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Tax Evasion and Inequality[†]

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Drawing on a unique dataset of leaked customer lists from offshore financial institutions matched to administrative wealth records in Scandinavia, we show that offshore tax evasion is highly concentrated among the rich. The skewed distribution of offshore wealth implies high rates of tax evasion at the top: we find that the 0.01 percent richest households evade about 25 percent of their taxes. By contrast, tax evasion detected in stratified random tax audits is less than 5 percent throughout the distribution. Top wealth shares increase substantially when accounting for unreported assets, highlighting the importance of factoring in tax evasion to properly measure inequality. (*JEL* D31, H24, H26, K34)

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

Who evades taxes, and how much, matters for both economists and policymakers. First, and most importantly, it matters for the study of inequality. Over the last 15 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

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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 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.

The leaked and amnesty data we exploit in this paper reveal a number of consistent and striking findings. 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 percent) and does not vary with wealth. As a result, the wealth in tax havens turns out to be extremely concentrated: the top 0.01 percent of the wealth distribution owns about 50 percent 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 percent evades about 25 percent 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.

Our estimate of tax evasion at the top (25 percent of taxes owed) is an order of magnitude larger than the tax evasion detected by random audits in other wealth groups (less than 5 percent throughout the distribution). Of course, random audits

are likely to miss some forms of tax evasion in the bottom and the middle of the distribution. Whenever there is no information trail, it is hard if not impossible for examiners to uncover noncompliance. It is important to note, however, that most individuals in rich countries truly have few possibilities to evade a lot of taxes, for the simple reason that most of their income derives from wages, pensions, and investment income earned in domestic financial institutions: income sources that are automatically reported to the tax authority. By contrast, tax evasion is possible for the very rich because there is an industry that helps them conceal wealth abroad, and most of their income derives from wealth.[1] Tax evasion is also possible for the self-employed, and indeed random audits uncover widespread tax evasion among them. But because self-employment income is only a small fraction of total income in Scandinavia and because the self-employed are scattered throughout the wealth distribution, noncompliance by these individuals does not appear to be enough to generate sizable evasion rates in any specific segment of the wealth distribution.[2] In that context, and although there was until recently no good data to study this issue, it is perhaps not too surprising that evasion rates at the top appear to be higher than those further down the wealth ladder.

Do our findings apply to other countries? We certainly do not claim that our estimates of evasion by wealth group in Scandinavia hold everywhere as a universal law. We note, however, that there is nothing unique to Scandinavia that could explain the high evasion rates we find at the top. Residents of all developed countries are typically, like in Scandinavia, 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. We stress, however, that in countries such as Greece and Mexico (and even more so in developing countries) where the self-employed generate a much higher fraction of output than in Scandinavia, the size and distribution of tax evasion is likely to be markedly different. Many tax authorities have access to random audit, amnesty, and leaked data similar to those we use in this research. In future work we plan to apply our methodology to estimate distributional tax gaps (i.e., how evasion across the distribution) in as many countries as possible.

Our paper adds to the large body of work on tax evasion.[3] Our main contribution to this literature is that we are able to document tax evasion by very rich taxpayers

[1] In recent years, for instance, a number of financial institutions have pleaded guilty of criminal conspiracies to defraud the IRS by helping American customers to hide assets in Switzerland or other tax havens; see Section V.

[2] For example, using the same random audit data as we use in Section IV, Kleven et al. (2011) find that 44.9 percent of Danish self-employed evade taxes. But self-employment income only accounts for 6 percent of factor-cost GDP in Denmark, where, like in other advanced economies, the bulk of economic activity takes place in the corporate and public sectors (see online Appendix Figure H.10). Moreover, one finds tax-evading self-employed individuals throughout the distribution: in the bottom or middle (e.g., plumbers) as in the top (e.g., lawyers).

