offshore wealth. The second ingredient we need is an estimate of how offshore assets are distributed across wealth groups. We have two such estimates: one from the HSBC sample, and one from the sample of amnesty participants. The top panel of Figure 5 shows that offshore wealth is similarly distributed in the two samples. It is, in both cases, extremely concentrated: close to 80% of it belongs to the top 0.1%, and about 50% belongs to the 0.01% richest households. For comparison, the top 0.01% owns only about 5% of all non-hidden wealth. Admittedly, Swiss banks had hundreds of thousands of customers at the time of the Falciani leak; by that metric, offshore evasion had become somewhat widespread. But the wealth held by bottom 99.9% evaders does not weigh much compared to that owned by the top 0.1%. Consistent with our finding that self-selection into amnesties is slightly negatively correlated with wealth, the concentration of offshore wealth appears slightly lower in the amnesty sample. The differences, however, are not statistically significant.

In our benchmark results, we allocate the macro stock of Scandinavians' offshore wealth proportionally to how offshore assets are distributed in the pooled HSBC and amnesty samples. That is, we allocate 51.6% of it to the top 0.01% richest Scandinavians, 25.3% to the next 0.09%, etc. Discarding the amnesty samples would lead us to allocate an even higher fraction to the top—hence would deliver an even steeper gradient in evasion with wealth—albeit with larger standard errors.

Taxes evaded on hidden assets. The last ingredient we need is an estimate of how much taxes are evaded out of a dollar in offshore wealth. All our estimates of tax evasion are for 2006 (the year immediately preceding the HSBC leak) using the tax law of the time. We first take into account that not all offshore wealth evades taxes: consistent with the evidence from the HSBC leak (and other sources), we assume that 10% of it was duly declared to Scandinavian tax authorities. Based on the observed composition of offshore wealth and the returns on global securities markets and deposits in 2006, we apply a 4.5% taxable rate of return to the wealth hidden.[30] In Appendix J, we consider a large number of robustness checks where we make the

[30]The average interest rate paid by Swiss banks on their term deposits was 4.3% in 2006; the US Federal fund rate was in range of 4.3% to 5.25%; the total nominal return (dividends reinvested) was 13.4% for the the S&P500 and 20.65% for the MSCI world (see Appendix Table J.4). As shown in Zucman (2013), about 75% of the world's offshore wealth was invested in global securities (equities, bonds, and mutual funds) before the financial crisis; the rest was held in bank deposits. Note that the 4.5% return we assume in our benchmark scenario is higher than the realized taxable return observed on non-hidden wealth (about 3.5% for the top 1% richest Scandinavians). The observed return on non-hidden wealth is a lower bound for the return on offshore

return vary from 2.0% to 7.0%. We then compute the amount of taxes evaded on the undeclared wealth itself (when a wealth tax exists, which was the case in Norway and Sweden in 2006) and the dividends, interest, and capital gains it generates by applying the relevant tax schedules. We do not attempt to take into account any tax evasion that might have occurred on the principal—some of the wealth held offshore is probably accumulated out of untaxed earnings, but we are not able to quantify that form of evasion with the data at our disposal. We also disregard tax evasion on inter-generational transmissions of hidden assets.

4.1.2 How Offshore Tax Evasion Varies With Wealth

The bottom panel of Figure 5 reports our estimates of the size and distribution of offshore tax evasion. We find large rates of evasion at the top of the wealth distribution. In our benchmark scenario—in which Scandinavians own in total 1.7% of their wealth offshore in 2006, of which 90% is undeclared—the top 0.01% evades 25% of its true tax liability through tax havens. In the lower bound scenario it still evades 11% of its tax bill, which is—as we shall see below—three times higher than the amount of evasion detected in random audits. This result underscores the importance of combining different data sources to study tax evasion. In our higher scenario, offshore tax evasion for the top 0.01% rises to 40% of taxes owed.[31]

Tax evasion is high at the top not because the macro stock of wealth in tax havens is large, but because it is hugely concentrated. As reported in Appendix Table J.3, in our benchmark scenario offshore evasion adds up to a mere 0.6% of personal taxes owed for the population as a whole. The figure rises to 25% for the top 0.01% for two reasons. First, the use of tax havens is widespread among the very wealthy: the key finding from the micro-data analyzed in Section 3 is that top 0.01% households are much more likely to hide assets, and, conditional on doing so, hide a lot (about 40% of their total wealth in the HSBC sample and 30% in the amnesty sample). Second, conditional on concealing wealth, taxes evaded offshore are large relative to taxes owed for top 0.01% households, because for them the vast majority of income derives from wealth. So when a taxpayer hides 40% of her wealth, she hides close to 40% of her income

assets, for two reasons. First, the portfolio composition differs: the non-hidden wealth of top 1% Scandinavians includes a large fraction (around 50%) of closely-held equities, which tend to have lower taxable returns than listed securities. Second, there are incentives to realize low returns on non-hidden wealth so as to avoid taxes, for instance by investing in non-dividend paying equities or by retaining earnings within closely-held firms. A case in point is Norway, where following the introduction of a new tax, dividend distributions collapsed in 2006 and retained earnings surged, leading to low realized rates of return (Alstadsæter et al., 2016). There are no such incentives to avoid taxes for offshore investments that evade taxes altogether.

[31] In Appendix Table J.4, we investigate how our benchmark results change when varying the taxable rate of return applied to hidden wealth. For a return of 3.5% (the one observed on non-hidden assets, a lower bound), the top 0.01% evades 20% of its total tax liability. For a return of 6.0%, it evades 35% of its taxes.

(or even more, if the taxable return on hidden assets is higher than on domestic wealth) and eschews close to (possibly more than) 40% of her taxes. For a less wealthy evader who hides 40% of his assets, the taxes evaded offshore will account for a smaller fraction of his tax bill, because a large fraction of taxes owed arise from labor income.[32]

One might wonder how the presence of a wealth tax in Sweden and Norway affects the results. In an accounting sense, it does not: when computing the ratio of taxes evaded to taxes owed, wealth taxes enter both the numerator and denominator; absent such taxes, rich Scandinavians would still evade a similarly high fraction of their tax liability (albeit a smaller amount in absolute terms). From an economic perspective, however, wealth taxes might have a causal effect on tax evasion. To analyze this issue, it is useful to consider the overall tax rate on capital income in Scandinavia. With a 4.5% rate of return, a wealth tax of 1.2% (as in Sweden) is equivalent to a tax on capital income at a rate of 27%, a wealth tax of 0.9% (as in Norway) to a tax on capital income of 20%.[33] All included, the marginal tax rate on capital income reaches 57% in Sweden and 48% in Norway, slightly higher than Denmark (42% on share income) where no wealth tax applies. These marginal rates are high, but not extraordinarily so. For instance, a wealthy New York City resident faces a 56% marginal tax rate on interest income and 36% on dividends and capital gains in 2016; marginal rates are slightly higher in California. In effect, Norway and Sweden offset part of their wealth taxes with flat rates on investment incomes, while similarly rich countries usually tax at least part of capital income progressively. What makes Scandinavian countries high-tax in international perspective is less their high taxes on financial wealth than their high, broad-base payroll and value-added taxes (Kleven, 2014), none of which are directly relevant for our purposes.[34]

[32]To reconcile the estimates of the rates of evasion shown in Figure 5B with the patterns of evasion in the micro-data studied in Section 3, consider the following simplified computation. As reported in Figure 3, about 1% of top 0.01% richest Scandinavians hid assets at HSBC Switzerland, and they held there about 40% of their wealth. Assuming that HSBC Switzerland accounts for 2% of all offshore tax evasion (and that HSBC customers do not hide assets in other offshore banks, and vice versa), this implies that 50% of top 0.01% Scandinavians hid assets abroad and that the top 0.01% concealed 20% of its total wealth offshore. The fraction of taxes eschewed is slightly larger than 20% in our benchmark scenario, because the return we assume on hidden wealth is slightly higher than on non-hidden wealth.

[33]More precisely, in Sweden the marginal wealth tax rate was 1.5%, and in Norway 1.1.% but in both cases it applied to only a fraction of wealth (e.g., 80% for equities in both countries). So the marginal tax rate on listed equity wealth was 1.2% in Sweden and 0.88% in Norway; see Appendix Table J.7b for detailed computations. The Swedish wealth tax was abolished in 2007.

[34]The evidence reported in Table 2 shows that Denmark—where wealth taxation was abolished in 1997 and the overall marginal tax rate on capital is slightly lower—seems to hide a smaller fraction of its wealth than Norway and Sweden. However, given the uncertainties involved, we caution against drawing strong conclusions from this difference. In our view, tax evasion is better analyzed at the level of Scandinavia as a whole; at the micro level, small sample sizes do not allow us to detect any statistically significant differences across countries. We leave to future research the task of investigating the causal effect of wealth taxation on capital flight using micro-data and within-country variation. For cross-country comparisons of marginal and average tax rates in

4.2 Distributional Tax Gaps

4.2.1 Random Audit Data

To approach total tax evasion, we combine our new estimates of offshore evasion with the tax evasion detected in random audits. We use the stratified random audits conducted by the Danish Tax Authority (SKAT). The first wave of this program, for tax year 2006, was studied by Kleven et al. (2011). Here we analyze the three subsequent waves, which were conducted for years 2008, 2010, and 2012. In each wave, SKAT randomly selects a sample of self-employed individuals and a sample of individuals who are not self-employed—mostly wage-earners and retirees. The sampling rate is higher for the self-employed who are relatively more numerous at the top of the distribution and more likely to evade taxes; in both groups taxpayers with complex tax returns are over-sampled. Our final sample pools tax years 2008, 2010, and 2012 and includes 18,985 randomly audited taxpayers (6,223 self-employed and 12,762 non self-employed).[35] Detailed summary statistics are presented in Appendix H.

The Danish random audits are widely considered as high quality, because the tax authority can draw on a particularly extensive set of information: returns provided by employers, banks, credit card companies, and other financial institutions; supporting documentation requested to the taxpayers themselves; and detailed wealth data. This enables SKAT to detect a wide range of errors, from mistakes in the claiming of deductions (e.g., for alimony or commuting expenses) to mis-reporting of income that is not declared by a third party (e.g., taxable fringe benefits) and unreported labor market activity (which can be inferred by comparing reported income to the change in wealth). Every line item on the tax return is examined. SKAT improved its audit technique after 2006—the first year it conducted a randomized audit—and now detects more errors. While mistakes were found for 10.7% of all individuals audited in 2006 (Kleven et al., Table 2 col. 2 line 2), the error rate climbed to 12.5% in 2010 and 2012 (which could also partly reflect a real decline in compliance between 2006 and 2010).

By construction, the rates of evasion measured in the random audits exclude offshore evasion. As discussed in Section 2 above, these audits are not able to detect evasion through offshore intermediaries satisfactorily. In the rare cases when the examiner might suspect such type of evasion, the case is transferred to a specialized unit within SKAT with the skills to conduct a specific investigation. Whatever is found at the end of this long process is not included in the

Scandinavia, see Appendix Figures J.1, J.2, and J.3.

[35] Overall, 0.15% of the entire adult Danish population is randomly audited each year in the context of this program. The empirical sampling rate is 3.5 times higher for taxpayers in the top 1% of the distribution (0.53%); our sample includes 663 taxpayers in the top 1% of the wealth distribution. See Appendix Table H.2.

result of the random audit study, as this would delay the publication of the results for too long. Despite the amount of resources devoted to them and the richness of the information available to SKAT, the random audits are also likely to miss some forms of purely domestic evasion.

