Tax Evasion and Inequality*

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Abstract

This paper estimates the size and distribution of tax evasion. We combine random audits, tax amnesties, and leaks from offshore financial institutions matched to wealth records in Scandinavia. Tax evasion rises sharply with wealth: 3% of personal taxes are evaded on average, versus 25%–30% in the top 0.01% of the wealth distribution. A model of the supply of evasion services can explain this gradient. Taking tax evasion into account increases inequality substantially. After using tax amnesties, evaders do not seem to increase legal tax avoidance, suggesting that fighting evasion can allow governments to collect more taxes from the 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 the multiplication of 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 both economists and policy-makers. 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 (see Roine and Waldenström, 2015, for a recent survey). Tax returns are the best available data source to study the top-end of the distribution, because they do not, contrary to surveys, suffer from sampling errors—everybody above a certain income level has to file a return. But they raise 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, 2017). Last, knowing how tax evasion is distributed would help 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 amount of unreported income and unpaid taxes (e.g., IRS, 2016), and academics have fruitfully used them to gain 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 one 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 make it possible to study tax evasion by

very rich individuals. These data come from recent, massive leaks from offshore financial institutions—HSBC Switzerland ("Swiss Leaks") and Mossack Fonseca (the "Panama Papers")—and tax amnesties conducted in the aftermath of the financial crisis of 2008–2009. Thanks to a cooperation with Scandinavian administrations, we were able to analyze the leaked and amnesty micro-data matched to population-wide administrative income and wealth records in Norway, Sweden, and Denmark. We combine these data with random audits to estimate the size and distribution of total tax evasion. While random audits show that most of the population in advanced economies does not evade much tax—because most of its income derives from wages and pensions, which are automatically reported to the tax authorities—leaks and amnesty data show pervasive tax evasion at the very top. Overall, tax evasion turns out to rise sharply with wealth. The top 0.01% of the Scandinavian wealth distribution—a group that includes households with more than $45 million in net wealth—evades 25%–30% of its personal 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 five key strengths for our study. 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 player in the offshore wealth management industry. Third, a body of evidence suggests that HSBC was representative of this industry as a whole; there is no indication that it was the "go-to" place for Scandinavians to hide their wealth, nor that it catered to especially wealthy individuals. Fourth, 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. Fifth, 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 the dividends, interest and capital gains earned on their account were not evading; those who did not were. In practice, the tax authorities found that about 90%–95% of the individuals on the HSBC list were evading taxes.

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 law firm Mossack Fonseca. Just like for HSBC, this leak is valuable as it can be seen as a random

event that 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, and the investigations conducted by the tax authorities to determine whether these shell companies were used to evade taxes are still ongoing.

We also analyze a large sample of Norwegian and Swedish households who voluntarily disclosed previously hidden wealth in the context of a tax amnesty. Many governments throughout the world resort to tax amnesties to encourage tax evaders to declare unreported assets. In the United States for example, beginning in 2009 the IRS has established a series of voluntary disclosure programs under which cooperating tax evaders pay reduced penalties and can avoid criminal sanctions (Johannesen et al., 2017). But one difficulty with amnesty data—and presumably the reason why they have not been used much so far to study the distribution of tax evasion—is the sample selection problem: richer (or poorer) tax evaders may be more likely to choose to participate in a tax amnesty than other tax evaders. By contrasting the amnesty and random leak data we have access to, we can directly test for such self-selection. We find that it is quantitatively small; if anything, wealthier tax evaders seem to be slightly less likely to participate in an amnesty.

The leaked and amnesty data all paint the same robust picture: the probability of hiding assets offshore rises sharply and significantly with wealth, including within the very top groups of the wealth distribution. Conditional on hiding assets, the fraction of one's true wealth hidden abroad is high (around 40%) and does not vary with wealth. As a result, the wealth in tax havens turns out to be extremely concentrated: the top 0.01% of the wealth 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 about 25% of its tax liability by concealing assets and investment income abroad. This estimate only takes into account the wealth held offshore that evades taxes; it excludes properly declared offshore assets: throughout the article, we maintain a clear distinction between legal tax avoidance and illegal evasion. When we add the tax evasion detected in random audits, total evasion in the top 0.01% reaches 25%–30%, versus 3% on average in the population. Our result that evasion at the top is much higher than average is robust to a wide range of robustness tests.

Do our findings apply to other countries? We certainly do not claim that the pattern of

evasion by wealth group found in Scandinavia holds everywhere as a universal law. But there is no strong reason why Scandinavian countries should fundamentally differ from other rich countries. The most developed economies are, like Norway, Sweden, and Denmark, likely to have low average levels of evasion, because most economic activity takes place in the corporate and public sectors, where third-party reporting strongly limits tax evasion. There is also nothing unique to Scandinavia that could explain the high evasion rates we find at the top. Residents of all developed countries are typically taxable on their worldwide income. And although Scandinavian countries are high-tax in an international perspective, this owes more to their high value-added and payroll taxes than to high rates on personal capital incomes, which are in fact taxed at flat, relatively low rates in Norway and Sweden (Kleven, 2014). In our view, Scandinavian economies are an interesting laboratory, because they rank among the countries with the strongest respect for the rule of law (Kauffmann and Kraay, 2017) and highest "tax morale" (Luttmer and Singhal, 2014), suggesting that evasion among the wealthy may be even higher elsewhere. 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 audit, amnesty, and leaked data 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), which can be seen as the demand 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 Scandinavian 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 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 is inequality, the lower the number of tax evaders. 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 reported top wealth shares exist. Because offshore wealth appears to be extremely concentrated, taking it into account lifts top wealth shares significantly. It increases the wealth reported by the top 0.01%—the wealthiest 300 Norwegian households—by more than 25%. 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 (Zucman, 2014).

The rest of this paper proceeds as follows. In Section 2 we relate our work to the literature. Section 3 presents the HSBC, Panama Papers, and amnesty data, and Section 4 analyzes them. In Section 5 we combine these micro-data with macro estimates of the stock of wealth in tax havens to estimate the size and distribution of offshore evasion. Section 6 constructs distributional tax gaps taking into account offshore evasion and all other forms of evasion detected in random audits. Section 7 presents our supply-side model of tax evasion, and Section 8 our results on the interplay between tax avoidance and evasion. We discuss the implications of our results for long-run trends in inequality in Section 9, and conclude in Section 10. This paper is supplemented by an Online Appendix.[1]

2 Related Literature

2.1 Literature on 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

[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.

United States.[2] 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. For example, Kleven et al. (2011) find that 44.9% of Danish self-employed evade taxes.[3] 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.[4]

Although a key data source, random audits face 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.[5] In doing so, it considers in effect that detected and undetected forms of tax evasion are similarly distributed across the income spectrum. 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 generally 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

[2]In addition to random audits, the literature also uses a variety of methods to detect traces of tax evasion in micro or macro data; see Slemrod and Weber (2012) and Slemrod (2007, 2017) for surveys.

[3]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.

[4]Nygård, Slemrod and Thoresen (2017) study the distributional implications of sales tax evasion in Norway.

[5]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).

the world's providers of offshore services.[6] In addition, the sample sizes in random audits are usually too small to analyze with precision tax evasion in top wealth groups.[7]

Our main contribution is that we are able to document tax evasion across the spectrum all the way up to the very top—including households with more than $50 million in net wealth, whose behavior could not be studied until now. 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. Another advantage of our setting is that Scandinavian administrations maintain high-quality population-wide datasets on reported wealth, which allows us to study how evasion varies with wealth. This is in contrast to the previous literature which focuses on how evasion varies with taxable income—with the exception of Artavanis et al. (2015) who analyze how tax evasion varies across quintiles of wealth (proxied by real estate values) in Greece. 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 when ranking people by wealth.

2.2 Literature on the 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.[8]

[6] As a matter of fact, 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 the cost basis on stock investments was not reported to the IRS 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).

[7] 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 find any such study. In the Danish random audit data used by Kleven et al. (2011) and exploited in Section 6 below, 59 taxpayers in the top 0.1% were audited and only 7 in the top 0.01%, see Appendix Table H2.

[8] 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 share series are collected in the World Wealth and Income Database, `http://wid.world` (Alvaredo et al., 2017).

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 over the last thirty years, but more so in the Anglo-Saxon world than in Continental Europe and Japan. Many of our current attempts to understand inequality take these 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.[9] 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. The problem is discussed in the literature (e.g., Atkinson, Piketty, Saez, 2011, pp. 36–40), but until recently there was little data that would allow to systematically quantify it. Zucman (2013) estimates that 8% of the world's financial wealth is held in tax havens globally; a similar estimate is obtained by Pellegrini et al. (2016). In the absence of micro data on who owns the wealth hidden offshore, however, 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.[10]

A wave of recent studies attempts to compute more comprehensive inequality statistics than in the top shares literature by distributing all of the national income recorded in the national accounts; see, e.g., Piketty, Saez and Zucman (2018) and Garbinti, Goupille-Lebret and Piketty (2017). For this purpose, one needs to distribute the amount of income which evades taxes and is explicitly factored into national income.[11] But there is no consensus on how to do this allocation

[9] 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. Alstadsæter et al. (2016) show that business income reported on individual income tax returns is responsive to tax changes.

[10] 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, 2009) is the only attempt to focus 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. The share of wealth owned by the top one percent rises from about 20 percent in the 2000s to a range of 25–30 percent depending on the methodology.

[11] The national accounts include some but not all forms of misreported taxable income. In the United States, national income includes an estimated $538 billion in unreported non-corporate business profits in 2013, and $80 billion in unreported wages, but it excludes unreported income earned offshore (Zucman, 2013). The currently

(Auten and Splinter, 2017). Our paper contributes to this area of research by providing evidence that tax evasion is likely to be more concentrated than what random audit data suggest—and that accounting for it accurately is likely to increase inequality. Looking forward, our goal is to correct global inequality statistics in a systematic way so as to better account for the true wealth of the rich.

3 Micro-Data on Households With Assets in Tax Havens

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 the tax evasion done through offshore intermediaries. Third, we add information about other forms of tax evasion, using random audits. We start in this Section by describing the samples of households with assets in tax havens we have access to.

3.1 HSBC Switzerland Leak

The first micro-dataset 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 complete internal records of this Swiss bank. Falciani turned the data over to the French government in 2008, who shared it with a number of foreign administrations when Christine Lagarde was Finance Minister in France (thus the "Falciani list" became known as the "Lagarde list"). The leaked files are not publicly available, but thanks to a cooperation with Scandinavian authorities, we were able to analyze the full portion of the Falciani/Lagarde list matched by the Scandinavian authorities to individual tax returns and administrative income and wealth data. From the complete set of leaked files, the authorities attempted to match all accounts potentially connected to Scandinavia (i.e., whose owner, controlling attorney, or other related party had an address in Scandinavia or Scandinavian nationality). They succeeded in about 90% of the cases, and we have access to all matched records.[12]

available distributional national accounts of Piketty, Saez, and Zucman (2018) match U.S. national income, hence do not take into account offshore tax evasion either. Looking forward, a comprehensive treatment of tax evasion would involve revising national income so as to account for missing offshore income.

[12]Some of the unmatched accounts could belong to tax evaders (e.g., accounts owned by shell companies with Scandinavian attorneys, but 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 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. This is what made it possible for the tax authorities to link the accounts to the tax returns of their owners.

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 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.[13] 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.[14]

The available evidence suggests that HSBC was representative of the Swiss banking industry. Importantly, there is no evidence that it was the "go-to" place for Scandinavians to park their wealth. A country-by-country breakdown of the wealth managed by HSBC Switzerland in 2007 is published by the International Consortium of Investigative Journalists (ICIJ), who obtained a copy of the complete set of files leaked by Falciani. An annual country-by-country breakdown of the amount of offshore wealth in all Swiss banks is published by the Swiss central bank. Figure 2

the wealthiest tax evaders, we under-estimate the concentration of tax evasion. Online Appendix E provides detailed background information about HSBC Switzerland, the leak, and the data we got access to in his research.