[3] One strand of the literature uses random audit data: see for instance Bishop, Formby, and Lambert (2000); Johns and Slemrod (2010); and Kleven et al. (2011). Another strand 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. Both of

(e.g., with more than $50 million in net wealth) whose behavior could not be properly 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. In the United States for instance, the top 0.1 percent owns about 22 percent of recorded household wealth, as much as the bottom 90 percent (Saez and Zucman 2016).

We also contribute to the literature on top-end inequality. Over the last 15 years, a number of studies have used tax data to construct top income and wealth shares for many countries.[4] The literature discusses the problem raised by tax evasion (e.g., Atkinson, Piketty, and Saez 2011), but until recently there were little data that would allow to systematically quantify it. Zucman (2013) estimates that 8 percent of the world's financial wealth is held in tax havens globally; a similar estimate is obtained by Pellegrini, Sanelli, and Tosti (2016). Absent micro-data on who owns the wealth hidden offshore, however, these studies could not 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 how hidden wealth is distributed.[5]

The rest of this paper proceeds as follows. Section I presents the HSBC, Panama Papers, and amnesty data, and Section II analyzes them. In Section III 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 IV constructs distributional tax gaps taking into account offshore evasion and all other forms of evasion detected in random audits. Section V attempts to explain the high rates of tax evasion among the rich we uncover by studying the role played by the supply of tax evasion services. This paper is supplemented by an online Appendix.[6]

I. Micro-Data on Households with Assets in Tax Havens

A. *HSBC Switzerland Leak*

The first micro-dataset used in this research is the leak from HSBC Private Bank Switzerland, the Swiss subsidiary of the banking giant HSBC. In 2007 a systems engineer employed by HSBC, Hervé Falciani, extracted the complete internal records of the 30,412 clients of this bank, a large fraction of whom were evading taxes. 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

these sources find high rates of evasion for the self-employed, whose true income is found to be on average about 1.5 to 2 times their reported income (e.g., Pissarides and Weber 1989; Feldman and Slemrod 2007; Artavanis, Morse, and Tsoutsoura 2016).

[4] See, e.g., Piketty and Saez (2003) for US top income shares, Saez and Zucman (2016) for US top wealth shares, Atkinson, Piketty, and Saez (2011) for a survey, Piketty (2014) for a broad interpretative synthesis, and Piketty, Saez, and Zucman (2018) for an attempt at distributing all of US national income (including legally tax-exempt income, but excluding income hidden abroad which is missed by the national accounts).

[5] Roine and Waldenström (2008, 2009) study 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 1 percent rises from about 20 percent in the 2000s to a range of 25–30 percent depending on the methodology.

[6] Please see the online Appendix. All our code and data are posted online, excluding de-identified 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.

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 percent of the cases, and we have access to all matched records.[7]

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 more than 30,000 clients (who controlled about 112,000 accounts) of this Swiss bank in 2007. Importantly, HSBC 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 authorities to link the accounts to their owners' tax returns.

Second, at the time of the leak, HSBC Switzerland was a major player in the offshore wealth management industry. It managed 4.4 percent 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 nonresident 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.[8] 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 percent of that total.[9]

Third, 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

[7] 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 nonprofit organizations). If these untraceable accounts are used by the wealthiest tax evaders, we underestimate 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.

[8] 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).

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

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 1 compares the two distributions; they look similar. Scandinavian residents, in particular, own in total about 1 percent of the wealth held at HSBC and 1 percent of all the wealth held in all Swiss banks.[10] 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.

A last 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 percent 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.[11] This result is consistent with a body of evidence suggesting that more than 90 percent of Swiss accounts were undeclared around 2007; this includes two US Senate (2008, 2014) reports finding that 85–95 percent of US-owned accounts at UBS and Credit Suisse were undeclared in 2007–2008, Roussille (2015) who estimates that more than 90 percent 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 to be nonresidents, hence not taxable in Scandinavia.[12] Some accounts

[10] Some countries are slightly overrepresented 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).