4.2.2 Patterns of Tax Evasion in Random Audits

Random audits find modest rates of tax evasion, albeit with a lot of heterogeneity across income sources. In total, 11.5% of all taxpayers are found making mistakes. As shown by the top panel of Figure 6, this probability rises sharply with wealth, to more than 35% for the 0.5% richest households. This trend reflects the facts that the probability to earn self-employment income rises a lot with wealth (to close to 50% in the top 0.5%), and that the error rate is much higher among the self-employed (around 60%, with no trend across the wealth distribution) than among wage-earners and retirees (around 10%, with no trend either); see Appendix Figure H.4. Conditional on evading, around 10–20% of income is misreported, with a declining trend across wealth bins (bottom panel of Figure 6). These fractions are modest, and as a result, the overall tax gap is small: 2.2% of personal taxes owed are found to be dodged in total. This number rises a little bit with wealth from the 90^{th} to the 99^{th} percentile, but taxes evaded never exceed 5% of taxes owed.[36]

In the United States, the IRS estimates that a larger fraction of taxes are evaded, about 11% (Johns and Slemrod, 2001).[37] There are two reasons for this difference. First, the IRS multiplies the tax evasion uncovered in its random audits by about three, contrary to SKAT which considers that its extensive information system allows it to detect the bulk of domestic evasion. Second, the self-employment sector—where the bulk of detected tax evasion takes place—accounts for a roughly twice larger fraction of total economic activity in the United States than in Denmark, 11% of factor-cost GDP vs. 6%. As shown by Appendix Figure H.10, Denmark is not unusual in having a low share of self-employment: the other Scandinavian countries have similarly low shares, as do most of the world's high-income countries, e.g., Japan (4%), France (6%) and the United Kingdom (8%). In countries such as Greece, Italy and Portugal, the self-employed generate a higher fraction of total output (about 20%-25%); tax evasion is likely to be much

[36]These figures include all mistakes found during the audit, whether deemed voluntary or not. In Appendix H, we report similar statistics where we exclude the errors that examiners deem non-deliberate. The fraction of households found evading taxes is reduced by a factor of 10 (Appendix Figure H.5), but the average amount of income misreported increases by a factor of 5 (Appendix Figure H.6), so that taxes deliberately evaded account for about half of all unpaid taxes. The distributional patterns are similar, with a slight increase in the fraction of taxes owed that go unpaid at the top of the distribution (Appendix Figure H.7).

[37]As shown by Appendix Figure H.3, although the level of evasion is different, its distribution across wealth (or income in the case of the United States) groups is similar, with an increase in the top 10%.

higher there than in Denmark. Looking forward, however, Scandinavian countries are likely to be more representative of the overall rich world than a country like Greece, since the share of self-employment typically falls as countries develop.

The key lesson from random audit studies is that in rich, developed economies, total tax evasion is limited, because the majority of the population is not able to evade. Most individuals earn only three forms of income in their lifetime—wages, pensions, and investment income in domestic financial institutions—which, due to third-party reporting, are difficult to hide (Kleven et al., 2011). Whenever tax evasion is possible, however, it tends to be high, even in a country like Denmark with high social trust, low corruption, and strong respect for the rule of law.

4.2.3 Combining Offshore Evasion with Random Audits

The top panel of Figure 7 shows the tax gap by wealth group, for domestic evasion (as estimated from the random audit data) and offshore evasion separately. Adding both types of evasion, we find that 2.8% of total taxes go unpaid, 20% due to offshore evasion and 80% due to other forms of tax cheating. For the vast majority of the population—up to the 99.5^{th} percentile—only domestic evasion matters and evaded taxes are small. It is only for the top 0.05%, where wealth concealment is widespread, that evasion becomes large.[38] Overall, a clear gradient in tax evasion by wealth group thus emerges. This gradient is robust to multiplying by three the evasion detected in random audits, similar to what the IRS does in the United States. In that cae, domestic tax evasion rises to about 6% of taxes owed, 10 times our estimated total offshore evasion. Yet the top 0.01% still evades 30% of its taxes, five times more than the average.

Because of tax evasion, the tax rate effectively paid by the wealthiest Scandinavians is substantially lower than implied by the tax law. The bottom panel of Figure 7 computes effective tax rates across the wealth distribution, taking into account payroll taxes, individual income taxes, and wealth taxes (when they exist), at all levels of government. Absent tax evasion, the top 0.1% richest Scandinavians would pay about 45% of their income in taxes. In practice, the rate effectively paid barely reaches 35% for the top 0.01%. This rate remains somewhat higher than the rate paid by the bottom 95% of the wealth distribution. But tax evasion strongly erodes the progressivity of the tax, and makes it regressive at the very top.

[38] Due to insufficient sample sizes, we cannot estimate how domestic tax evasion varies within the top 0.5% of the wealth distribution. We assume that all groups within the top 0.5% have the same evasion rate as the top 0.5% as a whole.

5 A Model of Tax Evasion and Inequality

How can we explain the sharp gradient of evasion with wealth that we find? The canonical Allingham and Sandmo (1972) model predicts that the very rich should evade less, because they are more likely to be (non-randomly) audited by the tax authority. Yet our results show the opposite: in all the samples we have access to, top 0.01% households are much more likely to hide assets abroad than households in the bottom of the top 1%. A simple model where there is a fixed cost of hiding wealth cannot realistically generate this pattern, because it only costs a few hundred dollars to create a shell company in the British Virgin Islands.[39] To explain our findings, we believe it is important to analyze the supply of tax evasion services instead of its demand only. We introduce such a model in this Section.

To keep things simple, assume that there is a single firm—say, a Swiss bank—that sells wealth concealment services.[40] Households differ in their wealth y but are all willing to pay the same unit price θ to hide one dollar of wealth. θ can be interpreted as the effective tax rate on capital, which is saved by hiding wealth abroad (and is typically constant within the top 1% richest households). The wealth distribution is described by the density function $f(y)$ and the mass of households is normalized to one. The more clients the bank serves, the higher the probability that a leak occurs; we assume that when it serves s clients, the bank has a probability λs to be caught breaking the law. If the bank is caught, it has to pay a fine equal to a fraction ϕ of the total assets it manages. Our model illustrates how, internalizing this cost, the bank will serve few but wealthy customers.

Assume that the bank is allowed to set different unit prices $p(y)$ across customers with different wealth y. Its expected profit function is:

$$\pi = \int yp(y)s(y)f(y)dy - \lambda s\phi \int ys(y)f(y)dy \tag{1}$$

where $s(y)$ is the share of households at wealth level y who hide assets in the bank. The first term captures the bank's revenue: at a given wealth level y, there are $s(y)f(y)$ households who each pay the bank $yp(y)$ for its services. The second term captures the bank's expected penalty:

[39] Purely informational explanations cannot fully account for our results either. At the time of the HSBC leak, there was almost no information exchange between offshore banks and foreign tax authorities, making tax evasion easy. This lack of third-party reporting is probably an important explanation for the high rates of tax evasion we obtain at the top of the distribution. However, it was as easy to hide assets for households with $2 million in net wealth as for households with $50 million, yet households with $50 million were much more likely to do so. The lack of third-party reporting thus does not seem enough to explain the gradient we obtain.

[40] In the Appendix, we consider an extension of the model to the competitive case; all our results carry over. Support for the monopolistic assumption comes from the fact that Swiss banks historically had a cartel agreement, the Convention IV of the Swiss Bankers Association, which strictly regulated fees; see Zucman (2015, chapter 1).

with probability λs it must pay a fine equal to a fraction ϕ of the wealth it manages. The bank's optimal pricing strategy extracts all surplus from customers who add to its profitability—by quoting a price equal to the willingness to pay, θ—and deters households who reduces its profitability from being customers—by quoting a prohibitive price above θ.[41] Thus, we can think of the bank's problem as choosing the set of customers that maximizes expected profits given the price θ. It follows directly from eq. (1) that, for a given level of total assets under management, the bank is more profitable when the number of customers is low. The bank optimally chooses to serve wealthier customers first, because they generate more revenue than less wealthy individuals and add the same risk. Letting $k(s)$ denote the total wealth owned by the wealthiest s households, we can restate the bank's expected profit function as:[42]

$$\pi = \theta k(s) - \lambda s \phi k(s) \tag{2}$$

The profit-maximizing number of customers, s^*, is determined by the first-order condition $d\pi/ds = 0$, which can be expressed as follows:

$$\theta = \left(1 + \frac{1}{\epsilon_k(s^*)}\right) \phi \lambda s^* \tag{3}$$

where $\epsilon_k(s) = sk'(s)/k(s)$ is the elasticity of the stock of wealth under management with respect to the number of customers.[43] The left-hand side is the marginal revenue of managing more wealth and the right-hand side is the marginal cost (increase in the expected penalty). The expected penalty increases when the bank manages more wealth both because the penalty applies to a larger stock in case of detection and because the probability of detection rises with the number of customers.

Proposition 1. *In equilibrium, the s^* wealthiest households face a unit price of θ for wealth concealment services and evade taxes, while all other households face a price higher than θ and do not evade.*

[41] In practice, private wealth management banks typically select customers by requiring them to have a minimum amount of assets (e.g., $1 million, $10 million, or $20 million), in effect setting an infinite price for less wealthy individuals, while advertising their services to potential high-net-worth clients through by-invitation only events (golf tournaments, galas, etc.). See, e.g., Harrington (2016).

[42] By construction, adding ever less wealthy customers adds wealth under management at a declining rate so that $k'(s) > 0$ and $k''(s) < 0$.

[43] The first-order condition indeed characterizes an optimum since

$$\frac{d\pi^2}{d^2 s} = (1 - \lambda s)\theta k''(s) - 2\lambda\phi k'(s) < 0$$

To gain further insights, assume that wealth follows a Pareto distribution at the top with a Pareto coefficient $a > 1$. This parameterization encompasses different levels of inequality: A high a corresponds to a relatively equal distribution of wealth; a low a corresponds to an unequal distribution; when $a \to 1$, inequality tends to infinity. Income and wealth tend to follow Pareto distributions at the top, and a large literature estimates Pareto coefficients over time and across countries (see, e.g., Atkinson, Piketty and Saez 2011, Table 3 and Figures 12, 13, 14 and 15). A typical value of a for the wealth distribution is $a = 1.5$. When wealth is Pareto-distributed, the equilibrium number of tax evaders takes a simple closed-form expression:

$$s^* = \frac{\theta}{\left(1 + \frac{a}{a-1}\right)\lambda\phi} \tag{4}$$

This equation pins down s^* as a function of the model's parameters: the penalty ϕ, the probability of detection λ, and inequality a. We summarize the comparative statics in the following Proposition:

Proposition 2. *The share s^* of households who evade taxes (i) falls with the probability of detection λ (ii) falls with the penalty rate ϕ, and (iii) falls as wealth becomes more unequally distributed (i.e., as the Pareto coefficient falls).*

The first result—that evasion falls when the probability of detection rises—is intuitive and also present in demand-side models of evasion (Allingham and Sandmo, 1972). In our context, however, it has new implications for recent and future trends in tax evasion. Since 2008, there has been a growing number of leaks from offshore financial institutions (see Johannesen and Stolper, 2017), maybe because technological change makes such leaks easier, or because of increases in the rewards offered to whistleblowers.[44] This could lead to a reduction in tax evasion. Looking forward, however, new technologies such as blockchain or improvements in the banks' internal IT systems might lead λ to fall—making tax evasion accessible to less wealthy individuals. λ might also be lower in small banks—where it might be easier to maintain a strong culture of secrecy—than in banking giants like HSBC. If wealth concealment services move to such small boutique banks, then enforcement might prove increasingly hard.