[13]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).

[14]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 in Section 5 when we try to estimate the size and distribution of total offshore tax evasion (i.e., at HSBC and other offshore banks).

compares the two distributions; they look similar. Scandinavian residents, in particular, own in total about 1% of the wealth held at HSBC and 1% of all the wealth held in all Swiss banks.[15] Moreover, we have not found evidence that HSBC was catering to very wealthy clients more than its peers. In the years before the leak it was in fact 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. All developed countries tax residents on their worldwide income. Owning offshore accounts is legal, as long as any interest, dividend, or capital gain earned is duly declared by the account's owner on his individual income tax return. Moreover, offshore accounts must typically be 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, after detailed investigations, found that 90% to 95% of all HSBC account-holders had failed to report the income earned on their account (and the wealth held there in the case of Norway, where a wealth tax exists) and were thus evading taxes.[16] 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) who obtain a similar estimate.

We construct our working sample of HSBC tax evaders as follows. Starting with all Scandinavians linked by the tax authorities to an HSBC account, we exclude taxpayers who claimed

[15]Some countries are slightly over-represented in the HSBC leak, 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 (who started off as a bodyguard for the late Venezuelan President Hugo Chávez).

[16]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 constraints. In particular, the nature of the evidence (a leaked file) raises legal issues and is generally insufficient to prove in court the existence of a hidden account. To circumvent this issue, tax authorities can ask for information from the Swiss tax authority and to HSBC. We know that in Denmark, in many instances neither the taxpayers nor the Swiss authorities cooperated, forcing the tax authority to drop cases. Note that it is optimal for the tax authority to focus its resources on 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 and the income it generated were declared on individual income tax returns (and wealth tax returns when a wealth tax exists). This is similar to what is done in random audit studies where non-compliance is estimated based on an examiner's assessment—not a court decision.

to be non-residents, hence not taxable in Scandinavia.[17] Some accounts are linked to several members of a single household; we remove any double-counting by conducting all our analysis at the household level. Last, we exclude the Norwegians who properly declared their accounts (we were not able to remove the few, around 20–30, properly declared Danish and Swedish accounts[18]). This leaves us with a sample of 520 households who owned at least one account at HSBC Switzerland, declared themselves as taxable in Scandinavia in 2006, could be matched to a tax return (and, for the Norwegian portion of the list, did not declare their account).

3.2 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 law firm Mossack Fonseca.[19] 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 is a major provider of offshore services, our working sample 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 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 corroborating information, as we shall see.

[17] Note that some of them might in fact 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 under-estimate tax evasion at the top.

[18] This is unlikely to bias our findings significantly, since we know that close to 95% of the matched Danish and Norwegian accounts were undeclared. If anything, the inclusion of the duly reported Danish and Swedish accounts may lead us to slightly under-estimate the actual concentration of hidden wealth, as 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 small size of the sample of declared accounts, however, does not give us enough power to reject the hypothesis that duly reported and undeclared accounts are distributed similarly. To simplify the exposition, in the rest of the analysis we consider that all matched Swedish and Danish households evade taxes.

[19] 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.

3.3 Tax Amnesty Participants

Our third dataset 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 2006.[20] 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.[21]

A key advantage of the amnesty dataset is the large sample size: 1,422 households in Norway and 6,811 in Sweden. Another strength is that we know that tax evasion is, by definition, involved. 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 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.

4 Patterns of Tax Evasion in Leaked and Amnesty Data

In this Section we study how the probability to have a hidden HSBC account, to own a shell company created by Mossack Fonseca, or to disclose hidden assets in a tax amnesty, varies with wealth. Because our three samples differ in size, these probabilities do not have the same

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

[21] In Norway we have access to details on the origin of the wealth disclosed: half was held in Switzerland and the other half in the other tax havens; a tiny amount was held in Norway itself.

absolute level, but in all cases they rise sharply with wealth. We start by describing how we rank households in the wealth distribution, before discussing the results.

4.1 How We Rank Tax Evaders 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 methodological principles and data sources.

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. Although the national accounts are unlikely to be perfectly accurate, this method enables us to estimate wealth levels and shares for each Scandinavian country that are directly comparable, and comparable to those estimated in the United States by Saez and Zucman (2016) and in a growing number of countries where a similar methodology is followed.[22]

One advantage of the Scandinavian context is that it is possible there to compute a particularly reliable estimate of the wealth distribution, for one simple reason. While in most countries one has to rely on indirect methods to estimate wealth inequality, in Scandinavia we directly observe the market value of most wealth components for the entire population. Scandinavian administrations collect individual-level wealth data from a large number of third parties—banks, mutual funds, central securities depositories, insurance companies, etc.—which report on the end-of-year market value of the wealth they manage on behalf of their clients. Non-financial assets are recorded using land and real estate registries, and marked to market using observed transaction prices. To capture 100% of the macro amount of household wealth, we supplement these administrative micro-data as follows. First, we account for funded pension wealth, which was not reported at the micro-level in 2007.[23] Second, we impute non-corporate business assets and unlisted equities, which are not consistently recorded in the three countries, by following a common methodology. Namely, we compute non-corporate business assets by capitalizing

[22] See the series published on the World Wealth and Income Database at `http://WID.world` (Alvaredo et al., 2017).

[23] Pension wealth has been reported at the individual level in Denmark data since 2012; see Jakobsen et al. (2018). In 2012 we observe that about 40% of Danish pension wealth belongs to wage-earners and 60% to retirees. We assume a similar breakdown in the other Scandinavian countries; we then allocate the pension wealth of workers proportionally to wage income (winsorized at the 99th percentile) and the pension wealth of retirees proportionally to the pension benefits paid out of pension funds. Saez and Zucman (2016) use the same imputation procedure in the United States.

business income (the capitalization rate is equal to the market value of business assets divided by the flow of business income reported on individual income tax returns); we similarly impute unlisted equities by capitalizing dividend income. The imputations introduce some 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.

As shown by Appendix Figure A.16, wealth is similarly distributed in Norway, Sweden, and Denmark. 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%. These estimates are the best we can form on the basis of the information available to the tax and statistical authorities; they disregard hidden assets (whose impact we investigate in Section 9 below). Taxable income is also similarly distributed, and the 3 countries share many macro features (in terms of average income and wealth, wealth composition, etc.; see Appendix Figure A.1 to A.17 for extensive comparisons). Thus for our main analysis, 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$,[24] and interpolate the distribution of wealth within each bin using generalized Pareto interpolation methods (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 virtually identical to the one that would exist if the population-wide files of the three countries could be appended (which is not currently possible). Of course, Norway, Sweden, and Denmark differ in some dimensions; e.g., Norway has less private wealth (maybe because it has more public wealth). But the gradients in the probability to hide assets are similar within each country; pooling them together simply allows us to reduce standard errors.

4.2 Tax Evasion in Leaks

The HSBC leak, the Panama Papers, and the amnesty data all paint the same robust picture: the probability of hiding assets offshore rises sharply, continuously, and significantly with wealth,

[24]In the context of our study that focuses on top-end wealth, using market exchange rates seems preferable to using PPP exchange rates, because rich 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 but 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, $44.5 million is the threshold to be part of the top 0.01% of the Scandinavian wealth distribution in 2006, using 2006 prices and exchange rates to convert Scandinavian currencies into US$).

including within the very top groups of the wealth distribution.

Starting with HSBC, the top panel of Figure 3 shows that the fraction of Scandinavians who hide asset in that Swiss bank is negligible up to the top 1% threshold, and then rises to almost 1% for the 0.01% richest households, 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 is notable. The gradient is notable too: households in the top 0.01% 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.[25] As shown by Appendix Figures E.4 and E.4b, the gradients look the same in the three Scandinavian countries separately.

A remark is in order here. For the purpose of ranking HSBC customers in the wealth distribution, we added the hidden HSBC wealth to non-hidden wealth.[26] This mechanically moves HSBC evaders up the wealth ladder. However, this re-ranking does not drive the gradient 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 similar.[27]

[25] 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%. 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.

[26] 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 owner remains observable in the files leaked by Falciani, but not the account details. As shown in Appendix Figure E.1, excluding accounts with no known values does not change the gradient reported in the top panel of Figure 3.

[27] Including hidden wealth when ranking households seems preferable, because doing so delivers the best estimate of the amount of wealth the HBSC evaders actually own given observable data. Johns and Slemrod (2010) follow a similar procedure in the United States. 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% and the gradient in the probability to hide assets abroad would be even steeper than implied by the HSBC data shown on Figure 3. 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 multiple or just one bank.

Households who evaded taxes through HSBC hid a strikingly 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 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. The two techniques are often combined, but the wealthiest tax evaders might be more likely to combine offshore accounts with shell companies, while less wealthy tax evaders may be relatively more likely to own offshore accounts in their own names.

4.3 Tax Evasion Among Amnesty Participants

Turning to amnesty participants, Figure 5 shows that the probability to disclose previously hidden offshore wealth also rises sharply with wealth. There are three additional findings. First, and most importantly, the amnesty data reveal widespread evasion among the rich. Strikingly, 14% of all top 0.01% Norwegian and Swedish households have disclosed hidden assets in a tax amnesty between 2009 and 2015. Thus, we know that at least 14% of Scandinavians' richest households were evading taxes on the eve of the financial crisis of 2008-09.

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 participate in an amnesty. 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. Overall, however, the self-selection is not massive. As

can be seen by comparing the top panel of Figure 3 to Figure 5, the gradients in the probability to hide assets at HSBC vs. report hidden wealth in an amnesty are remarkably similar. As a result, our key estimates would be almost unchanged should we only use the amnesty data and disregard the leaked data altogether. This finding suggests that amnesty data—that are widely available in many tax authorities throughout the world—could be leveraged to study tax evasion and its distribution more extensively than they have been so far.[28]

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 notion that the most aggressive tax evaders are 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 greater than than of the next 0.05%, and so on.

5 The Size and Distribution of Offshore Tax Evasion

The samples analyzed above are drawn from the universe of individuals who use tax havens. In this Section we combine these samples with macro statistics on the stock of wealth held in tax havens to estimate how much tax is evaded through offshore intermediaries by each group of the wealth distribution. We proceed in four steps. First, we estimate the total amount of wealth held by Scandinavians in tax havens; second, we assume this wealth is distributed in the same was as in the micro-samples we have access to; third, we estimate what fraction of offshore wealth is hidden vs. properly declared; last we compute the extra amount of taxes that would be paid if all this wealth and the income it generates were duly declared to tax authorities. We discuss each step in turn.

5.1 The Macro Stock of Offshore Wealth

The available evidence suggests that Scandinavians held in total around 1.6% of their wealth (the equivalent of 4.2% of their GDP) in tax havens in 2007. This estimate includes household wealth only, whether hidden or duly reported to tax authorities; it disregards corporate assets,

[28]Data from U.S. state amnesties were analyzed by Mikesell (1986), Fisher et al. (1989), and Crane and Nourzad (1990). These studies did not address the effect of tax evasion on U.S. income or wealth inequality.

such as assets owned by mutual funds operating in Luxembourg. As shown by Alstadsæter, Johannesen and Zucman (2017, Figure 5), Scandinavian countries appear to have one of the world's smallest stock of household offshore assets: significantly less than the United States (the equivalent of 7.3% of GDP), Continental European countries like France, Germany, and the U.K. (around 16% of GDP), or Greece (36% of GDP). 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 results using two different methodologies, presented in Table 2.

Bottom-up estimate. 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 billion in wealth in 2007. Based on a systematic investigation of the international statistics and the anomalies therein, Zucman (2013) estimates that households held $5.6 trillion 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. This method has two potential drawbacks. First, 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, it might under-estimate the total amont of offshore assets owned by Scandinavians. Second, if HSBC was the "go-to" place for Scandinavians to park their wealth, the 47.5 multiplicative factor we use would be too high.