[11] 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 subsample of cases that eventually led to conviction would thus introduce a selection bias and would lead us to overestimate 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 noncompliance is estimated based on an examiner's assessment, not a court decision.

[12] Note that some of them might in fact be taxable in Scandinavia; claiming to be nonresident 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 underestimate tax evasion at the top.

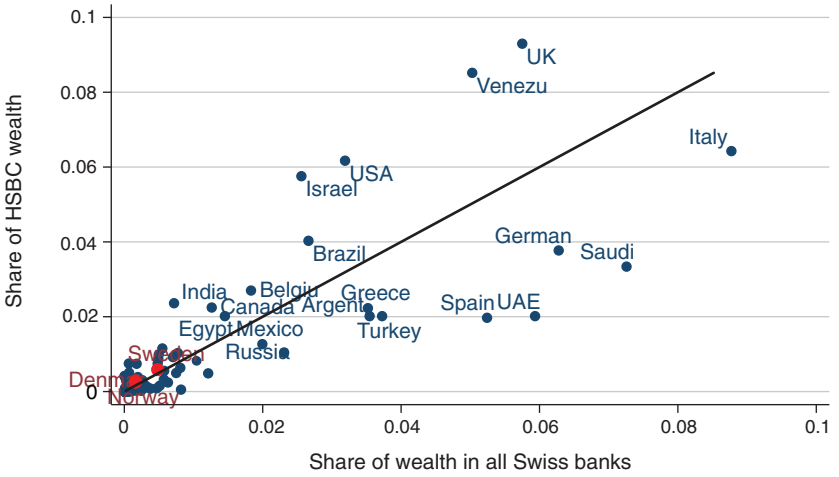

FIGURE 1. COUNTRY DISTRIBUTION OF WEALTH AT HSBC VERSUS IN ALL SWISS BANKS

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 banks 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 online 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 $b = 0.90$ (standard error $= 0.04$) and R^2 of 0.75.

Source: Online Appendix Table E.8

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).[13] 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).

B. *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

[13] This is unlikely to bias our findings significantly, since we know that close to 95 percent 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 underestimate 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 online Appendix Figure E.5, the wealth held by Norwegians at HSBC, which excludes accounts properly declared, is more concentrated than that 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.

created by the Panamanian law firm Mossack Fonseca.[14] 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. 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.

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 versus 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. Another limitation of the Panama Papers is that we do not 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 on the extensive use of tax havens at the top of the distribution, as we shall see.

C. *Tax Amnesty Participants*

Our third micro-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 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. 2018). In Norway and Sweden, we have access to all the voluntary disclosures made since 2006.[15] The number of amnesty participants picked up significantly in 2009, when G20 countries compelled tax havens to exchange bank information upon request with foreign authorities (Johannesen and Zucman 2014); it was negligible before.

A key advantage of the amnesty dataset is the large sample size: 1,422 households in Norway and 6,811 in Sweden.[16] 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

[14] 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.

[15] Online Appendix G discusses the specifics of the Norwegian and Swedish amnesties. In Norway we can observe the amounts disclosed, but in Sweden we cannot (that is, we can only see who used the amnesty, but not the amount of wealth these participants disclosed). Moreover, in Norway we have access to details on the origin and composition of the wealth disclosed. About half of it was held in Switzerland and most of the rest in other tax havens such as Luxembourg. More than 95 percent of the wealth disclosed was financial wealth (equities, bonds, mutual fund shares, bank deposits) and less than 5 percent housing. Andersson, Schroyen, and Torsvik (2018) analyze the characteristics of Norwegian amnesty participants.

[16] In online Appendix Table A.4, we report the number of observations in each of our micro-datasets of offshore evaders by bins of wealth and by country.

Allingham and Sandmo (1972) model of tax evasion (and assuming risk neutrality for simplicity), 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.[17] 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. By contrasting the amnesty and random leak data we have access to, we can directly test for such self-selection. The results discussed below suggest it is quantitatively small; if anything, wealthier tax evaders seem to be slightly less likely to participate in an amnesty.