The second result—that evasion falls when penalties rise—suggests that policy-makers can dramatically reduce tax evasion. In the extreme case in which they were willing to impose infinite penalties—e.g., by systematically putting out of business the financial institutions found

[44] In the United States, the IRS signed a check for $104 million to the ex-banker UBS banker, Bradley Birkenfeld, who revealed the practices of his former employer. UBS entered into a deferred prosecution agreement with the Department of Justice and had to pay a fine of $780 million in 2009.

facilitating evasion—then s^* would go to 0. Large sanctions against the suppliers of tax evasion services may be a more practical way to curb tax evasion by the wealthy than high penalties on the tax evaders themselves—if only because fewer cases need to be investigated. It is, however, easier to close small banks than systematically important institutions. Since 2009, the U.S. government has been able to shut down three Swiss banks (Wegelin, Neue Zürcher Bank, and Bank Frey). But in 2014, Credit Suisse was able too keep its U.S. banking licence despite pleading guilty of a criminal conspiracy to defraud the IRS; in 2012 U.S. authorities similarly decided against indicting HSBC despite evidence that the bank had enabled Mexican drug cartels to move money through its American subsidiaries.[45] If big financial institutions become "too big to indict" (because regulators fear that this would destabilize financial markets), tax evasion might flourish.

The third result—that the number of tax evaders falls when inequality increases—is specific to the supply-side model developed here. Its intuition is the following: when inequality is high, a handful of individuals own the bulk of wealth; they generate a lot of revenue for the bank and are unlikely to be detected. Moving down the distribution would mean reaching a big mass of the population that would generate only relatively little additional revenue but would increase the risk of detection a lot; it is not worth it. As inequality rises, the fraction of households who evade taxes falls, but the fraction of wealth which is hidden increases. In the extreme case where inequality is infinite ($a \to 1$), only one person evades taxes—but 100% of capital taxes owed are evaded.

This inequality effect could explain some of the observed trends in top-end evasion. The number of clients of Swiss banks seems to have declined over the last ten years; as shown by Appendix Figure E.6, it has been divided by 3 at HSBC Switzerland over the 2006–2014 period. While part of this fall probably owes to changes in λ and ϕ (and in the specific case of HSBC, to the Falciani leak), one other contributing factor might be the rise in global wealth concentration.[46] Indeed, while the number of HSBC clients fell, the average account value increased 80%, from \$3.7 million in 2006 to \$6.6 million in 2014; the offshore wealth managed by Swiss banks has also increased significantly since 2000 (Zucman, 2015). As the world becomes more unequal, offshore banks might choose to serve fewer but wealthier clients.

Appendix K shows that introducing competition in our model does not affect the comparative

[45] Instead, HSBC was fined \$1.92 billion, in a year when its pretax profits reached \$22.6 billion.

[46] In the world's two largest economies, the United States and China, top wealth shares have increased significantly since the beginning of the century (Saez and Zucman, 2014; Piketty, Yang, Zucman, 2017). Forbes magazine data suggest that the wealth of global billionaires is rising faster than world wealth (Piketty, 2014).

statics summarized in Proposition 2,[47] but generates an additional insight. With competition, an exogenous increase in the number of suppliers of wealth concealment services—for instance due to market liberalization that lowers entry costs—increases the fraction of households who evade taxes. Supply forces could thus help explain the rise in offshore tax evasion through the 1980s, 1990s, and 2000s.

6 The Interplay Between Tax Avoidance and Evasion

Should tax evasion become impossible, would wealthy individuals pay significantly more taxes? The answer largely depends on how substitutable illegal tax evasion and legal tax avoidance are. In this Section, we address this question by analyzing the behavior of the large sample of Norwegians who voluntarily disclosed previously hidden wealth in the context of a tax amnesty.

6.1 Sample of Amnesty Participants

Norway's tax amnesty program allows taxpayers to avoid penalties and criminal sanctions for past tax evasion. Tax evaders can benefit from the program under three conditions: they must offer information about hidden wealth voluntarily and not in connection with investigations by the tax authority; the information must be sufficient for the tax administration to assess the correct amount of taxes owed; and the origin of the hidden wealth and income must be revealed.

The amnesty program was rarely used in the decades following its inception in 1950. The number of participants first increased in 2008, when, in a scandal widely covered by the media, the mayor of Oslo had to resign from office after his ex-son-in-law revealed that he had owned undeclared bank accounts in Switzerland. As Appendix Figure G.6 shows, most subsequent disclosures happened in two waves, in 2009 and 2013-14. The 2009 wave coincides with the G20 tax haven crackdown where tax havens like Switzerland, Luxembourg, and Singapore agreed to provide bank information to foreign tax administrations upon request (Johannesen and Zucman 2014). The 2013-2014 wave waves coincides with the commitment by the same tax havens to exchange bank information automatically. The sample we use includes all individuals who disclosed hidden offshore wealth in the amnesty during the 2008-2016 period, whose cases were not dropped by the tax authority, and for whom a tax return with income and wealth information

[47] While the offshore banking sector continues to serve all households above a wealth threshold, competition prevents banks from appropriating the full economic rent associated with tax evasion and equilibrium unit prices in the market for wealth management are declining in the wealth level of the customers. Intuitively, prices for customers with more wealth are competed down to lower levels because they generate more revenue for the banks while adding the same detection risk as customers with less wealth.

exists for 2007.

Tax amnesty participants tend to be extremely wealthy. Table 3 reports summary statistics for our sample in 2007, before they use the amnesty. Individuals in that sample report on average 150 times more wealth (at tax value) than other Norwegians. Accounting for the hidden wealth subsequently disclosed, they own almost 250 times more taxable assets. They are older, more likely to be male, married, and foreign-born than the rest of the population.

Before using the amnesty, disclosers also engaged more frequently in tax avoidance, although far from systematically. We consider four indicators of legal tax avoidance. First, the introduction of a dividend tax in 2006 created an incentive for owners of closely-held firms to pay out dividends in 2005. Among the sample of amnesty participants, 6.7% paid out all the retained earnings of a closely-held firm in 2005 as compared to 0.7% in the rest of the population. Second, until 2009 the tax rules provided for a wealth tax rebate if the combined wealth and income tax liabilities exceeded 80% of the taxpayer's taxable income; 6.5% of the disclosers benefited from this rebate in 2007 compared to 0.3% of the non-disclosers. Third, a well-known tax planning technique in Norway is the holding of unlisted shares, which are taxed for only a fraction of their actual market value.[48] 28.6% of the amnesty participants held unlisted securities in 2007 (vs. 3.9% in the rest of the population). Fourth, rich Norwegians can defer personal taxes on capital income by holding assets through a separate legal entity: 11.9% of our sample owned a holding company in 2007 (vs. 0.6%).

6.2 Estimating Substitution Between Evasion and Avoidance

To test whether a decrease in tax evasion sparks an increase in tax avoidance, we use an event-study framework. We estimate how the reported wealth and income of amnesty participants and the taxes they pay evolve around the time they voluntarily disclose hidden assets. Our estimating sample includes all 1,485 disclosers described above plus a sample of non-disclosers serving to establish a counterfactual. This control group includes all non-disclosers in the top 10% of the 2007 wealth distribution and—for computational reasons—a randomly selected 10% sample of the non-disclosers in the bottom 90%. Indexing individuals by i and years by t, we run the following model:

[48] While listed equities enter the wealth tax base at their market value, unlisted equities are taxed at the tax value of the underlying business assets, which typically implies a significant rebate. Gobel and Hestdal (2015) estimate that the tax rebate to the most liquid unlisted equities is around 70% and exceeds 90% for a set of unlisted equities that were eventually listed.

$$\log(Y_{it}) = \alpha_i + \gamma_t + X'_{it}\psi + \sum \beta_k D^k_{it} + u_{it}$$

where α_i denotes individual fixed effects, γ_t year fixed-effects, and D_{it} year time dummies. These dummies are the main variables of interest and measure the change in the outcomes Y_{it} of amnesty participants relative to the year before they use the amnesty, over and above the changes observed for similar non-amnesty participants.[49] We also include a set of non-parametric controls X_{it} for wealth, income, and age. Specifically, we divide the sample of amnesty participants into ten equally-sized groups based on their wealth in 2007, assign non-disclosers to these wealth groups, and introduce a separate set of time dummies for each group. This allows time trends to vary across taxpayers with different wealth and ensures that we identify from a comparison of evaders and non-evaders that are similar with respect to their wealth in 2007. We similarly allow time trends to vary across taxpayers of different ages (6 age groups) and with different levels of 2007 income (10 income groups).

6.3 Results

The first finding is that the wealth and income reported by amnesty participants on their tax return jumps sharply just after they use the amnesty. As shown by Figure 8, reported income and wealth follow the same trend among disclosers and non-disclosers in the years $t-5$ to $t-2$ (where t is the year when the disclosers use the amnesty), but the taxable wealth reported by disclosers increases by more than 50% relative to non-disclosers between $t-2$ and t. The level of the jump is consistent with the evidence discussed in Section 3 that amnesty participants hid on average one third of their true wealth. Reported taxable income similarly rises by around 20%.

Second, taxes paid rise in line with the increase in income and wealth declared. As shown by Figure 9, the taxes paid by amnesty participants increase by about 30% right at the time they use the amnesty, relative to non-participants. This increase corresponds to what one would mechanically expect given the rise of 20% in taxable income and 50% in taxable wealth, and given the respective tax rates that apply to taxable income and wealth.

Third, and most importantly, income, wealth, and taxes paid remain permanently higher through to year $t+4$. There is no sign that the tax bases and tax liabilities of disclosers decrease after the initial surge, suggesting that substitution away from evasion toward legal

[49] Since evaders disclosing offshore wealth in the beginning of year t can incorporate the disclosed wealth into the tax return for year $t-1$, we let year $t-2$, the last year for which the tax return has definitely been submitted at disclosure in year t, be the omitted event time category.

tax avoidance is limited. This interpretation is supported by Table 4 , in which we analyze patterns in tax avoidance around disclosure. We find no sign that tax evaders incorporate holding companies more frequently after disclosing their offshore wealth (col. 4) nor that they increase their holdings of tax-favored asset classes such as unlisted equities (col. 5) and real estate, which is typically taxed at only about 20% of its market value (col. 6). These results do not seem to mask heterogeneity in the form of a tail of aggressive avoiders: tax evaders do not become more likely to report zero capital income after using the amnesty (col. 7), nor are they more inclined to emigrate (col. 8). Along all these dimensions, substitution from evasion towards avoidance seems negligible.

One potential concern with our interpretation of these results is that amnesty participants might have already exhausted all available avoidance strategies by the time they use the amnesty. This would be the case if the most tax-averse individuals first search for legal ways to cut their taxes before turning to illegal ways. We test this hypothesis in a set of cross-sectional regressions for 2007, where avoidance dummies are regressed on a dummy indicating whether the individual discloses hidden wealth at some point during the 2008-2016 period, and flexible non-parametric controls for wealth, income, and age. This specification tests for whether tax evaders were avoiding more prior to disclosure than taxpayers who were similar in terms of wealth, income, and age. The results are reported in Appendix Table G.7. We find that amnesty participants, prior to disclosure, were in fact less likely to maximize dividend payments from closely-held firms, less likely to own a holding company, and less likely to artificially lower their taxable income so as to reduce their wealth tax bill by virtue of the 80% tax ceiling rule. These results are not driven by differences in wealth across our treated and control groups, which we appropriately control for.