Top-down estimate. Our second strategy is a top-down approach that does not rely on the HSBC data. It is this top-down approach that we retain for our benchmark estimates. Starting from the $5.6 trillion in global offshore wealth, we allocate this total across countries by using macro statistics disclosed by tax havens on who owns deposits in their banks. The Swiss central bank has published a breakdown of the bank deposits owned in Switzerland by country of the owner 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. 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 countries, and provide a comprehensive discussion of the data and methodology involved. By this estimate, Scandinavians owned 1.6% of their wealth in tax havens in 2007.

It is notable that our two methods deliver consistent results, despite the fact that they rely on independent data. This result confirms that Scandinavians did not have an idiosyncratic preference for HSBC. The amnesty data also clearly show that the wealth hidden at HSBC was only a small fraction of that concealed in total by Scandinavians. Among the 8,233 Norwegian and Swedish households who disclosed previously hidden assets in a tax amnesty over the 2007–2015 period, only about 50 disclosed an HSBC Switzerland account. More than 99% of amnesty participants hid assets in other offshore banks.[29]

If anything, our estimate of Scandinavians' offshore wealth is likely to be conservative. Both our bottom-up and top-down approaches rely on Zucman's (2013) estimate that $5.6 trillion was held by households 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 estimate 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.

5.2 The Distribution of Offshore Wealth

The second step involves distributing the macro amount of offshore wealth owned by Scandinavians across wealth groups. To do this allocation, we assume that Scandinavia's offshore wealth is distributed like in the HSBC and the amnesty samples. That is, we assume that 77% of it belongs to the top 0.1% richest households, 52% belongs to the 0.01%, etc., which are the fractions observed in these two micro datasets (top panel of Figure 6).

It is striking to note that offshore wealth is very similarly distributed in the HSBC and amnesty samples. All available evidence suggests that in 2007, the offshore wealth of Scandinavians was extremely concentrated. Admittedly, Swiss banks had hundreds of thousands of customers at the time of the Falciani leak, but the wealth held by bottom 99.9% evaders does

[29]Because the wealth disclosed by amnesty participants tends to be smaller than that held by tax evaders at HSBC, in terms of amounts, HSBC accounts for a bit more than 1% of the total assets disclosed during the amnesty (about 1.2%). Note that 1.2% is less than what we estimate was the share of Scandinavians' offshore wealth held at HSBC (2.0%). This suggests that we may under-estimate the total offshore wealth of Scandinavians. Another interpretation is that HSBC customers were less likely to self-select into the amnesty. Nothing, however, prevented them from using it, since Scandinavian tax authorities only received the HSBC list in 2015, following the "Swiss leaks" scandal—hence before 2015, HSBC evaders had not been prosecuted for hiding assets in that bank and were free to use the amnesty.

not account for much compared to that owned by the top 0.1%. While the top 0.01% owns only about 5% of all non-hidden wealth, it owns about half of all hidden wealth. 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 small and not statistically significant. To allocate Scandinavia's macro stock of offshore wealth, we thus simply take the arithmetic average of the HSBC and amnesty distributions (e.g., we assume that 51.6% of Scandinavia's offshore wealth belongs to the top 0.01%, which is the arithmetic average of 55.3%—observed in the HSBC sample—and 47.8%—observed in the amnesty sample; see Appendix Table J.1).

5.3 Taxes Evaded on Offshore Assets

The last step involves computing how much tax each group of the wealth distribution evades offshore.

First, we take into account that not all offshore wealth evades taxes. Consistent with the evidence from the HSBC leak and several other concurring sources (US Senate, 2008, 2014; Roussille, 2015; Johannesen and Zucman, 2014), we assume that 10% of the macro stock of Scandinavians' offshore wealth was duly declared to tax authorities in 2006, and 90% hidden.

Next, 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] We then compute the amount of taxes evaded on the hidden 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 using a detailed tax simulator that allows us to estimate the average marginal tax on capital income and wealth by wealth group in Norway, Sweden, and Denmark.[31] We apply these empirical marginal tax rates to the amounts of income and

[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 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]See Appendix J, in particular Figures J.1 and J.2.

wealth hidden by each wealth group. This procedure is reliable, because there is very little heterogeneity in the marginal tax rates on financial capital faced by individual taxpayers at the top of the distribution, as marginal tax rates in Sweden and Norway are the same for interest, dividends, and capital gains.[32] 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.

5.4 How Offshore Tax Evasion Varies With Wealth

The bottom panel of Figure 6 reports our estimates of how much tax each group of the wealth distribution evades offshore, as a fraction of their true tax liability. We find large rates of evasion at the top of the wealth distribution: in our benchmark scenario, the top 0.01% evades 25% of its true tax liability through tax havens.

Tax evasion is high at the top not because the macro stock of wealth in tax havens is large (indeed, it is small in Scandinavia), but because it is hugely concentrated. As we saw in Section 4, 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). This explains why offshore tax evasion is orders of magnitude higher in the top 0.01% (25% of taxes owed) than in the overall population (a mere 0.6%). A second factor drives the sharp gradient displayed in the bottom panel of Figure 6: at the very top, the vast majority of income derives from wealth. So when a top 0.01% taxpayer hides 40% of her wealth, she hides close to 40% of her income (or even more, if the taxable return on hidden assets is higher than on domestic wealth) and evades 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.[33]

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

[32] In Denmark, share income is taxed at a lower rate, 42% vs. 48% for interest at the top.

[33] To reconcile the estimates of the rates of evasion shown in the bottom panel of Figure 6 with the patterns of evasion in the micro-data studied in Section 4, 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.

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%.[34] 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. In effect, Norway and Sweden offset part of their wealth taxes with flat rates on investment incomes, while other rich countries usually tax at least part of capital income progressively. What makes Scandinavian countries high-tax in an international perspective is not so much their high taxes on financial wealth as their broad-base payroll and value-added taxes (Kleven, 2014), none of which are directly relevant for our purposes.[35]

5.5 Robustness Tests and Sensitivity Analysis

Because our estimates of offshore tax evasion are obtained by transparently combining macro stocks of hidden assets with observed distributions and assumed taxable rates of returns, it is straightforward to asses how changing one, several, or all of our assumptions at the same time affects the results. We consider a large number of robustness tests in the Online Appendix, based on varying the macro stock of Scandinavians' offshore wealth (variants a, b, c, d, e in Appendix Tables J.1, J.2, J.3), the fraction of offshore wealth that is hidden from the tax authorities (Appendix Table J.1), the distribution of offshore assets (cols. 9, 10, and 11 in Appendix Tables J.1, J.2, J.3), and/or the rate of return on hidden wealth (Appendix J.2 and J.4). In all cases, offshore tax evasion turns out to be large at the top—much larger than the evasion detected in

[34] 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.

[35] 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 Scandinavia, see Appendix Figures J.1, J.2, and J.3.

random audits. For all plausible scenarios, it is in a range of 20% to 30%.

In the bottom panel of Figure 6, we consider two extreme scenarios. In the low-end scenario, we assume that Scandinavians own no offshore assets outside of Switzerland. The Swiss central bank publishes direct, official data on the stock of wealth owned by foreigners in its banks, with a country-by-country breakdown.[36] We only include these directly observable assets, and exclude any wealth held by Scandinavians in Luxembourg, Singapore, or any other tax haven, which is less directly observable. This reduces the offshore wealth of Scandinavians by about half. The top 0.01%, however, still evades 12% of its tax bill, which is—as we shall see below—three times higher than the amount of evasion detected in random audits. Note that we know as a fact that Scandinavians hid a sizable amount of wealth in Luxembourg, Jersey, and similar havens in 2006—if only because around half of the wealth disclosed in the Norwegian tax amnesty was held outside of Switzerland. So our low-end scenario is maybe better interpreted as reflecting a world where about half of Scandinavians' global offshore wealth is duly declared to tax authorities. Conversely, we report a high-end scenario, where we assume that Scandinavians own the same fraction of their wealth offshore as the world as a whole. This scenario is informative of how offshore evasion might look like in Continental European countries, where macro stocks of offshore assets are larger than in Scandinavia. Offshore tax evasion for the top 0.01% then rises to 40% of taxes owed.

6 Distributional Tax Gaps

Offshore evasion is just one form of evasion, and it is not too surprising that it is concentrated among the rich. The interesting and non-obvious result of our research is that, at the top, offshore tax evasion alone is much larger than all forms of evasion detected in random audits—the current gold standard in the literature. This suggests that combining different data sources is critical to study tax evasion. In this Section, we contrast and combine offshore tax evasion with the evasion detected in random audits.

6.1 Random Audit Data

The random audit data we use come from the stratified random audits conducted by the Danish Tax Authority (SKAT). The first wave of this program, for the tax year 2006, was studied by Kleven et al. (2011). Here we analyze the three subsequent waves, which were conducted for the tax years 2008, 2010, and 2012. In each wave, SKAT randomly selects a sample of self-employed

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

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 (of which 6,223 are self-employed and the remaining 12,762 are not).[37] Detailed summary statistics are presented in Appendix H.

The Danish random audits are widely considered to be of high quality, because the tax authority can draw on a particularly comprehensive set of information: returns provided by employers, banks, credit card companies, and other financial institutions; supporting documentation requested from 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 SKAT can infer 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, for the following reason. As discussed in Section 2 above, examiners are not well equipped to detect evasion through offshore intermediaries in the context of random audits. In the rare cases when an 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 result of the random audit study, as this would delay the publication of the results for too long.

6.2 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 7, 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

[37] 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.

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 7). 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 in no wealth group does evaded tax exceeds 5% of taxes owed.[38]

In the United States, the IRS estimates that a larger fraction of taxes is evaded, about 11% (Johns and Slemrod, 2001).[39] There are two reasons for this difference. First, the IRS blows up the tax evasion its random audits uncover by a factor of about three, contrary to SKAT which does not correct the results found in its random audit program. As discussed in Section 2 above, the multiplication done by the IRS rests on weak foundations. Second, the self-employment sector—where the bulk of detected tax evasion takes place—accounts for roughly twice as much 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%) and France (6%). In countries such as Greece and Italy, the self-employed generate a higher fraction of output (about 20%-25%); tax evasion is likely to be much higher there than in Denmark. Looking forward, Scandinavia is likely to be more representative of the overall rich world than a country like Greece, since self-employment typically falls as countries develop. The use of cash, which is conducive of evasion and is limited in Scandinavia, is also declining globally (Rogoff, 2016).

The key lesson from random audit studies is that in 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.

[38] 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 (1.28% of audited taxpayers are found deliberately evading taxes, a fraction rising to 5.4% in the top 1%; see 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 (Appendix Figure H.7).

[39] 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%.

6.3 Combining Offshore Evasion with Random Audits

The top panel of Figure 8 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. 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. Overall, a clear gradient in tax evasion by wealth group thus emerges.

One limitation of our estimated distributional tax gap is that it only includes evasion on payroll, personal income, and net wealth taxes. It excludes evasion on the VAT, the corporate tax, real estate taxes, and excise duties. These forms of tax evasion account for the majority of the tax gap estimated by Scandinavian tax authorities (see Skatteverket, 2014, for Sweden), but are harder to allocate across the wealth distribution. We leave to future work the task of producing comprehensive tax gaps including all taxes. Another limitation is that there might be forms of personal tax evasion that neither random audits, nor the leaked and amnesty data we use can capture, hence that our estimates miss. At a modest level, our main finding is that combining random audits, leaks, amnesties, and macroeconomic statistics makes it possible to obtain a more comprehensive picture of tax evasion than was available until now.

Because of tax evasion, the personal tax rate effectively paid by the wealthiest Scandinavians is substantially lower than implied by the tax law. The bottom panel of Figure 8 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 system, and makes it regressive at the top.

7 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 our samples, top 0.01% households are much more likely to hide assets abroad than households in the bottom of the top 1%. A simple model with a fixed cost of

hiding wealth cannot realistically generate this pattern, because it only costs a few hundred dollars to create a shell company (see Findley, Nielson, and Sharman, 2012), and even less to open an offshore bank account.[40] 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.[41] 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: 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

[40] 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. Although both types of households could have felt very confident in the evasion strategy used (i.e., could have felt they had a low probability of being caught), only the very wealthy evaded. The lack of third-party reporting thus does not seem enough to explain the gradient we obtain.