II. 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 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.

A. *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 percent of the macroeconomic amount of household wealth at market value recorded in the national accounts, following international guidelines codified in Alvaredo et al. (2016). 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 applied.[18]

[17] See Baer and Le Borge (2008) for an analysis of a theoretical and empirical analysis of tax amnesties.
[18] See the series published on the World Inequality Database at http://wid.world/ (Alvaredo et al. 2018a).

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. Nonfinancial assets are recorded using land and real estate registries. These data have been successfully used in various research contexts, for instance by Fagereng et al. (2018) to study how rates of return vary across the wealth distribution in Norway and by Jakobsen et al. (2018) to study how wealth taxation affects wealth accumulation in Denmark.

To ensure comparability across the three Scandinavian countries (and with other countries), we make a number of adjustments, closely following the literature (e.g., Jakobsen et al. 2018). We summarize these adjustments in online Appendix Table A.3. First, whenever appraisal values for housing are below market values, we upgrade the recorded values using the ratio of observed market prices to appraisal values. Second, we account for funded pension wealth, which was not reported at the micro level in 2007.[19] Last, we impute noncorporate business assets and unlisted equities by capitalizing business income and dividends respectively.

One might be concerned that these imputations introduce noise correlated with being a tax evader, which could bias some of our estimates. We have tested this by recomputing key results using the raw wealth data (without adjustments), and found negligible differences.[20] This result is not too surprising, since the largest form of wealth missed by the administrative data is pension wealth (and housing wealth in Norway, which is recorded for only a fraction of its market value), forms of wealth which only account for a small fraction of total wealth at the top of the distribution, the main focus of our analysis.

As shown by online Appendix Figure A.16, wealth is similarly distributed in Norway, Sweden, and Denmark. The top 1 percent owns about 20 percent of total non-hidden wealth, the top 0.1 percent around 9 percent, and the top 0.01 percent around 4–5 percent. 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. Taxable income is also similarly distributed, and the three countries share many macro features (in terms of average income and wealth, wealth composition, etc.; see online Appendix Figures 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 ten tax units at

[19] 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 percent of Danish pension wealth belongs to wage-earners and 60 percent 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 ninety-ninth 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.

[20] See online Appendix Figure G.6 which shows that in the case of Norway, the probability to hide assets by wealth bin is virtually unchanged whether one ranks households by their taxable net wealth or our measure of wealth.

the top), compute average, minimum, and maximum wealth in each bin, using current market exchange rates to convert local currencies into US$,[21] and interpolate the distribution of wealth within each bin using generalized Pareto interpolation methods (Blanchet, Fournier, and Piketty 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). Admittedly, 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.

B. *Tax Evasion in Leaks*

The HSBC leak, the Panama Papers, and the amnesty data all paint the same picture: the probability of hiding assets offshore appears to rise sharply, continuously, and significantly with wealth, including within the very top groups of the wealth distribution.

Starting with HSBC, panel A of Figure 2 shows that the fraction of Scandinavians who hide asset in that Swiss bank is negligible up to the top 1 percent threshold, and then rises to almost 1 percent for the 0.01 percent 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 percent 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 percent are 13 times more likely to hide assets at HSBC than households in the bottom half of the top 1 percent, 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 percent level.[22] As shown by online Appendix Figures E.4 and E.4b, the gradients look the same in the three Scandinavian countries separately.

[21] In the context of our study that focuses on top-end wealth, using market exchange rates seems preferable to using purchasing power parity (PPP) exchange rates, because rich Scandinavians all have access to the same basket of goods and global assets. In online 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, $44.5 million is the threshold to be part of the top 0.01 percent of the Scandinavian wealth distribution in 2006, using 2006 prices and exchange rates to convert Scandinavian currencies into US$).