Overall, the Norwegian amnesty seems to have been an effective way to generate more tax revenue from the very wealthy. The rise in income, wealth, and taxes paid when amnesty participantes disclose previously hidden assets is not eroded by a rise in legal tax avoidance, despite ample opportunities to do so. Tax amnesties, however, raise other issues that we cannot address with our data: they might, for example, encourage tax evasion if taxpayers expect they will always be able to come clean for a modest cost if need be. The main lesson we draw from our analysis is that fighting tax evasion can, at least in some circumstances, be an effective way to increase tax collection on the very wealthy.[50]

[50]This needs not to be true in all contexts. In an important contribution, Slemrod, Blumenthal and Christian (2001) analyze a randomized experiment in Minnesota, where randomly selected taxpayers were informed by letter that the returns they were about to file would be "closely examined". They find that high-income treated

7 Implications for the Measurement of Inequality

In this Section, we analyze the implications of our results for the measurement of long-run trends in wealth inequality. We consider the case of Norway, where consistent, long-run time series of top wealth shares exist.[51]

Norway has been levying a wealth tax throughout most of the twentieth century. Based on published tabulated tax statistics, Roine and Waldenström (2015) estimate long-run top wealth shares. From 2001, we have access to micro-level estimates of wealth for each Norwegian individual based on reports by third-parties (Norwegian banks, mutual funds, depositories, etc.). We use these data to construct top wealth shares following the methodology described in section 3.2 and further detailed in Appendix B. Our top wealth shares are fully consistent in level and trends with those reported by Roine and Waldenström (2015). Before 2001, the estimates produced by Roine and Waldenström (2015) are not based on population-wide micro-files but on tabulated statistics, so they involve some margin of error. The overall long-run evolution, however, seems pretty clear. Wealth concentration—as seen from tax data—was relatively high in the early twentieth century: the top 0.1% richest households owned around 12–14% of total wealth. It then declined from the 1940s to the 1970s: over these four decades, the top 0.1% wealth appears to have been more than halved, reaching a low water-mark of around 6% in the 1970s. Since then, it seems to have rebounded to about 8% on average over the 2010–2013 period.

How does factoring in hidden wealth affect this evolution? In our benchmark scenario we estimate the Norway owns about 2.3% of its total household wealth offshore. We assume that this wealth is distributed like in the HSBC and amnesty samples, i.e., that about 80% of it belongs to the top 0.1%, and about 50% to the top 0.01%. As reported in the top panel of Figure 10, including offshore wealth increases the top 0.1% wealth share significantly: from 8% to 10%. For the top 0.01%—the wealthiest 330 Norwegian households—it increases their wealth by a third (bottom panel of Figure 10). These results highlight the need to move beyond tax records to capture income and wealth at the very top, even in countries where tax compliance is generally high.

taxpayers paid *less* taxes relative to the control group, suggesting potentially large substitution away from evasion toward legal avoidance.

[51] Estimates of historical top wealth shares exist for Sweden and Denmark too, but the currently available series do not include the very top groups such as the top 0.01% (Sweden) or are not consistent with the population-wide, micro-level wealth data available for recent decades (Denmark); see Appendix B (Sweden) and C (Denmark). We leave the task to construct long-run, homogenous series of top wealth shares corrected for tax evasion in as many countries as possible to future research.

In order to give a broad sense of how tax havens affect the long-run trends in wealth inequality, we correct top wealth share back to the 1930s. In the 1990s, two international commissions got access to the archives of Swiss banks. The first—presided over by Paul Volcker, former chairman of the US Federal Reserve—aimed at identifying the dormant accounts belonging to victims of Nazi persecutions and their heirs; the second—chaired by the historian Jean-François Bergier—aimed at better understanding the role played by Switzerland during World War II. Drawing on the work of these commissions, Zucman (2015, chapter 1) constructs historical series for the amount of foreign wealth managed by Swiss banks back to the early twentieth century. We assume that Norway's offshore wealth has followed the same evolution as the foreign wealth in Swiss banks, and that hidden wealth was as concentrated in the past as today. Although a sizable margin of error is involved here, the broad patterns are likely to be robust: all the available evidence suggests that although the wealth held by foreigners in Switzerland was not insignificant back in the 1930s, it is in the 1980s and 1990s that it grew the most. As a result, accounting for hidden assets erases half of the decline in the top 0.1% wealth share observed in tax data since the 1930s. Strikingly, the top 0.01% appears to have now fully recovered from the decline in wealth concentration caused by World War II and the policy changes of the post-war decades. By our estimate, the top 0.01% is now slightly higher than in the 1930s and 1940s. This finding suggests that the historical decline in wealth inequality over the course of the twentieth century, one of the core findings in the literature on the long-run distribution of income and wealth (e.g., Piketty 2014, chapter 10), may be less spectacular in actual facts than suggested by tax data.

8 Conclusion

In this paper, we combine micro-data leaked from financial institutions in tax havens with randomized audits and population-wide registry data to study the size and distribution of tax evasion in rich countries. Random audits show high evasion rates among the self-employed, but little evasion among salaried workers and retirees, for whom third-party reporting greatly limits evasion possibilities. Since self-employed individuals only account for a small fraction of the population in rich countries, random audits suggest that tax evasion is low overall. Leaks, on the other, imply sizable tax evasion by very rich households, a phenomenon random audits do not capture. Combining random audits and leaks, we estimate that the top 0.01% of the wealth distribution—a group that includes households with more than $45 million in net wealth—evades about 30% of its taxes. This is an order of magnitude more than the average evasion

rate of 3%. To have a good measure of tax evasion, combining different data sources is critical.

Because the income and wealth that evades taxes is extremely concentrated, tax evasion turns out to have important implications for the measurement of inequality. In the case of Norway, accounting for it leads to an increase of 30% of reported wealth at the top of the distribution. Our results suggest that tax data may significantly under-estimate the rise of wealth concentration over the last four decades, as the world was less globalized in the 1970s, it was harder to move assets across borders, and offshore tax havens played a less important role. Because most Latin American, and many Asian and European economies own much more wealth offshore than Norway, the results found in Norway are likely to be lower bound for most of the world's countries. Fortunately, many countries have access to leaked data similar to those we exploit in this paper. Although the HSBC list is not public, it was shared by the French tax authority with foreign countries' aministrations in 2009. The Panama Papers database is publicly accessible at `https://panamapapers.icij.org`. Other leaks have occurred in recent years from majors providers of offshore financial services, for instance from the Swiss bank Credit Suisse whose offices in London, Paris, and Amsterdam were searched in March 2017 in the context of a multi-country criminal investigation on 55,000 suspect Swiss bank accounts.[52] Our analysis could thus be implemented by tax authorities and researchers around the world, including in countries where tax evasion may be more prevalent than in Scandinavia.

[52]See "Credit Suisse embroiled in major global tax evasion investigation", *The Guardian*, March 31, 2017.

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Table 1: HSBC evaders, Panama papers individuals, & amnesty participants, by wealth group

	HSBC				Panama papers		Amnesty				HSBC + Amn.	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
	Extensive margin		Intensive margin		Extensive margin		Extensive margin		Intensive margin		Extensive margin	
Wealth group	% of all households	Test	% of evaders' wealth	Test	% of all households	Test	% of all households	Test	% of evaders' wealth	Test	% of all households	Test
P0-90	0.00		35.08	A	0.00		0.03		36.52	C	0.03	
	(0.00)		(9.21)		(0.00)		(0.00)		(1.86)		(0.00)	
P90-95	0.01		38.27	A	0.01	A	0.25		25.32	A	0.26	
	(0.00)		(4.45)		(0.00)		(0.01)		(2.06)		(0.01)	
P95-99	0.03		39.34	A	0.01	A	0.78		27.42	AB	0.80	
	(0.00)		(3.51)		(0.00)		(0.02)		(1.26)		(0.02)	
P99-99.5	0.07		42.32	A	0.04	B	2.83		31.02	B	2.89	
	(0.01)		(5.91)		(0.01)		(0.09)		(1.95)		(0.09)	
P99.5-99.9	0.19		46.51	A	0.04	B	4.31		30.89	B	4.49	
	(0.02)		(3.77)		(0.01)		(0.12)		(1.52)		(0.12)	
P99.9-99.95	0.38	A	36.19	A	0.16	B	8.16		31.26	ABC	8.51	
	(0.08)		(5.85)		(0.06)		(0.45)		(2.79)		(0.45)	
P99.95-99.99	0.66	A	36.63	A	0.17	B	11.49	A	32.84	BC	11.76	
	(0.12)		(9.24)		(0.07)		(0.58)		(2.92)		(0.59)	
P99.99-100	0.94	A	38.60	A	1.19		13.77	A	26.30	AB	14.83	
	(0.30)		(9.34)		(0.39)		(1.25)		(4.51)		(1.29)	
Number of households	10,617,167		10,617,167		7,547,170		7,547,170		7,547,170		7,547,170	
Number of tax evaders	520		300		165		8,233		1,375		8,571	

Notes: Cols. 1, 5, 7, and 11 show the fraction of all Scandinavian households who evaded taxes at HSBC Switzerland, who are in the Panama papers, or who used a tax amnesty to voluntarily disclose hidden wealth, by wealth group. For HSBC, our sample pools Norwegian, Swedish, and Danish households; therefore wealth groups are defined relative to Scandinavia as a whole (Norway, Sweden, plus Denmark). For the Panama papers and amnesty participants, our sample pools Norwegian and Swedish households; therefore wealth groups are defined relative to Norway plus Sweden. Col. 3 shows the wealth hidden at HSBC Switzerland as a fraction of each evader's own total wealth (including that hidden at HSBC); the sample includes all HSBC evaders for whom HSBC account values are available. Col. 9 shows the same statistic for the sample of Norwegian amnesty participants. All values are expressed in percentage points. Bootstrapped standard errors are reported in parenthesis. Cols. 2, 4, 6, 6, 8, 10, and 12 show the results of pairwise tests for the equality of the group means displayed in cols. 1, 3, 5, 7, 9, and 11. Wealth groups sharing a common letter are not significantly different at the 5% level.

Table 2: Offshore wealth at HSBC, in all Swiss banks, and in all tax havens (2007)

	World	Scandinavia	*Sweden*	*Norway*	*Denmark*
A. Wealth held offshore ($ billion)					
At HSBC Switzerland Private Bank	118.4	1.01	*0.49*	*0.32*	*0.20*
In all Swiss banks	2,670	19.5	*11.1*	*4.1*	*4.3*
In all the world's tax havens (benchmark estimate)	5,620	54.4	*29.4*	*16.7*	*8.3*
- Bottom-up estimate	5,620	48.1	*23.3*	*15.4*	*9.5*
- Proportional allocation	5,620	108.8	*49.0*	*24.0*	*35.9*
B. Wealth held offshore (% of household wealth)					
In all Swiss banks	1.5%	0.6%	*0.8%*	*0.6%*	*0.4%*
In all the world's tax havens (benchmark estimate)	3.3%	1.7%	*2.0%*	*2.3%*	*0.8%*
- Bottom-up estimate	3.3%	1.5%	*1.6%*	*2.1%*	*0.9%*
- Proportional allocation	3.3%	3.3%	*3.3%*	*3.3%*	*3.3%*

Notes: This Table reports estimates of (i) the wealth managed by HSBC Private Bank Switzerland, (ii) the offshore wealth managed by all Swiss banks, and (iii) the offshore wealth held in all the world's tax havens. Offshore wealth is defined as bank deposits and portfolio securities managed by domestic banks on behalf of non-resident households. All the data are for the middle of 2007, the time of the Falciani leak. For HSBC, the column "world" is the official total published by HSBC (2015); totals for Scandinavia, Sweden, Norway, and Denmark only include the accounts that could be matched to an individual taxable in Scandinavia; they exclude all unmatched accounts, non-resident account-holders, and remove the double-counting of joint accounts; see Appendix E. The offshore wealth in all Swiss banks is constructed from official statistics published by the Swiss central bank; see Zucman (2013, 2015), and Appendix I. The wealth held in all the world's tax havens is estimated by averaging the end-2006 and end-2007 estimate of Zucman (2013); see text for a description of the benchmark, bottom-up, and proportional allocation of this total to Scandinavia. Panel B divides the amounts reported in Panel A by household wealth totals constructed by averaging end-2006 and end-2007 values; see Appendix A.