[41] In Appendix K.2, 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 (which supplied the vast majority of cross-border wealth management services until the 1980s, before financial liberalization in the U.K. and the emergence of new offshore centers) historically had a cartel agreement, the Convention IV of the Swiss Bankers Association, which strictly regulated fees; see Zucman (2015, chapter 1).

profitability from being customers—by quoting a prohibitive price above θ.[42] 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:[43]

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

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.[44]

The left-hand side is the marginal revenue of managing more wealth and the right-hand side is the marginal cost (i.e., the 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.*

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

[42] 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).

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

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

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

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). 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.[45] This could lead to a reduction in tax evasion. But 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—has implications for policy-making. Although evasion also falls with penalties in standard demand-side models of tax evasion, increasing penalties for tax evaders has not proved to be a practical way to curb tax cheating. There are limits to the penalties that can be applied to persons conducting such crimes; and if the penalties set by law are too high, judges might require a stronger burden of proof from prosecutors, potentially leading to fewer convictions. Large sanctions against the suppliers of

[45] 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.

tax evasion services may, by contrast, be a more practical way to curb tax evasion—if only because fewer cases need to be investigated. If policy-makers were willing to systematically put out of business the financial institutions found facilitating evasion, then s^* could be reduced dramatically. It is, however, easier to close small banks than systematically important institutions. Since 2009, 80 Swiss banks have admitted helping U.S. persons to evade taxes; 16 others have been under criminal investigation by the Department of Justice. But the U.S. government has been able to shut down only three relatively small institutions (Wegelin, Neue Zürcher Bank, and Bank Frey); 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.[46] 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. It holds true with any well-behaved distribution of wealth. 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.[47] 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

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

[47] 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).

more unequal, offshore banks might choose to serve fewer but wealthier clients. Conversely, when wealth inequality was low in the 1950s and 1960s (following the destructions of World War II, nationalizations in Europe, and a number of other anti-capital policies), Swiss banks may have chosen to serve a broader segment of the population. This could explain why on top of ultra-rich households, we also observe a number of moderately wealthy, old evaders in the HSBC leak and the amnesty data.

Appendix K shows that introducing competition in our model does not affect the comparative statics summarized in Proposition 2,[48] 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 by reducing unit prices for wealth concealment. Supply forces could thus help explain the rise in offshore tax evasion through the 1980s, 1990s, and 2000s.

8 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.

8.1 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 hidden bank accounts in Switzerland. As Appendix Figure G.6 shows, most subsequent disclo-

[48] 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.

sures happened in two waves, in 2009 and 2013-14. The 2009 wave coincides with the G20 tax haven crackdown where tax havens like Switzerland and Luxembourg agreed to provide bank information to foreign tax administrations on request (Johannesen and Zucman 2014). The 2013–2014 wave coincides with the commitment by most tax havens to exchange bank information automatically. The sample we use includes all individuals who disclosed hidden offshore wealth in the amnesty during the 2008–2015 period, whose cases were not dropped by the tax authority, and for whom a tax return with income and wealth information 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 and 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.[49] 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%).

8.2 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

[49]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.

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 estimate the following model:

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

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.[50] 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).

8.3 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 9, 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 effect of the amnesty shows up as soon as $t-1$ because tax evaders using the amnesty in the beginning of year t can account for the disclosed income and assets in the tax return for year $t-1$. The jump is consistent with the evidence discussed in Section 4 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 10, the taxes paid by amnesty participants increase by about 30% right at the time

[50] 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.

they use the amnesty, relative to non-participants. The magnitude of the increase corresponds to what one would mechanically expect given the rise of 20% in taxable income and 50% in taxable wealth, and the marginal tax rates that apply. There is thus no indication that amnesty participants start avoiding more just at the time when they use the amnesty.

Third, and most importantly, income, wealth, and taxes paid remain permanently higher through 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 tax avoidance is limited. This interpretation is supported by Table 4, in which we analyze patterns in tax avoidance around the time of 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 do they emigrate more (col. 8). Along all these dimensions, substitution from evasion towards avoidance is 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 2008-2015 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, to own a holding company, and 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 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 taxable income, taxable wealth, and taxes paid when amnesty participants 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 collections from the very wealthy.[51]

9 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.

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 4.1 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 administrative 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 1980s. Since then, it seems to have rebounded to about 8%. The time evolution of top income shares is similar (Aaberge and Atkinson, 2010).

How does factoring in hidden wealth affect this evolution? In our benchmark scenario we estimate that Norwegians own about 1.9% of their 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 11, including offshore wealth increases the top 0.1% wealth share significantly: from 8.4% to 9.8% on average over the 2000–2009 period. For the top 0.01%—a group that includes about 300 Norwegian households in 2010—reported wealth increases by more than 25% (bottom panel

[51] 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 that the returns they were about to file would be "closely examined". They find that high-income treated taxpayers paid *less* tax relative to the control group, suggesting substitution away from evasion toward legal avoidance.

of Figure 11). That is, these households own more than 20% of their wealth in tax havens.

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 U.S. 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 almost half of the decline in the top 0.1% wealth share observed in tax data since the 1930s. The top 0.01% appears to have now recovered from the decline in wealth concentration caused by World War II and the policy changes of the post-war decades. This finding suggests that the historical decline of European inequality over the last 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 than suggested by tax data.

10 Conclusion

In this paper, we combine micro-data leaked from financial institutions in tax havens with randomized audit, amnesty, 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 and tax amnesties, on the other, imply sizable tax evasion by very rich households, a phenomenon random audits do not capture. Combining leaks, amnesties, and random audits, 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 25%–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 highly concentrated, tax evasion turns out to have important implications for the measurement of inequality. In the case of Norway, accounting for hidden assets increases the wealth of the top 0.01% by more than 25%. 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 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' administrations in 2009. The Panama Papers database is publicly accessible. Other leaks have occurred in recent years from majors providers of offshore financial services. Moreover, tax amnesty data are widely available in many countries, and our results suggest they can yield valuable insight into the distribution of tax evasion. 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.

As a first step in this endeavor, in Alstadsæter, Johannesen and Zucman (2017) we construct estimates of the macro amount of wealth held in tax havens by households of each country in the world, and we investigate the implications of hidden wealth for inequality, assuming that offshore wealth is as concentrated in the other countries as in Scandinavia. We report the results for 6 economies in Figure 12. In an international perspective, Scandinavians own a relatively small fraction of their wealth offshore; the effects of accounting for offshore wealth are therefore larger in the U.K., Spain, and France, where, by our estimates, 30%–40% of all the (hidden plus non-hidden) wealth of the 0.01% richest households is concealed abroad. In the United States, offshore wealth also increases inequality significantly. The effect is more muted than in Europe, because U.S. top wealth shares are very high even disregarding tax havens. Although more research is needed to have fully accurate estimates of the size and distribution of the wealth held in tax havens, these results highlight the importance of looking beyond tax data to study wealth accumulation among the rich in a globalized world.

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

	HSBC				Panama Papers		Amnesty				HSBC + Amnesty	
	[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 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, amnesty participants, and HSBC plus amnesty columns, 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 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	105.0	1.01	*0.49*	*0.32*	*0.20*
In all Swiss banks	2,670	21.5	*12.8*	*4.2*	*4.4*
In all the world's tax havens (benchmark estimate)	5,620	51.0	*28.4*	*14.1*	*8.4*
- Bottom-up estimate	5,620	54.2	*26.2*	*17.3*	*10.7*
B. Wealth held offshore (% of household wealth)					
In all Swiss banks	1.5%	0.7%	*0.9%*	*0.6%*	*0.4%*
In all the world's tax havens (benchmark estimate)	3.3%	1.6%	*1.9%*	*1.9%*	*0.8%*
- Bottom-up estimate	3.3%	1.7%	*1.8%*	*2.4%*	*1.0%*

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 and bottom-up 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: Norwegian tax amnesty participants: 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%

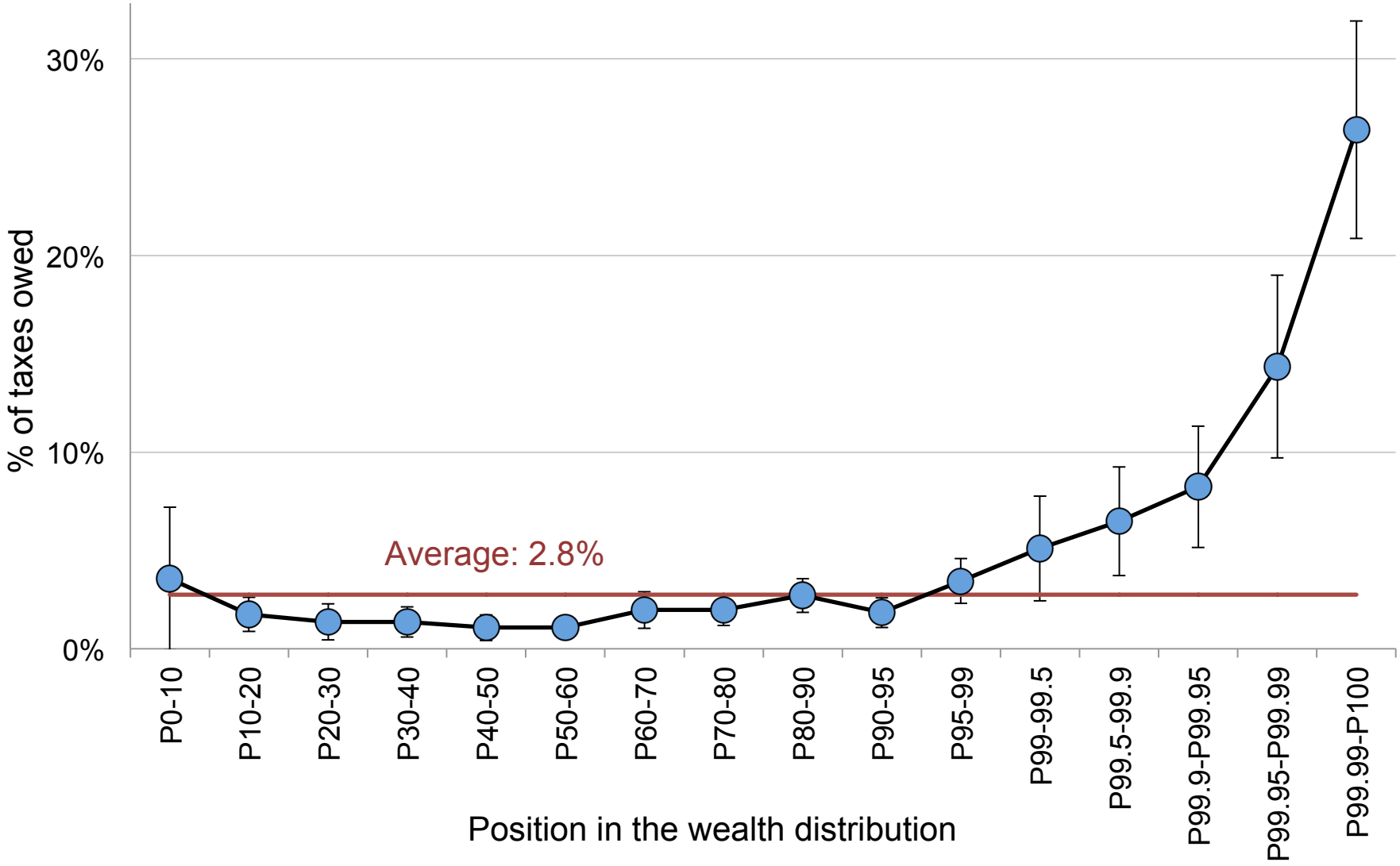
Notes: The Table provides summary statistics for individuals who have used the Norwegian tax amnesty to disclose previously hidden offshore assets and individuals who have not used the amnesty. Amnesty participants whose cases were dropped by the tax authorities are excluded. For computational tractability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