[22] The only exception is for the very top bin, the top 0.01 percent, 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 percent. Online Appendix Table E.7 reports a version of Table 1 where the top 0.01 percent is lumped together with the next 0.04 percent, i.e., the top 0.1 percent 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 percent level.

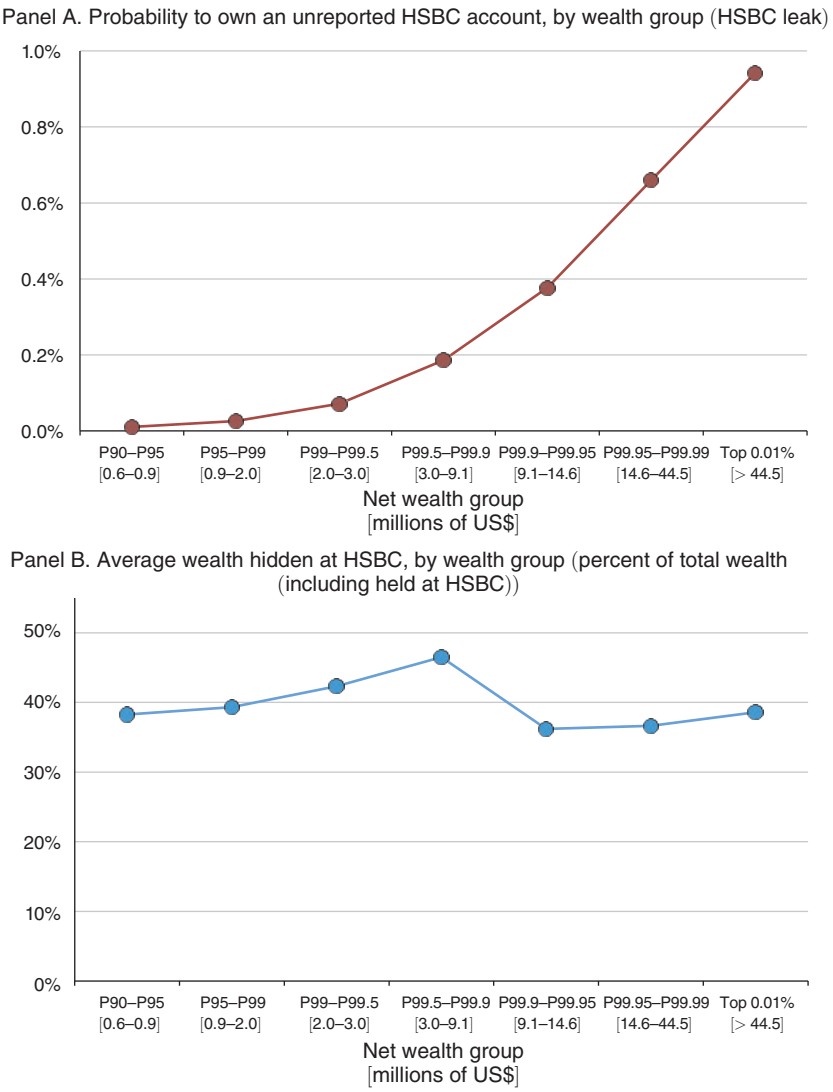

FIGURE 2. TAX EVASION AT HSBC: INTENSIVE VERSUS EXTENSIVE MARGIN

Notes: Panel A 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. Panel B 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: Online Appendix Tables E.2 and E.6

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.[23]

[23] The amount hidden at HSBC is observable for 300 households out of 520. As discussed in online 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 online Appendix Figure E.1, excluding accounts with no known values does not change the gradient reported in panel A of Figure 2.