Table 3: The voluntary discloser sample: summary statistics

	All Norwegian residents (2007)	
	Not amnesty participants	Amnesty participants
Number of individuals	3,807,650	1,485
DEMOGRAPHICS		
Age	46	58
Male	50%	66%
Number of children	2.3	2.2
Foreign born or foreign national	12%	22%
Married	46%	61%
INCOME AND WEALTH ($)		
Reported taxable wealth (tax value)	20,268	3,106,924
True taxable wealth (tax value)	20,268	4,830,379
Reported taxable income	55,713	202,759
Reported taxable capital income	3,264	93,762
TAX AVOIDANCE INDICATORS		
Maximized dividend payments in 2005	0.7%	6.7%
80% wealth tax reduction	0.3%	6.5%
Owns unlisted shares	3.9%	28.6%
Owns a holding company	0.6%	11.9%

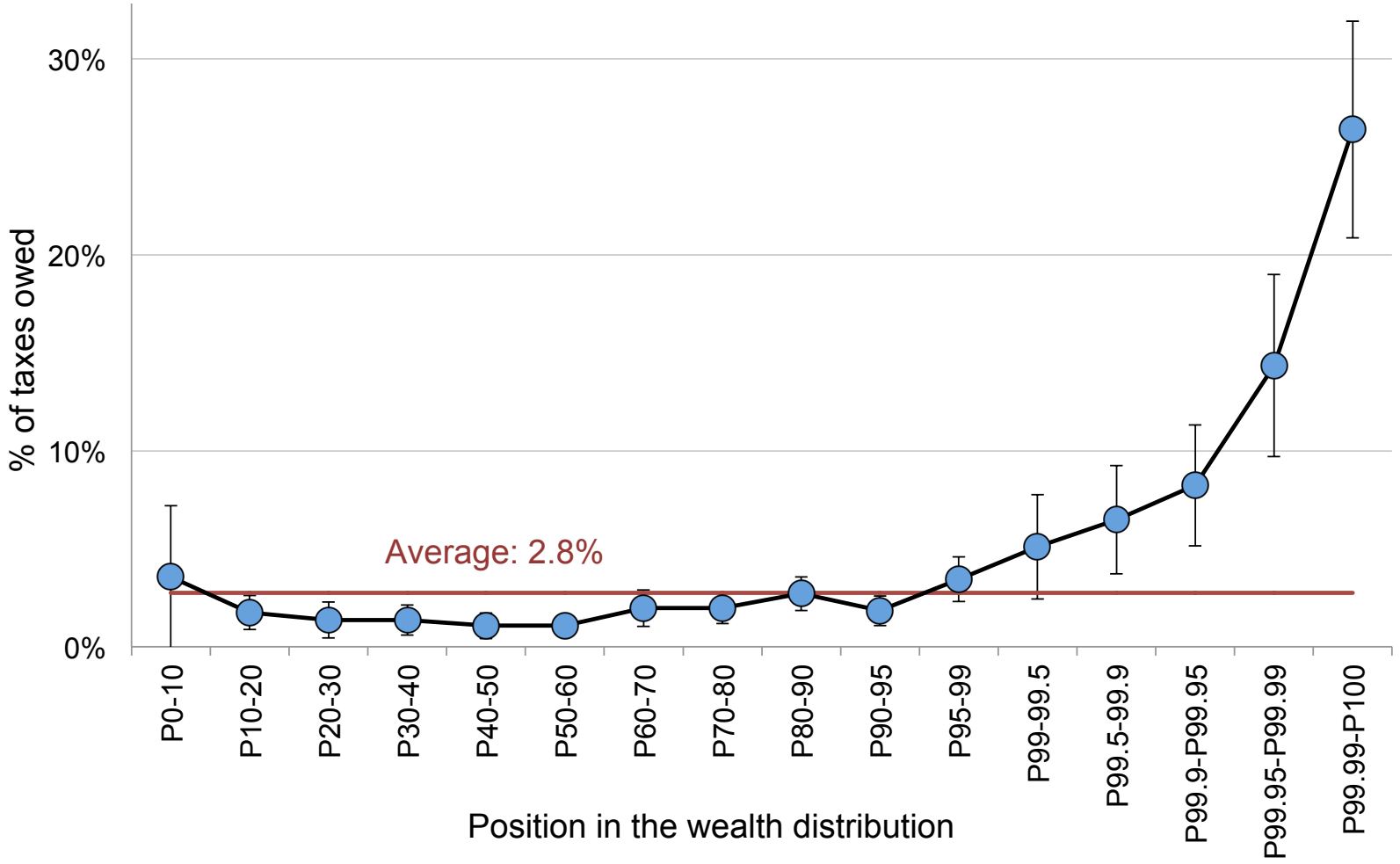
Notes: The Table provides summary statistics for individuals who have used the Norwegian tax amnesty to disclose previously hidden offshore assets ("disclosers") and individuals who have not ("non-disclosers"). Individuals whose cases were dropped by the tax authorities are excluded. For computational tractability the sample consists of all disclosers (with weight 1); all non-disclosers with wealth above the 90th wealth percentile (with weight 1); and a 10% random sample of all non-disclosers with wealth below the 90th wealth percentile (with weight 10). The variables are defined in the main text.

Table 4: The effect of using a tax amnesty on tax avoidance

	Compliance			Channels of avoidance				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Reported wealth (in logs)	Reported income (in logs)	Taxes paid (in logs)	Founds holding company (dummy)	Unlisted shares (in logs)	Housing wealth (in logs)	Zero capital income (dummy)	Emigration (dummy)
Post-disclosure (periods 0-2) relative	0.4562***	0.1761***	0.2218***	-0.0007	-0.0778	-0.0989*	0.0084	-0.0004
to pre-disclosure (period -4 to -2)	(0.0415)	(0.0341)	(0.0317)	(0.0018)	(0.1039)	(0.0542)	(0.0075)	(0.0010)
Observations	5,821,045	7,957,037	7,772,277	8,177,190	900,979	6,142,434	8,177,190	8,316,826
R-squared	0.8501	0.7252	0.7998	0.0943	0.8617	0.7442	0.6064	0.1010
Individual fixed effects	X	X	X	X	X	X	X	X
Wealth x year fixed effects	X	X	X	X	X	X	X	X
income x year fixed effects	X	X	X	X	X	X	X	X
Age x year fixed effects	X	X	X	X	X	X	X	X

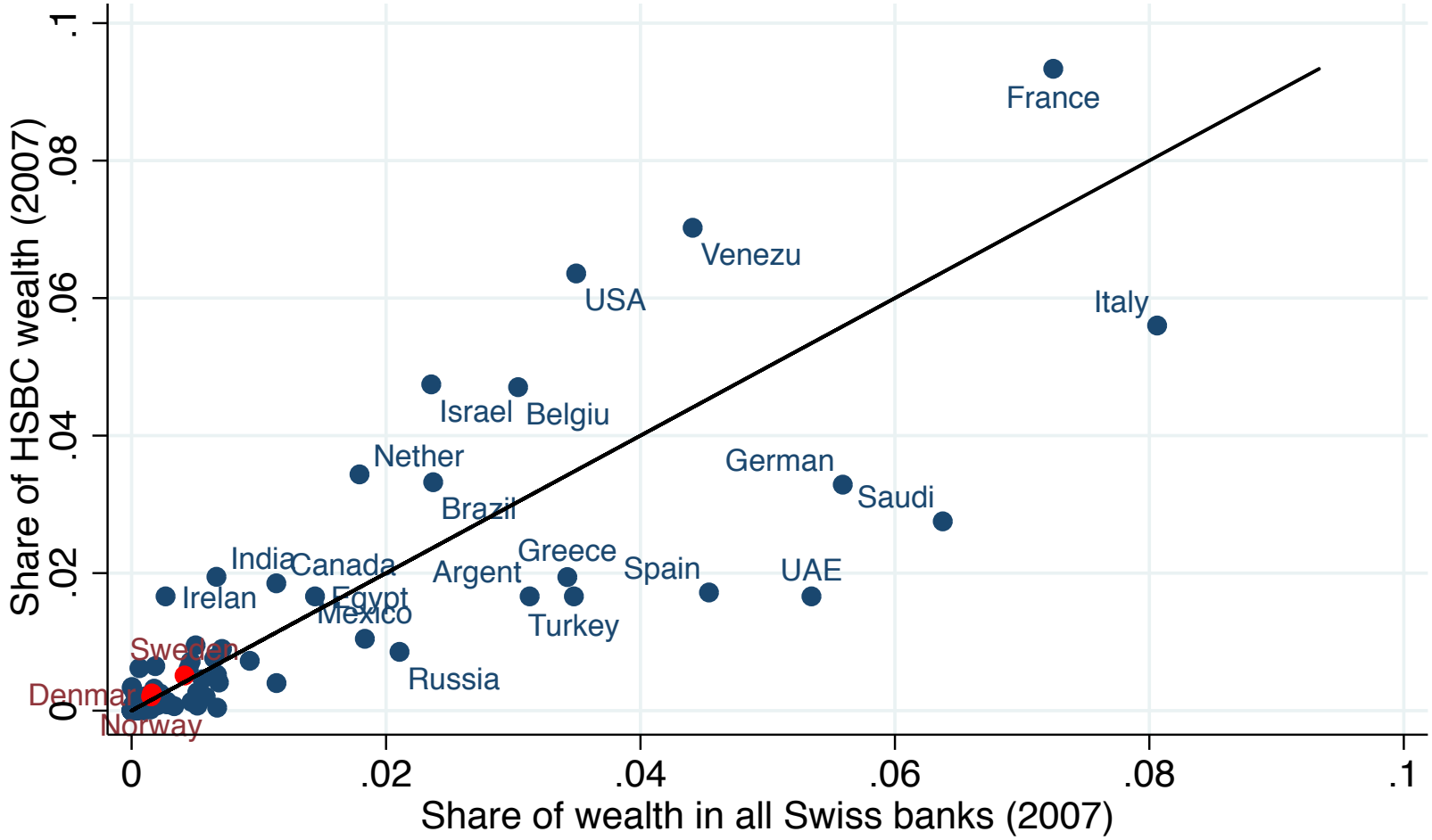
Notes: The Table shows the results from event-study regressions where the event is voluntary disclosure of hidden wealth and the outcomes are: reported taxable wealth (col. 1), reported taxable income (col. 2), claimed tax liability (col. 3), a dummy indicating the incorporation of a holding company (col. 4), the tax value of unlisted securities (col. 5), the tax value of housing (col. 6), a dummy indicating zero reported capital income (col. 7) and a dummy indicating emigration (col. 8). Outcomes are regressed on individual fixed effects, year fixed effects, even-time dummies indicating the year relative to disclosure and non-parametric controls for 2007 wealth (deciles of disclosers' wealth at market value), income (deciles of disclosers' income), and age (6 age groups) interacted with time. The event time categories $t-4$, $t-3$ and $t-2$ ("pre-disclosure period") are omitted and event time categories t, $t+1$ and $t+2$ are replaced by a single dummy ("post-disclosure period"). The sample period is 2002-2013. Standard errors are clustered at the individual level.