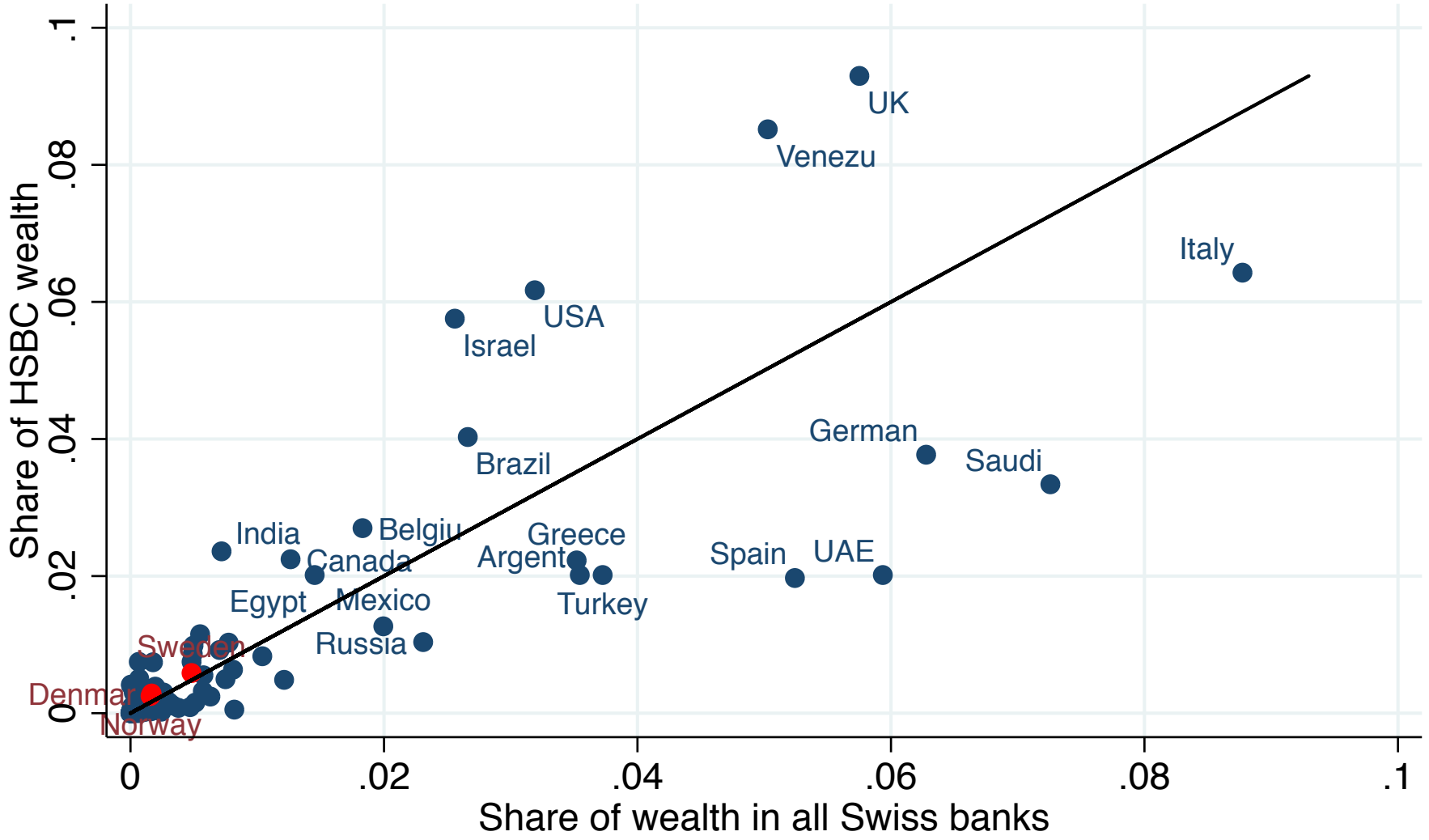
Notes: The Table shows the results from event-study regressions where the event is voluntary disclosure of hidden wealth and the outcomes are: reported taxable wealth (col. 1), reported taxable income (col. 2), claimed tax liability (col. 3), a dummy indicating the incorporation of a holding company (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) are omitted and event time categories t, $t+1$ and $t+2$ are replaced by a single post-disclosure dummy. The sample period is 2002–2013. Robust standard errors are clustered at the individual level.

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



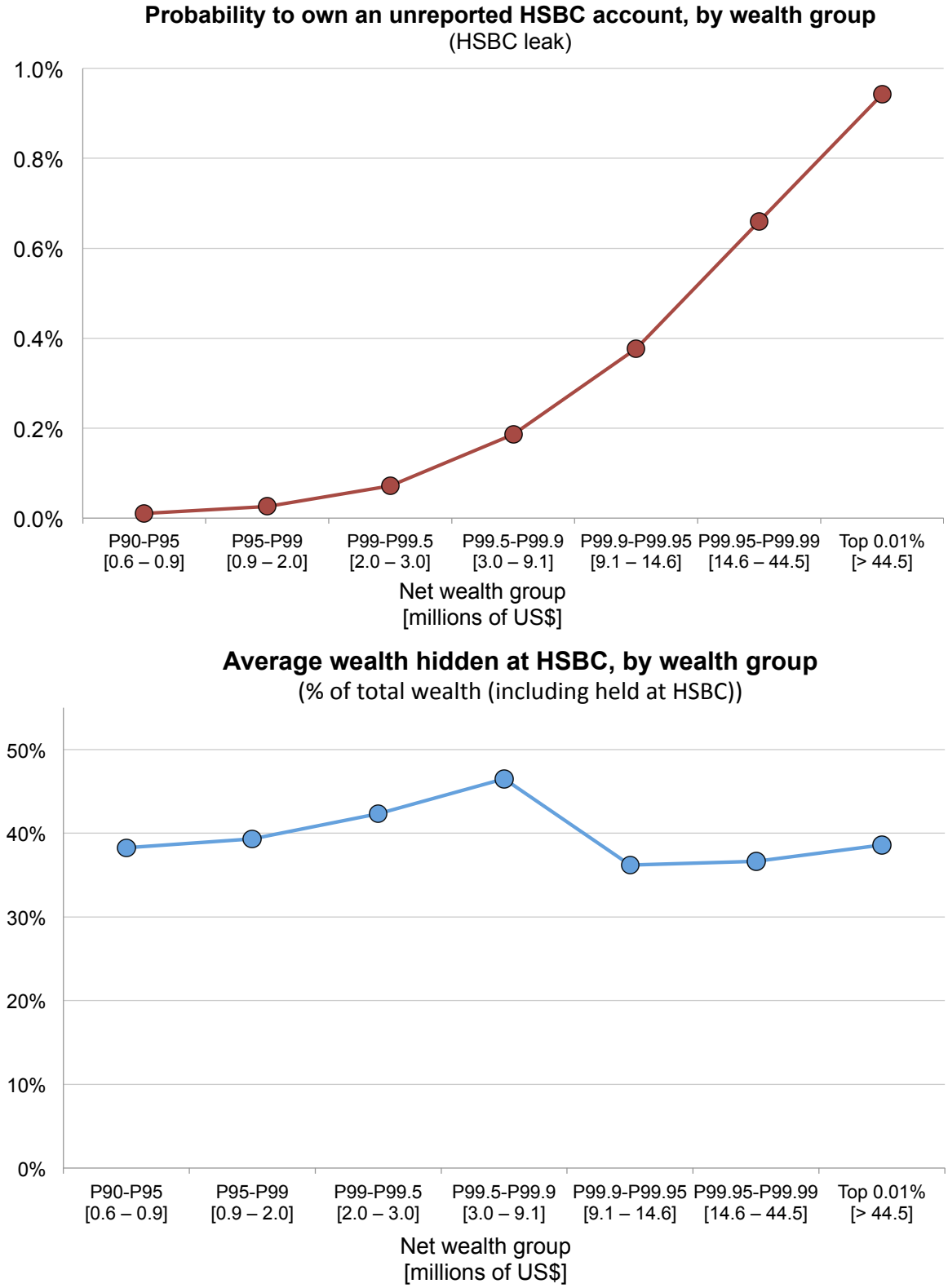
Notes: This figure combines random audits with micro-samples of households hiding assets abroad and macro estimates of the stock of wealth held in tax havens to estimate the size of tax evasion across the wealth distribution in 2006. Each dot is equal to the average ratio of taxes evaded to total taxes 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



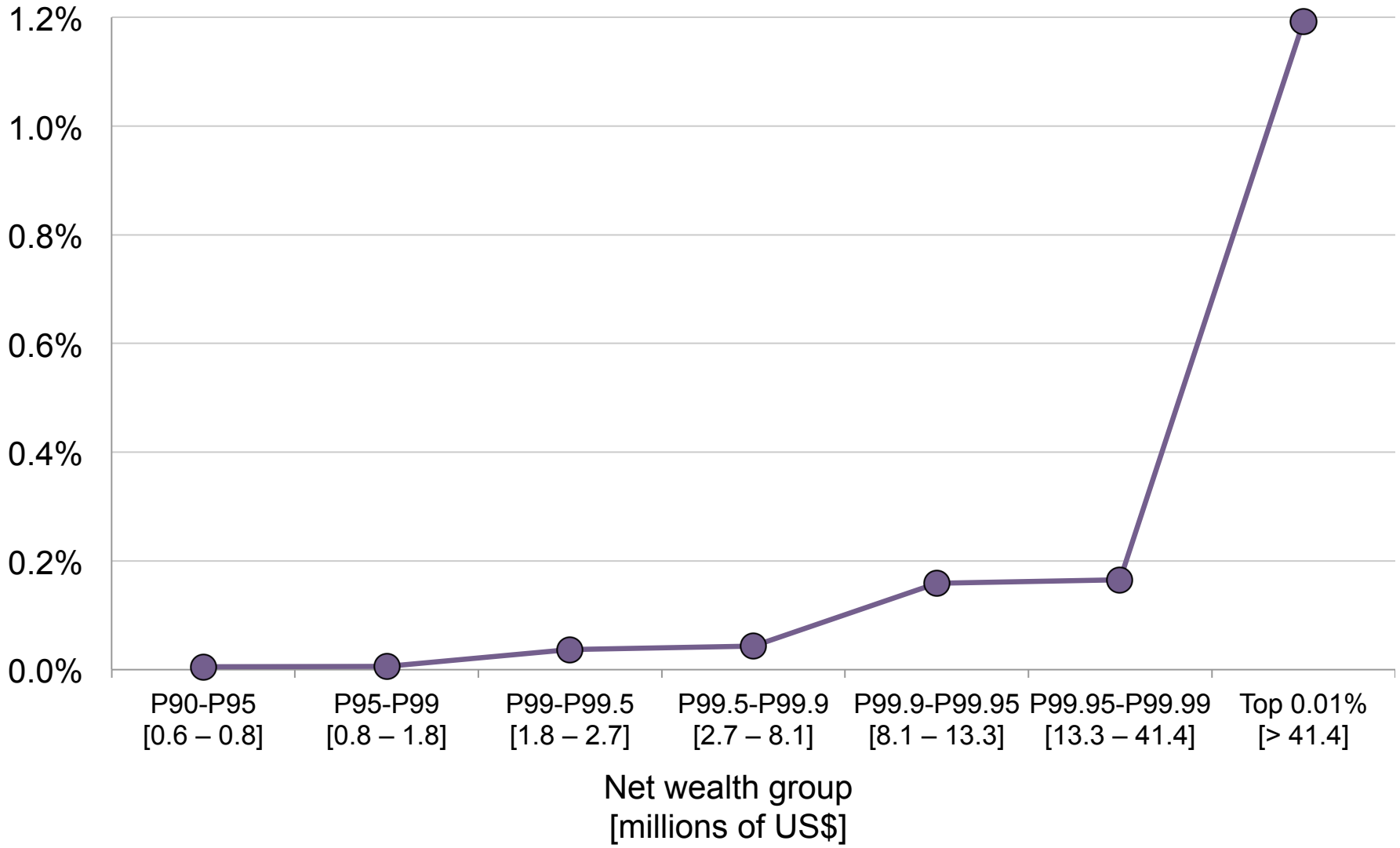
Notes: This figure shows the country distribution of the wealth managed by HSBC Private Bank Switzerland in 2007 and the country distribution of the foreign wealth managed by all Swiss bank in 2003-2004 (the last years before the introduction of the European Saving Tax Directive which greatly increased the use of shell corporations by European owners of Swiss accounts; see Appendix E.2). The black line is the 45 degree line. In the full sample excluding tax havens (134 countries), a regression of the share of HSBC wealth on the share of Swiss deposits has slope $b = 0.90$ (se $= 0.04$) and R-square of 0.75. Source: Appendix Table E.8.

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



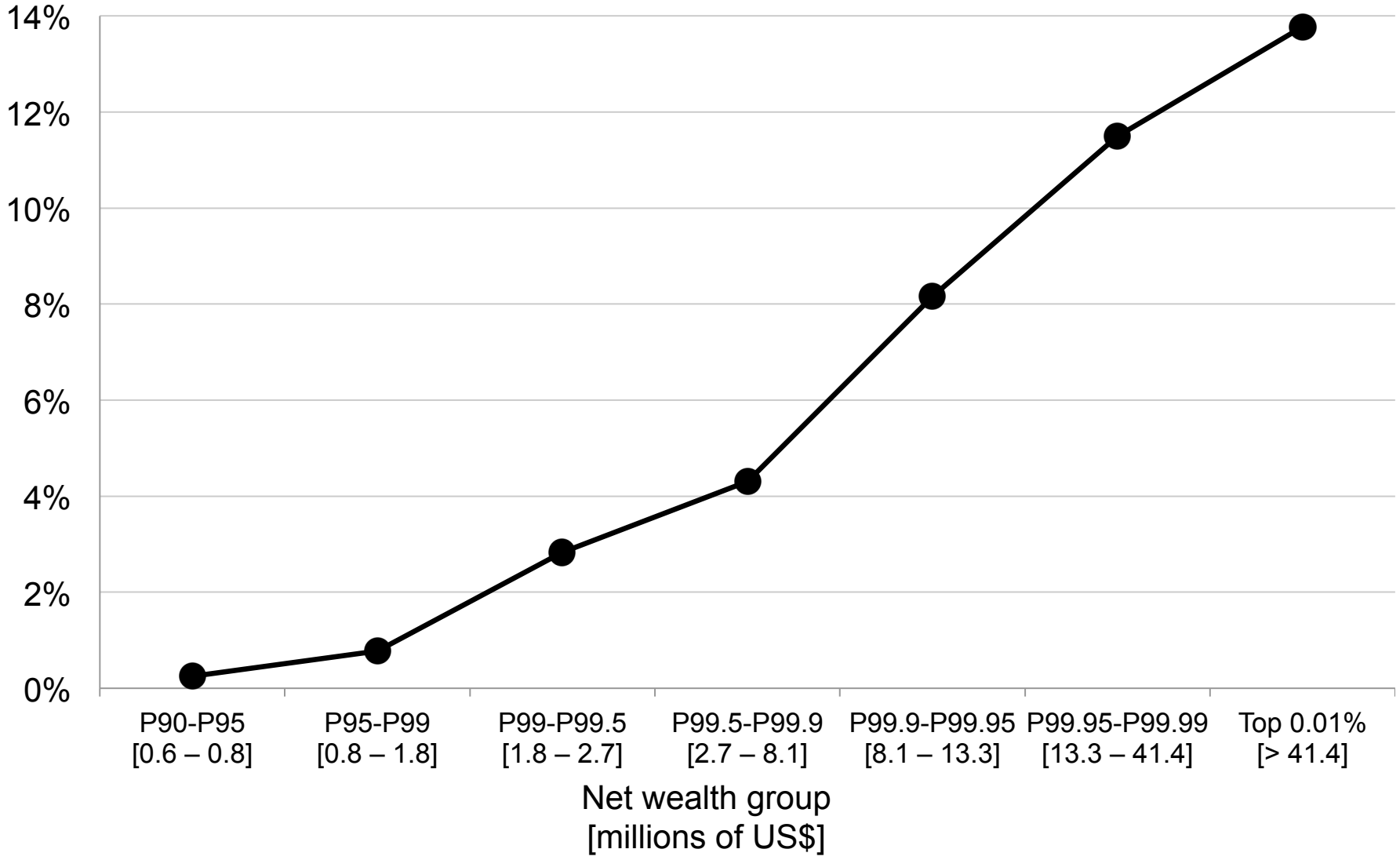
Notes: The top panel shows the fraction of households in Scandinavia (Norway, Sweden and Denmark) who had an unreported bank account at HSBC Switzerland in 2006, by bins of 2006 Scandinavian wealth. The sample includes 520 Scandinavian households who could be matched to a tax return; see text. The bottom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

Figure 4: Probability to appear in the Panama Papers, by wealth group



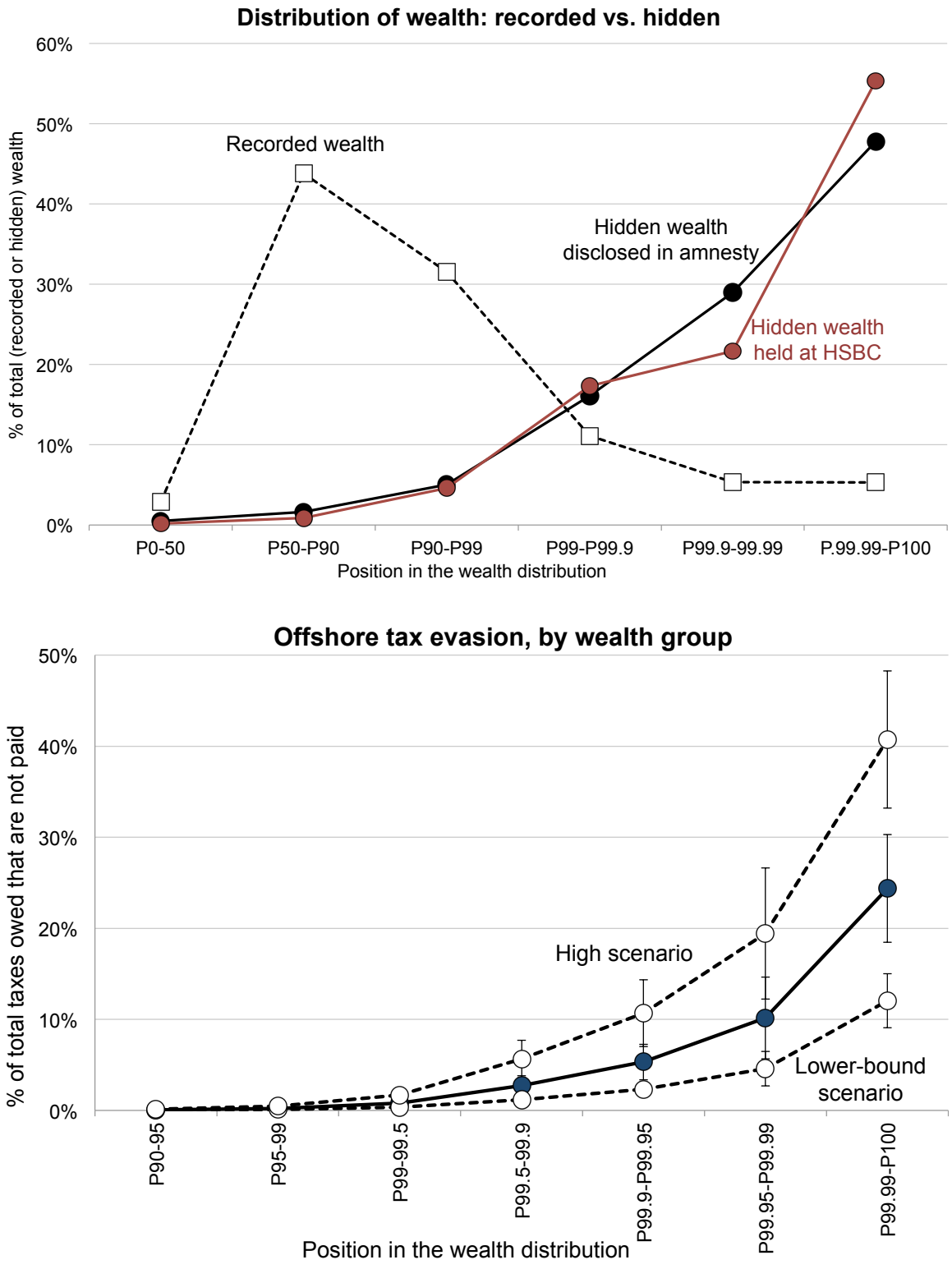
Notes: This figure shows the fraction of households in Norway and Sweden who are identified in the Panama Papers as beneficial owners of shell companies created by the Panamanian law firm Mossack Fonseca, by bins of 2006 wealth. The wealth bins are defined relative to the pooled Norwegian plus Swedish population. Source: Appendix Table F.1.

Figure 5: Probability to use a tax amnesty, by wealth group



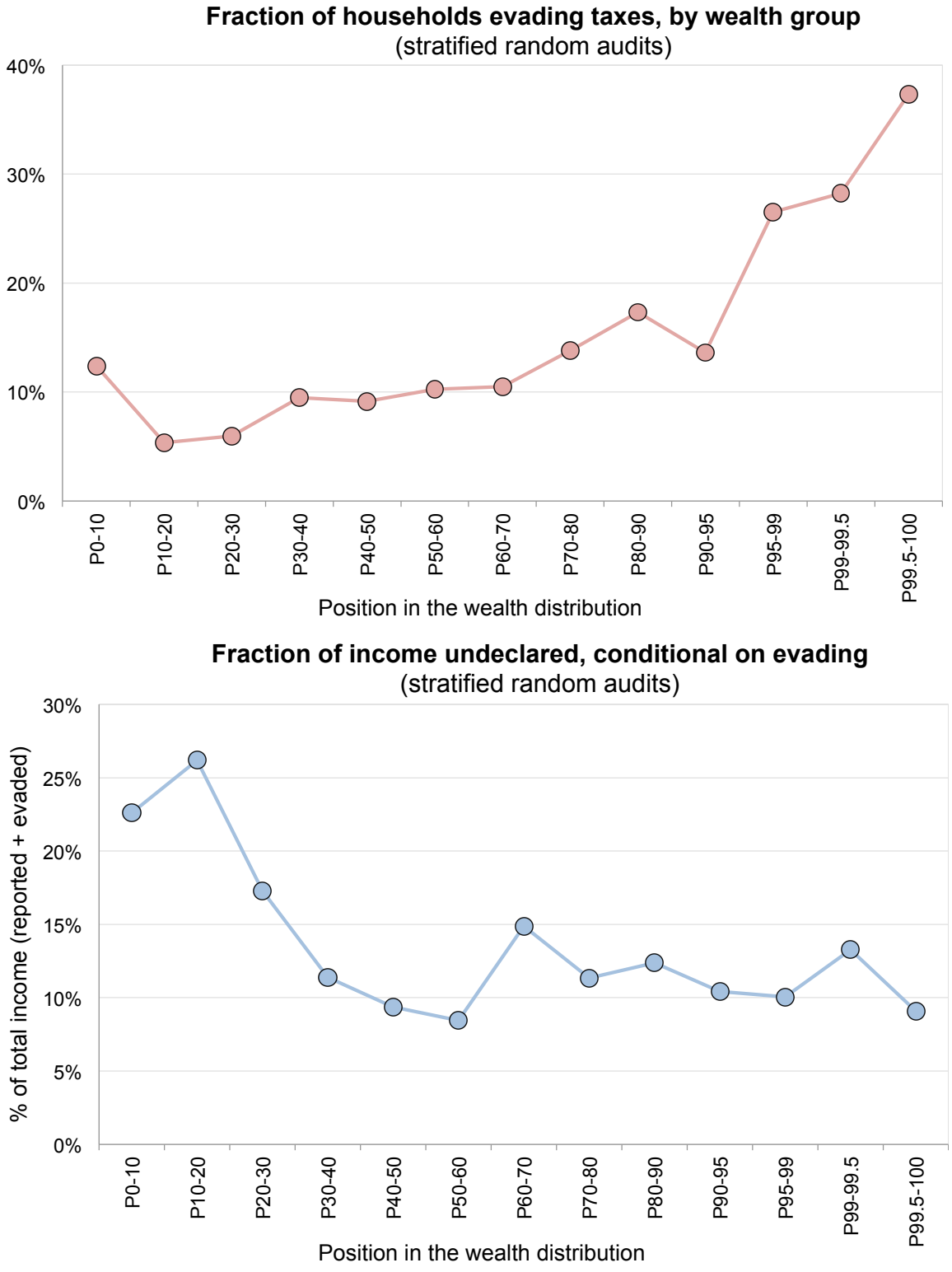
Notes: This figure shows the fraction of households in Norway and Sweden who voluntarily declared previously hidden wealth in a context of a tax amnesty over the period 2007 to 2015, by bins of 2006 wealth. The wealth bins are defined relative to the pooled Norwegian plus Swedish population. Source: Appendix Table G.2.