Figure 1: Taxes evaded as a % of taxes owed, by wealth group



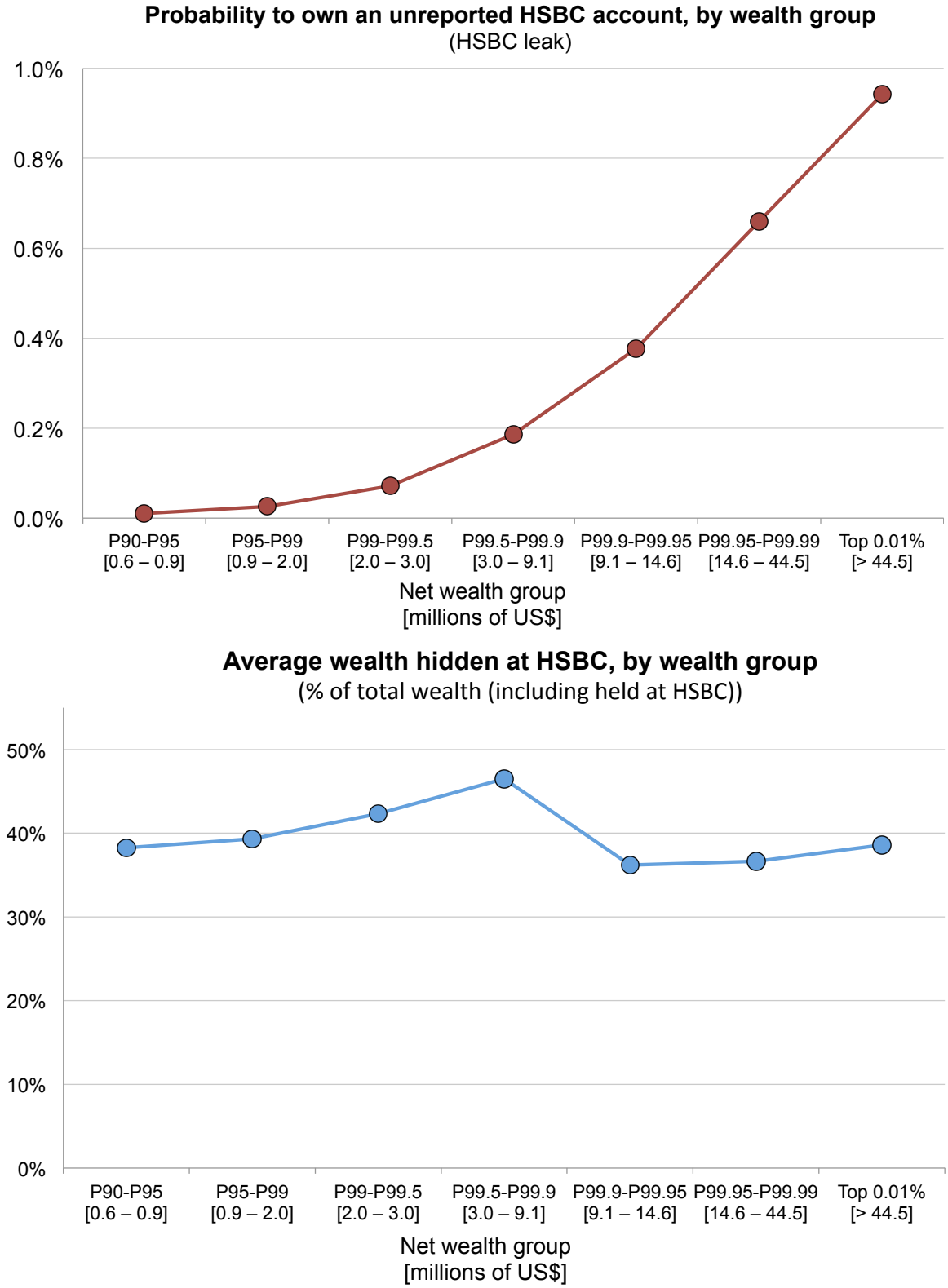
Notes: This figure combines random audits with micro-samples of households hiding assets abroad and macro estimates of the stock of wealth held in tax havens to estimate the size of tax evasion across the wealth distribution in 2006. Each dot is equal to the average ratio of taxes evaded to total taxes owed in the corresponding wealth bin. P0-10 denotes the bottom decile of the Scandinavian wealth distribution, and P99.99-P100 the top 0.01% (households with more than $45 million in net wealth in 2006). 95% confidence intervals based on bootstrapped standard errors. Source: Appendix Table J.5.

Figure 2: Country distribution of wealth at HSBC vs. in all Swiss banks



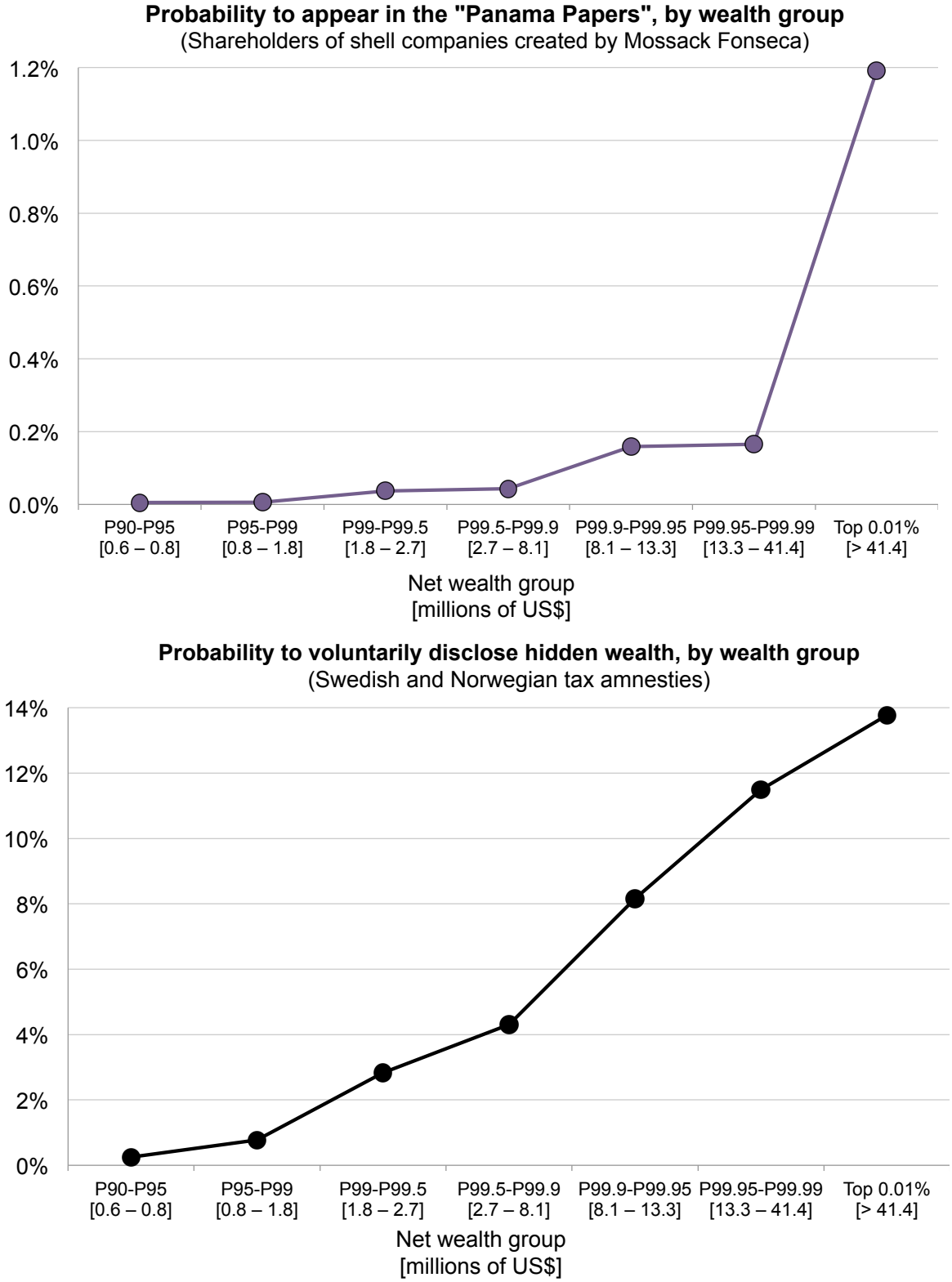
Notes: This figure shows the country distribution of the wealth managed by HSBC Private Bank Switzerland and the country distribution of the foreign wealth managed by all Swiss bank in 2007. The black line is the 45 degree line. In the full sample excluding tax havens (131 countries), a regression of the share of HSBC wealth on the share of Swiss deposits has slope $b = 1.00$ (se $= 0.04$) and R-square of 0.80. Source: ICIJ (`http://projects.icij.org/swiss-leaks/`) and Swiss National Bank.