Figure 6: The distribution of offshore wealth and offshore tax evasion



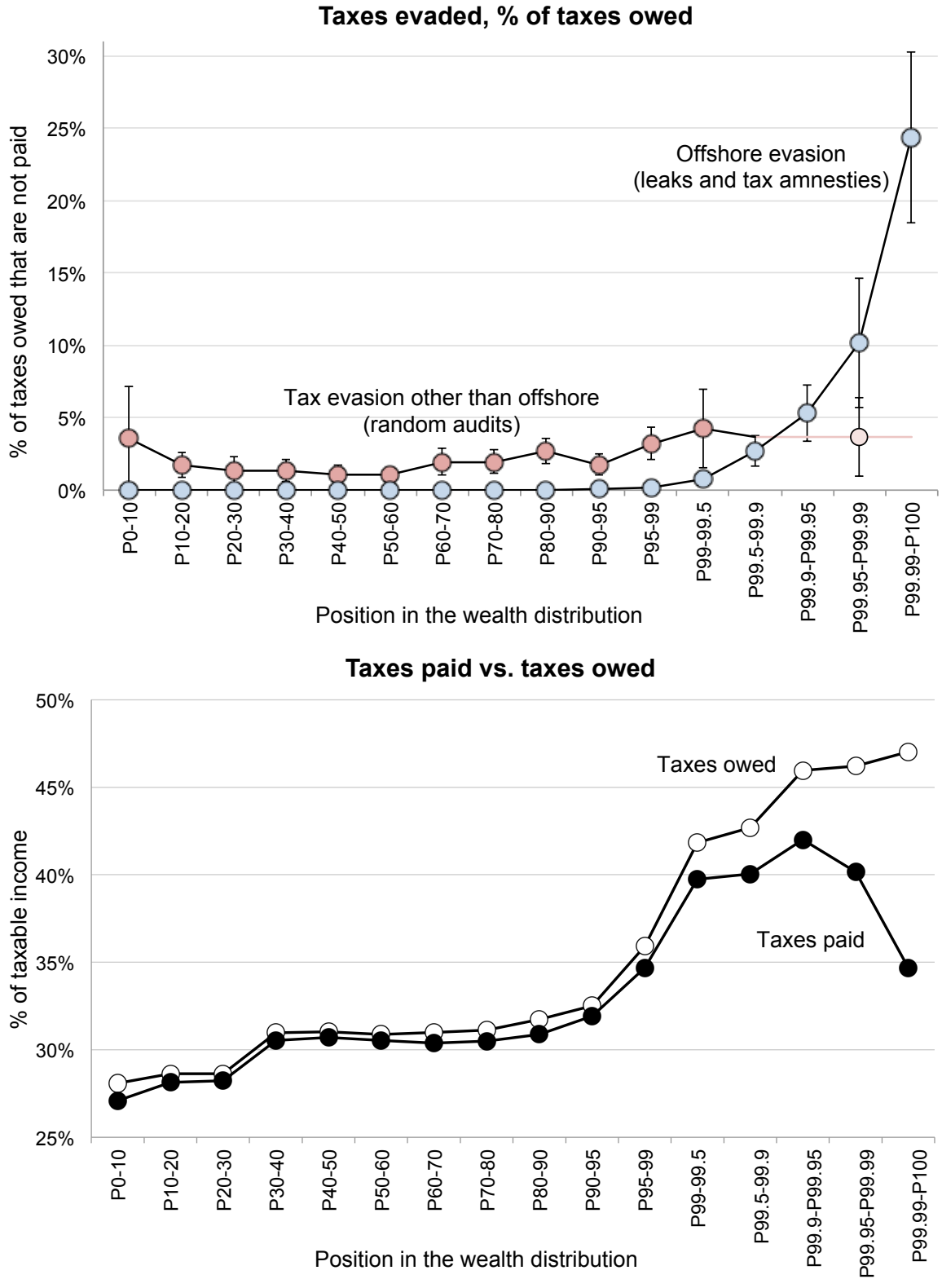
Notes: The top panel shows the distribution of wealth in Scandinavia (Norway, Sweden, Denmark) excluding offshore wealth, and the distribution of wealth held at HSBC and disclosed by amnesty participants. The bottom panel distributes the macro stock of offshore across wealth groups and computes the implied 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 7: 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.

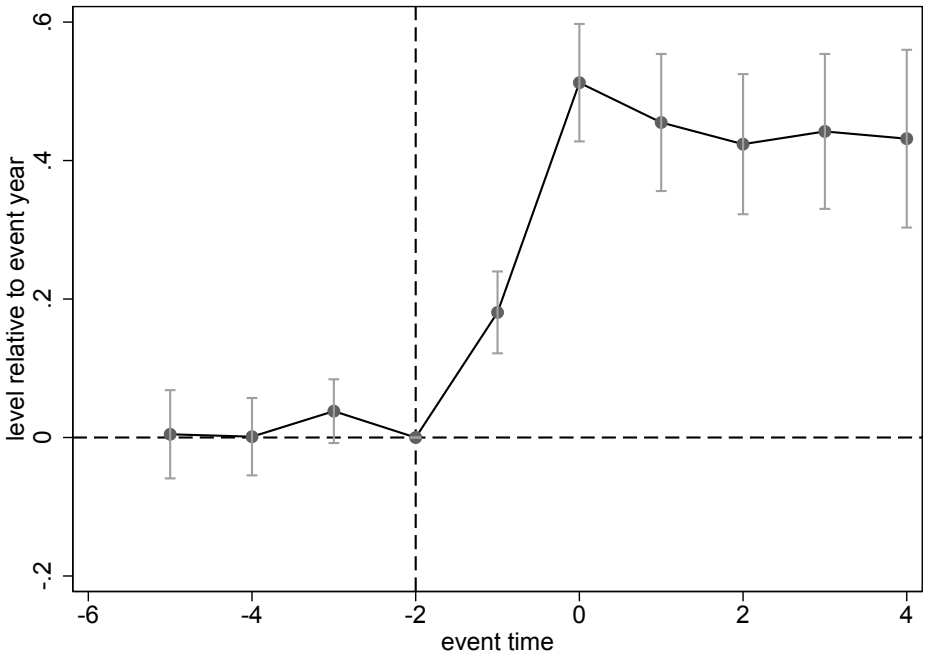
Figure 8: Total tax evasion and its effect on effective tax rates



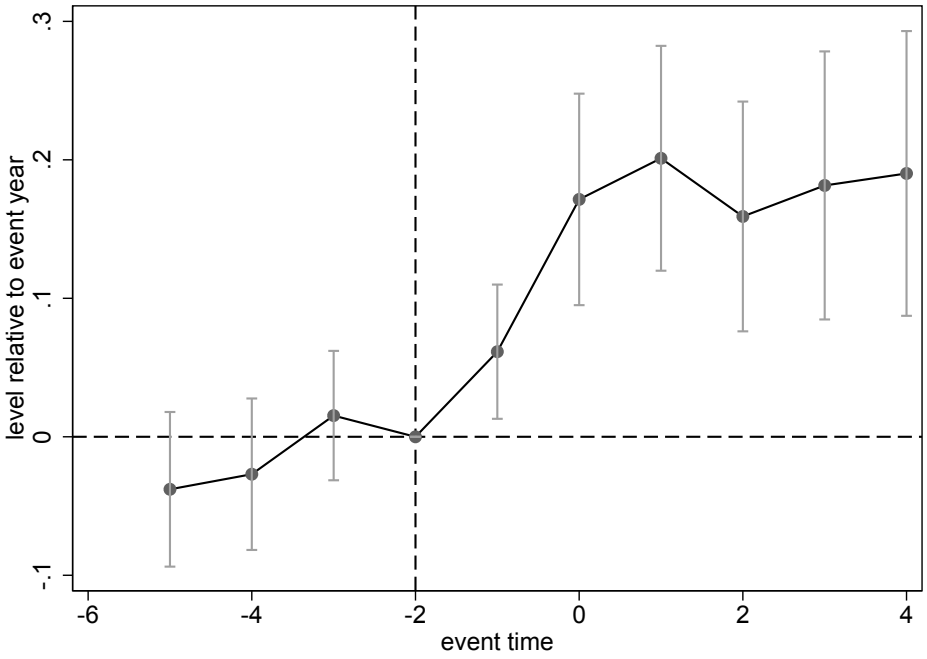
Notes: The top panel shows the fraction of taxes owed which are evaded as detected in SKAT's random audits. The last dot shows the average for P99.5–100 (as due to insufficient sample sizes, we cannot estimate how detected tax evasion varies within the top 0.5%). For comparison, we report our benchmark estimate of taxes evaded offshore from Figure 6. 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 9: The impact of using a tax amnesty

Panel A: Impact on reported wealth

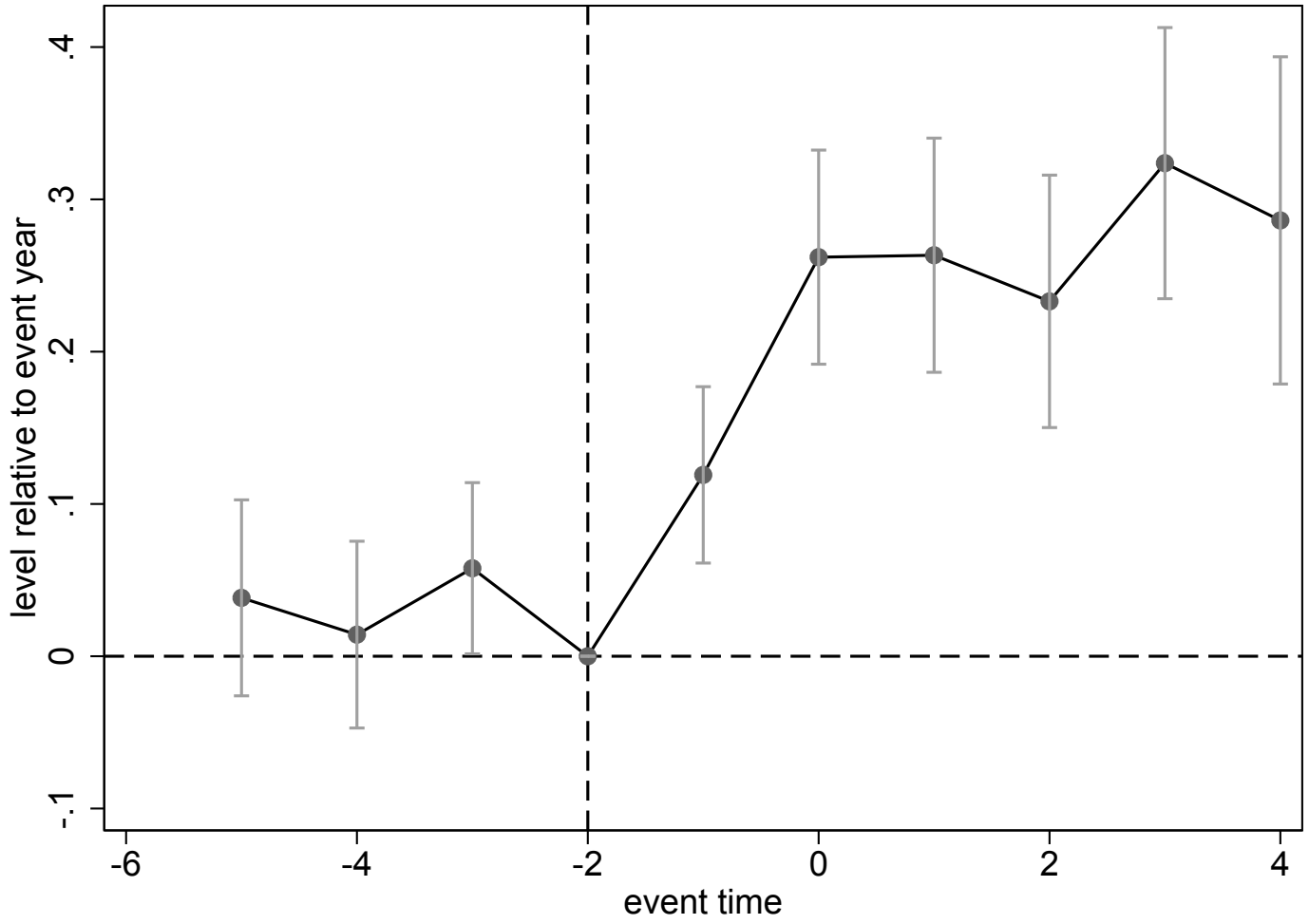


Panel B: Impact on reported income



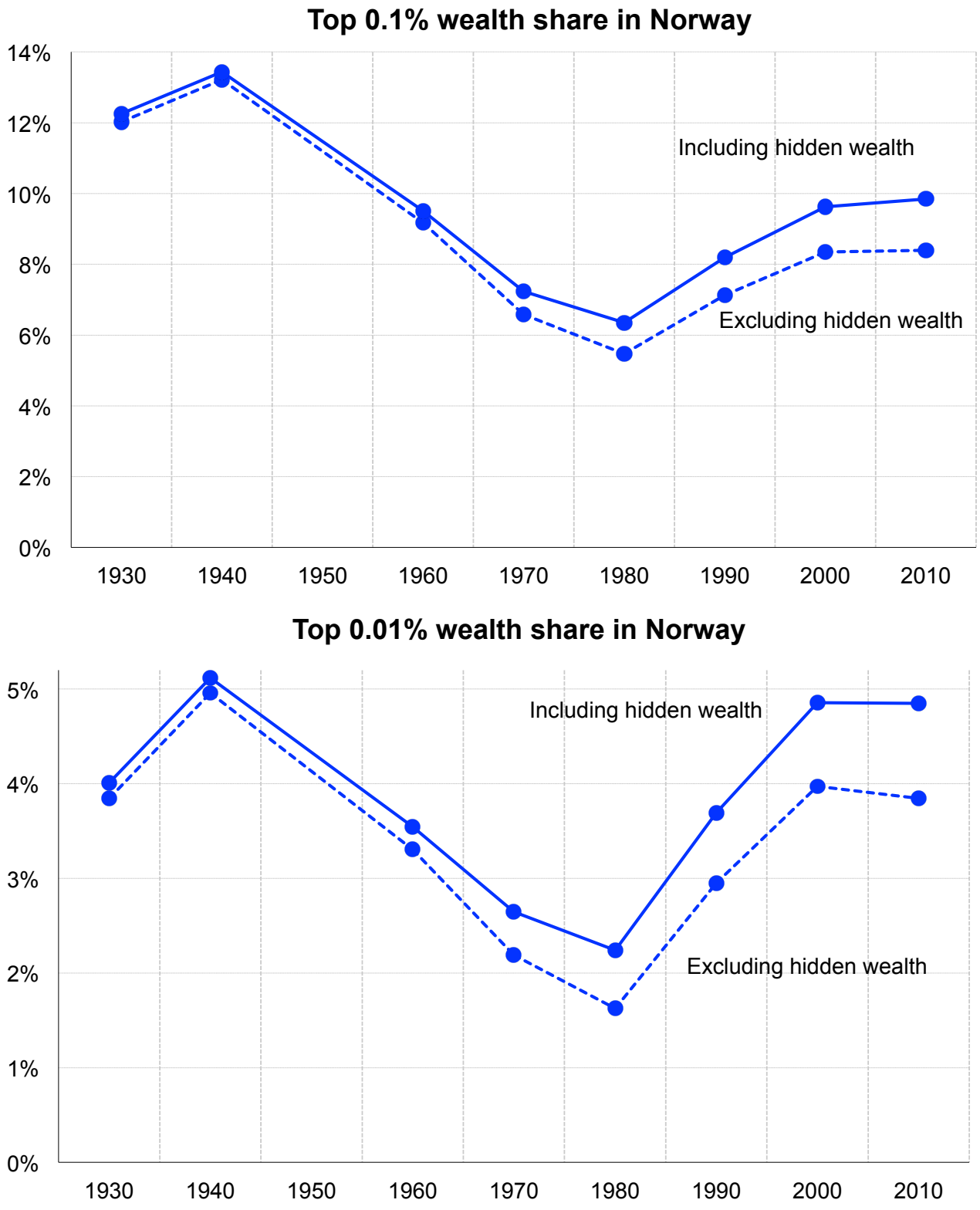
Notes: Panel A shows the results from an event-study regression where the event is voluntary disclosure of hidden wealth and the outcome is taxable wealth as claimed by the tax payer before any corrections are made by the tax authorities. The outcome is regressed on individual fixed effects, year fixed 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), because evaders disclosing offshore wealth in the beginning of year t can incorporate the disclosed wealth into their tax return for year $t-1$, hence the effect of the amnesty shows up as soon as $t-1$ on the graphs. The sample period is 2002-2013. Robust 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 10: The impact of using a tax amnesty on taxes paid



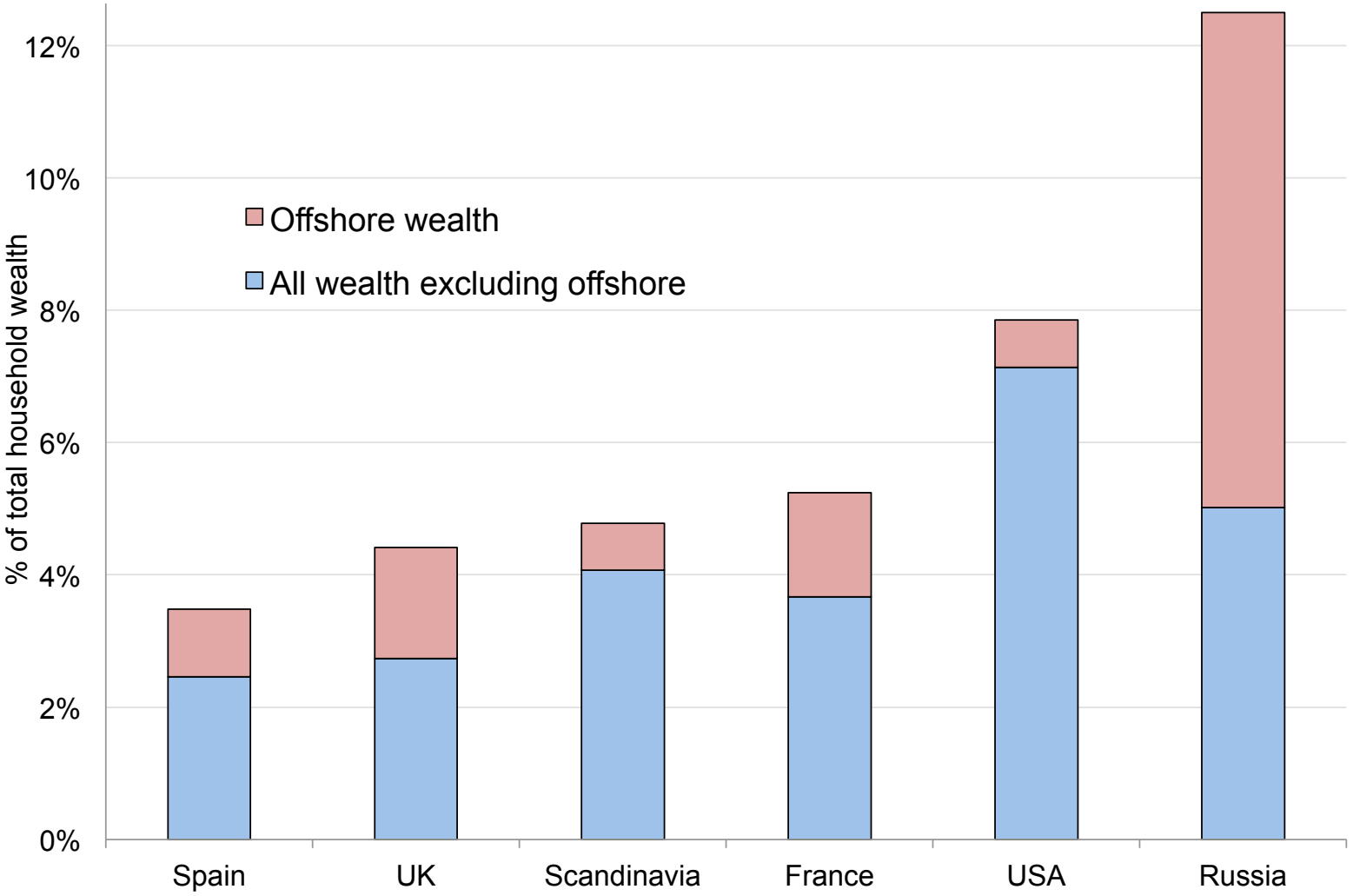
Notes: The figure shows the results from an event-study regression where the event is voluntary disclosure of hidden wealth and the outcome is total tax liabilities (i.e., income and wealth taxes at all levels of government) as claimed by the taxpayer before any corrections are made by the tax authorities. 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), because evaders disclosing offshore wealth in the beginning of year t can incorporate the disclosed wealth into their tax return for year $t-1$, hence the effect of the amnesty shows up as soon as $t-1$ on the graph. The sample period is 2002-2013. Robust standard errors are clustered at the individual-level. Source: Authors' computations.

Figure 11: 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 (bottom panel) as estimated from administrative data vs. corrected by including offshore wealth. In both cases, top shares are expressed as a percentage of total household wealth. For series excluding hidden wealth, total household wealth is the total recorded in the national accounts. For corrected series, total household wealth is the total recorded in the national accounts plus the estimated total offshore wealth of Norwegians. Source: Appendix Table B.2 and B.4.

Figure 12: The top 0.01% wealth share and its composition (2000-2009)



Notes: This figure plots the level of the top 0.01% wealth share in six economies on average over the 2000–2009 period. To ensure comparability, all top shares are estimated following the same methodology. We first distribute the total amount of household wealth recorded in the national accounts following the methodology in Saez and Zucman (2016) and Alvaredo et al. (2017) (blue portion). We then add unreported offshore assets (red portion) in both the numerator (fraction of offshore wealth belonging to the top 0.01%) and the denominator (total offshore wealth). Wealth is equally split among married couples. Scandinavia is the arithmetic average of Norway, Sweden, and Denmark. Estimates for Scandinavia are from this paper; estimates for other countries are constructed in Alstadsæter, Johannesen and Zucman (2017). Source: Alstadsæter, Johannesen and Zucman (2017).