Figure 3: Tax evasion at HSBC: intensive vs. extensive margin



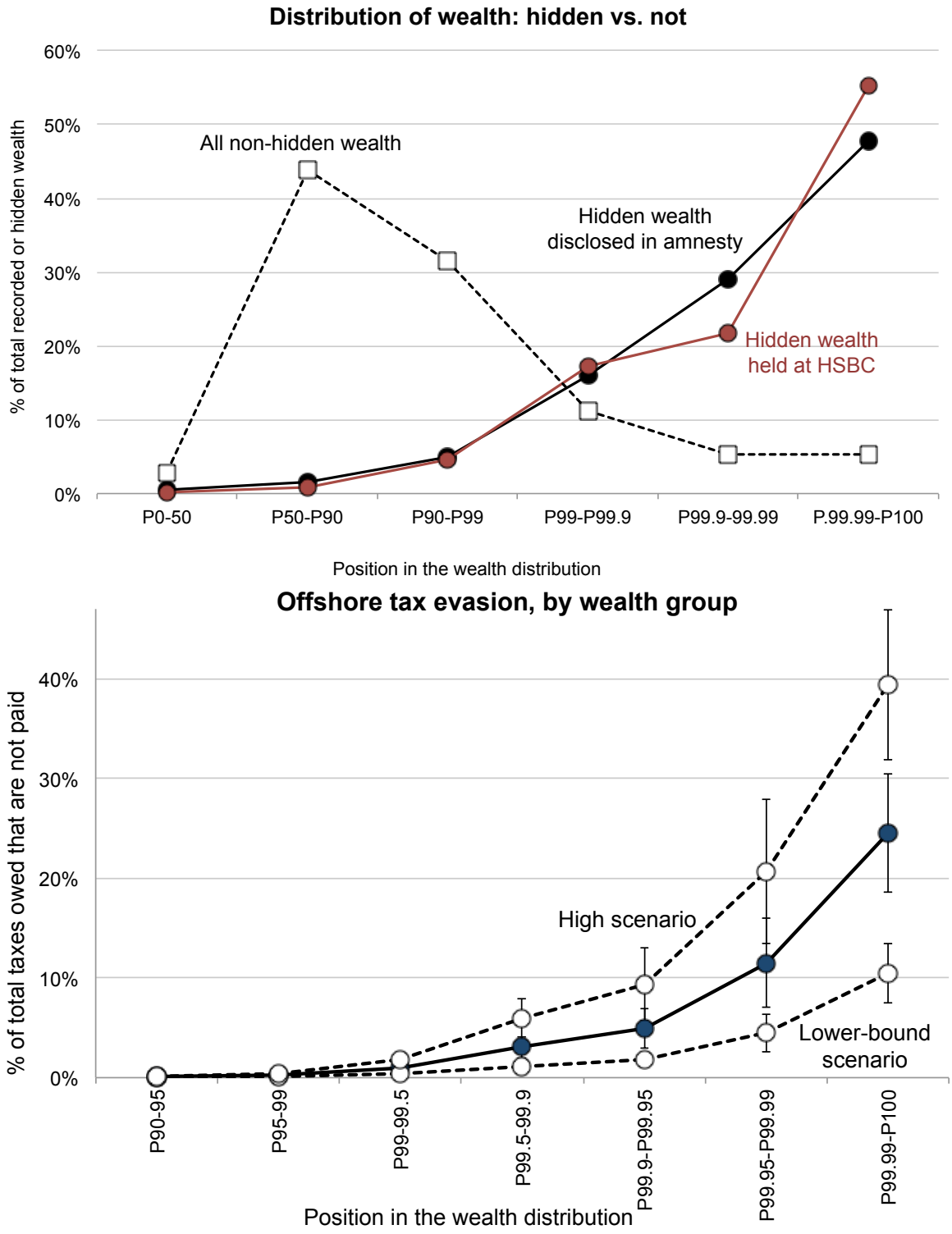
Notes: The top panel shows the fraction of households in Scandinavia (Norway, Sweden and Denmark) who had an unreported bank account at HSBC Switzerland in 2006, by bins of 2006 Scandinavian wealth. The sample includes 520 Scandinavian households who could be matched to a tax return; see text. The bottom panel shows the ratio of the wealth held at HSBC over total observable wealth, in the sample of 300 account holders with available account values. Source: Appendix Tables E.2 and E.6.

Figure 4: Panama papers individuals & amnesty participants



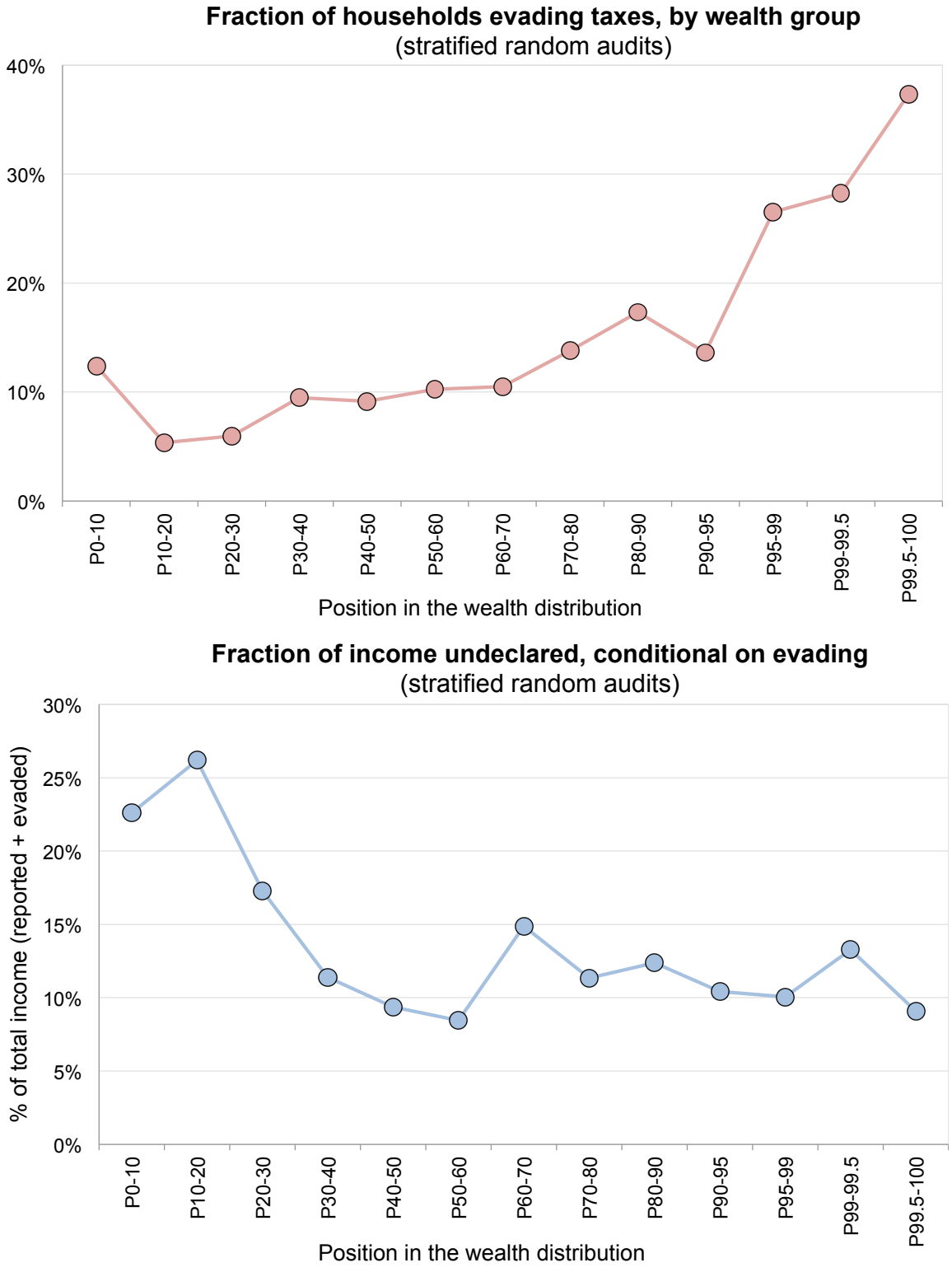
Notes: The top panel shows the fraction of households in Norway and Sweden who are identified in the Panama Papers as beneficial owners of shell companies created by Mossack Fonseca, by bins of 2006 wealth. The bottom panel pools the HSBC and Panama Papers samples. Both panels pool Norway and Sweden (hence the wealth thresholds are not exactly the same as in Figure 3 that pools Norway, Sweden and Denmark). Source: Appendix Tables F.1 and G.2.

Figure 5: The distribution of offshore wealth and offshore tax evasion



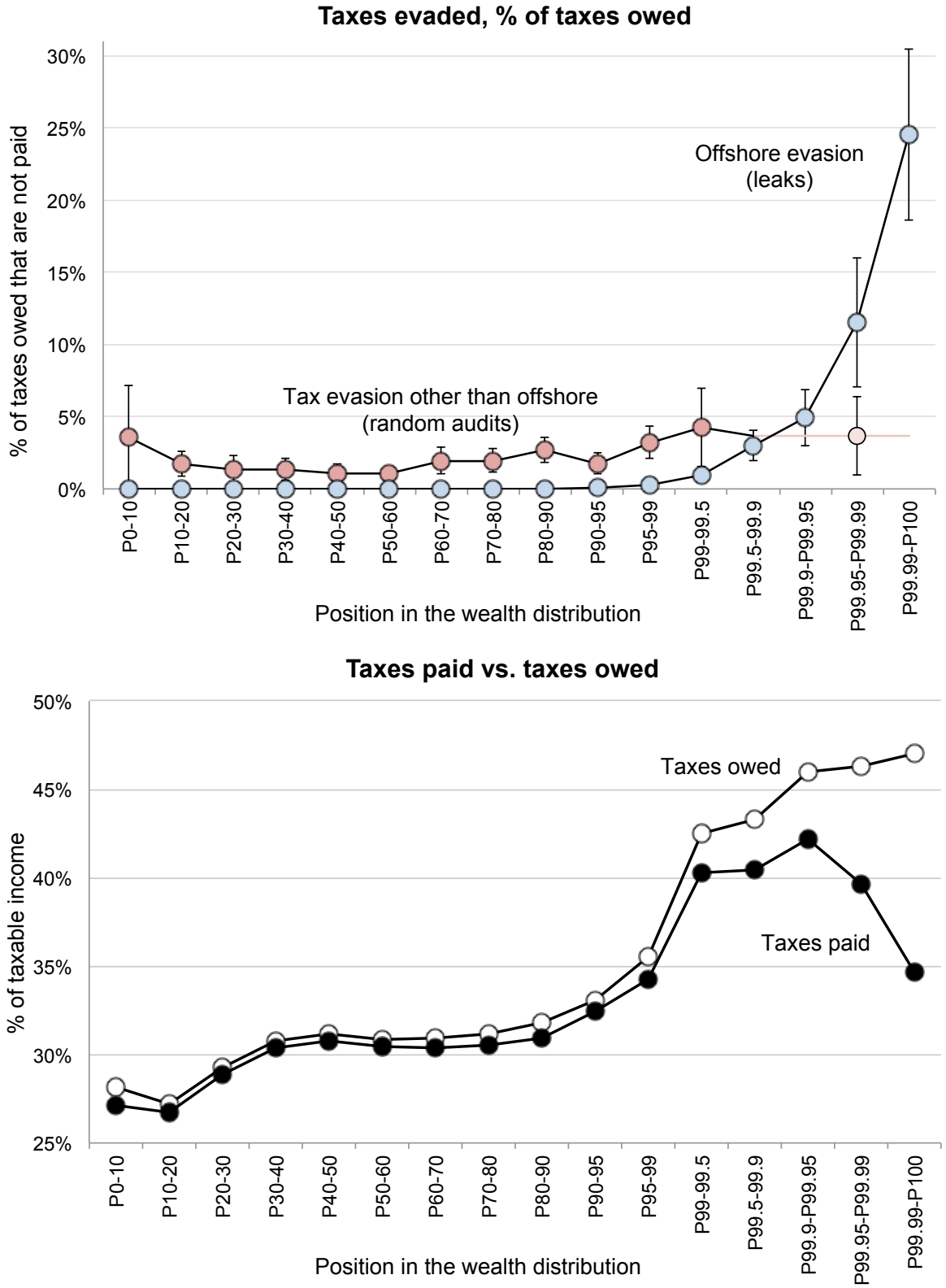
Notes: The top panel shows the distribution of wealth in Scandinavia (Norway, Sweden, Denmark) excluding offshore wealth, and the distribution of wealth held at HSBC and disclosed by amnesty participants. The bottom panel distributes the macro stock of offshore across wealth groups and computes the implied amount of taxes evaded. See text for a description of the benchmark, higher, and lower-bound scenarios. 95% confidence intervals based on bootstrapped standard errors. Source: Appendix Tables A.2, J.1, J.3, J.3b and J.3c.

Figure 6: Tax evasion detected in random audits



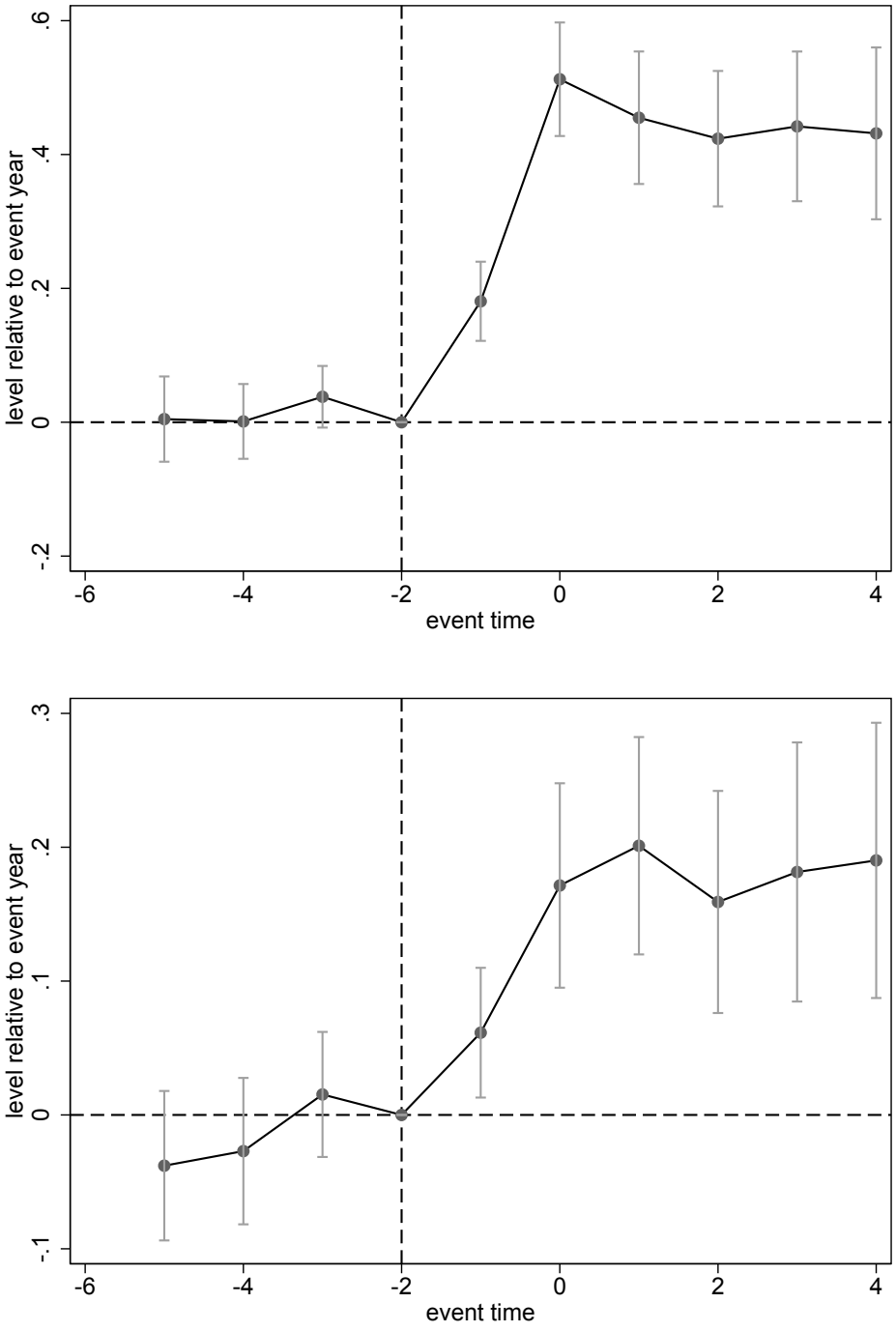
Notes: The top panel shows the probability to be found evading taxes in SKAT's random audits, by wealth groups. Tax evasion includes all mistakes found by the examiner, whether deemed deliberate or involuntary. The bottom panel shows the ratio of income undeclared to true income, conditional on evading taxes. Source: Appendix H.3.

Figure 7: Total tax evasion and its effect on effective tax rates



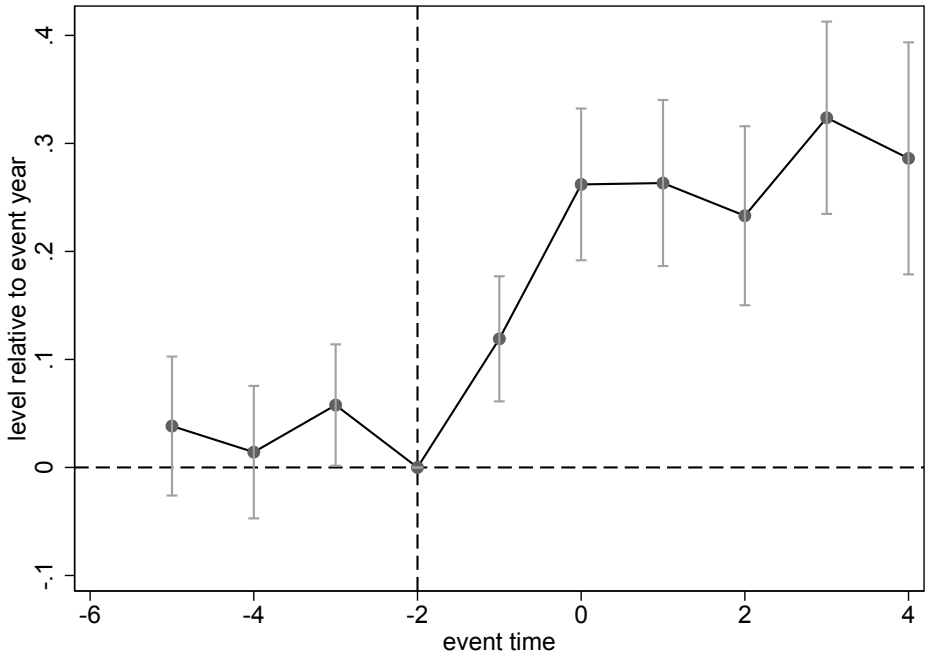
Notes: The top panel shows the fraction of taxes owed which are evaded as detected in SKAT's random audits. The last dot shows the average for P99.5–100. For comparison, we report our benchmark estimate of taxes evaded offshore from Figure 5. The bottom panel shows average tax rates across the wealth distribution, including vs. excluding evaded taxes and income. Taxes include individual income taxes, wealth taxes (in Norway and Sweden), and payroll taxes, at all levels of governments. Source: Appendix Tables H.4 and J.6.

Figure 8: The impact of using a tax amnesty on reported wealth & income



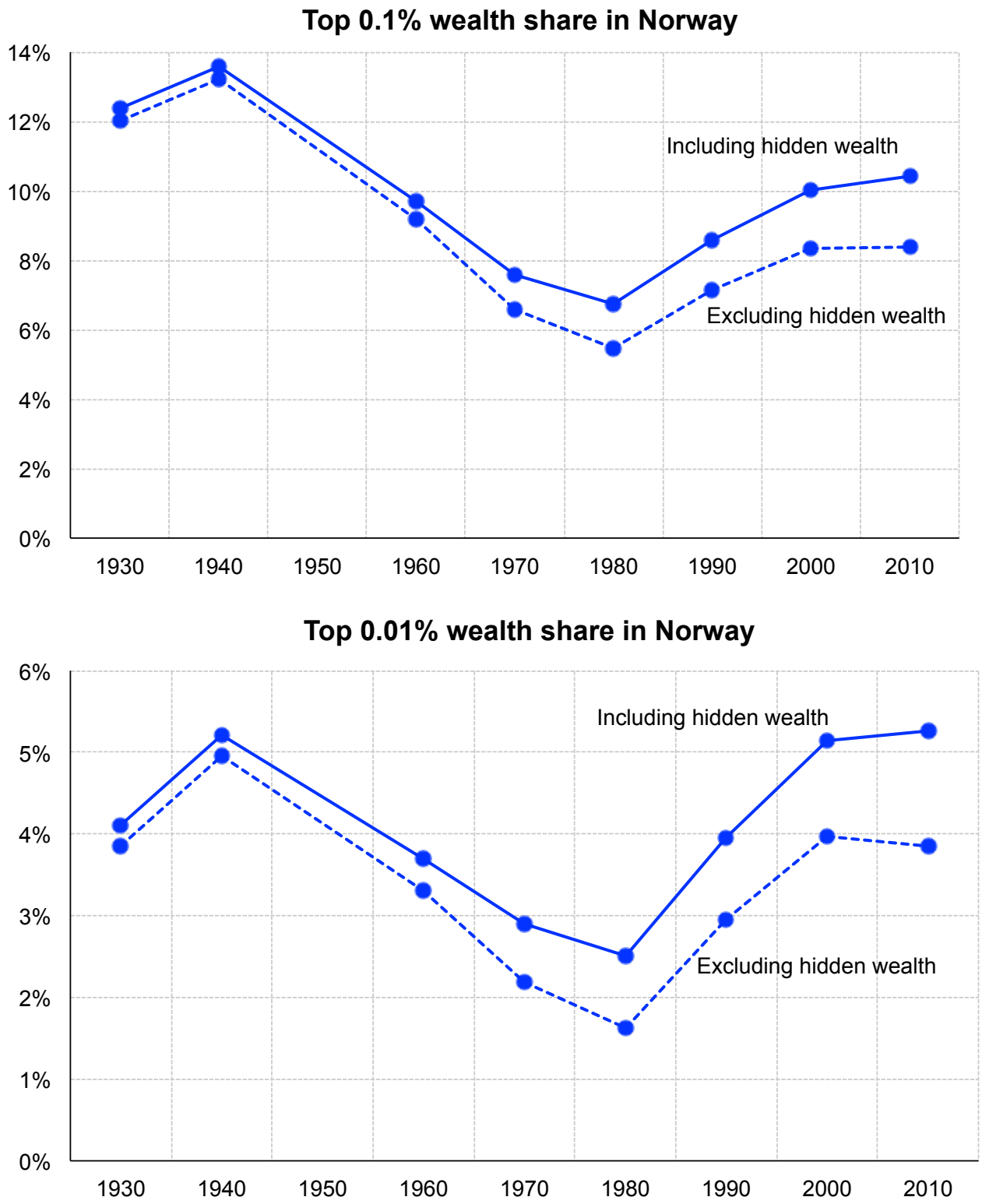
Notes: Panel A shows the results from an event-study regression where the event is voluntary disclosure of hidden wealth and the outcome is taxable wealth as claimed by the tax payer before any corrections are made by the tax authorities. The outcome is regressed on individual fixed effects, year fixed effects, even-time dummies indicating the year relative to disclosure and non-parametric controls for 2007 wealth (deciles of disclosers' wealth at market value), income (deciles of disclosers' income), and age (6 age groups) interacted with time. The omitted time category is t - 2 (two years before disclosure). The sample period is 2002-2013. Standard errors are clustered at the individual-level. Panels B shows results from an analogous regression where the outcome is claimed income (including capital gains). Source: Authors' computations.

Figure 9: The impact of using a tax amnesty on taxes paid



Notes: The figure shows the results from an event-study regression where the event is voluntary disclosure of hidden wealth and the outcome is total tax liabilities (i.e. income and wealth taxes at all levels of government) as claimed by the tax payer before any corrections are made by the tax authorities. The outcome is regressed on individual fixed effects, year fixed effects, even-time dummies indicating the year relative to disclosure and non-parametric controls for 2007 wealth (deciles of disclosers' wealth at market value), income (deciles of disclosers' income), and age (6 age groups) interacted with time. The omitted time category is t - 2 (two years before disclosure). The sample period is 2002-2013. Standard errors are clustered at the individual-level. Source: Authors' computations.

Figure 10: Top wealth share in Norway including hidden wealth



Notes: This graph compares the top 0.1% wealth share (top panel) and top 0.01% wealth share as estimated from uncorrected tax data vs. corrected by including offshore wealth. Source: Appendix Table B.2 and B.4.