Table 1—HSBC Evaders, Panama Papers Individuals, and Amnesty Participants, by Wealth Group

	HSBC				Panama Papers	
	Extensive margin		Intensive margin		Extensive margin	
Wealth group	Percent of all households	Test	Percent of evaders' wealth	Test	Percent of all households	Test
	(1)	(2)	(3)	(4)	(5)	(6)
P0–90	0.00		35.08	A	0.00	
	(0.00)		(9.21)		(0.00)	
P90–95	0.01		38.27	A	0.01	A
	(0.00)		(4.45)		(0.00)	
P95–99	0.03		39.34	A	0.01	A
	(0.00)		(3.51)		(0.00)	
P99–99.5	0.07		42.32	A	0.04	B
	(0.01)		(5.91)		(0.01)	
P99.5–99.9	0.19		46.51	A	0.04	B
	(0.02)		(3.77)		(0.01)	
P99.9–99.95	0.38	A	36.19	A	0.16	B
	(0.08)		(5.85)		(0.06)	
P99.95–99.99	0.66	A	36.63	A	0.17	B
	(0.12)		(9.24)		(0.07)	
P99.99–100	0.94	A	38.60	A	1.19	
	(0.30)		(9.34)		(0.39)	
Number of households	10,617,167		10,617,167		7,547,170	
Number of tax evaders	520		300		165	

	Amnesty				HSBC + Amnesty	
	Extensive margin		Intensive margin		Extensive margin	
	Percent of all households	Test	Percent of evaders' wealth	Test	Percent of all households	Test
	(7)	(8)	(9)	(10)	(11)	(12)
P0–90	0.03		36.52	C	0.03	
	(0.00)		(1.86)		(0.00)	
P90–95	0.25		25.32	A	0.26	
	(0.01)		(2.06)		(0.01)	
P95–99	0.78		27.42	AB	0.80	
	(0.02)		(1.26)		(0.02)	
P99–99.5	2.83		31.02	B	2.89	
	(0.09)		(1.95)		(0.09)	
P99.5–99.9	4.31		30.89	B	4.49	
	(0.12)		(1.52)		(0.12)	
P99.9–99.95	8.16		31.26	ABC	8.51	
	(0.45)		(2.79)		(0.45)	
P99.95–99.99	11.49	A	32.84	BC	11.76	
	(0.58)		(2.92)		(0.59)	
P99.99–100	13.77	A	26.30	AB	14.83	
	(1.25)		(4.51)		(1.29)	
Number of households	7,547,170		7,547,170		7,547,170	
Number of tax evaders	8,233		1,375		8,571	

Notes: Columns 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 + Amnesty* columns, our sample pools Norwegian and Swedish households; therefore wealth groups are defined relative to Norway plus Sweden. Column 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. Column 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 parentheses. Columns 2, 4, 6, 8, 10, and 12 show the results of pairwise tests for the equality of the group means displayed in columns 1, 3, 5, 7, 9, and 11. Wealth groups sharing a common letter are not significantly different at the 5 percent level. For example, the letter C in column 10 indicates that P0–90, P99.9–99.95, and P99.95–99.99 are not statistically different from each other.

This mechanically moves HSBC evaders up the wealth ladder. However, this reranking does not drive the gradient reported in panel A of Figure 2. In online Appendix Figure E.2, we reproduce this figure, but ranking households by their wealth *excluding* that held at HSBC; the patterns are similar.[24]

Households who evaded taxes through HSBC hid a strikingly large fraction of their total wealth in that Swiss bank. Panel B 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 panel A. HSBC customers owned around 40 percent 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 panel A of Figure 3, the probability to own a Mossack Fonseca offshore shell company reaches 1.2 percent in the top 0.01 percent of the (Norwegian plus Swedish) wealth distribution, against less than 0.2 percent for all groups below the top 0.01 percent. The difference between the top 0.01 percent and all other groups is highly significant (Table 1, column 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 online Appendix Figure F.1, one finds very few households who own Mossack Fonseca shell companies in the bottom 99.9 percent 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.

C. *Tax Evasion Among Amnesty Participants*

Turning to amnesty participants, panel B of Figure 3 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 percent of all top 0.01 percent Norwegian and Swedish households have disclosed assets in a tax amnesty between 2009 and 2015. Thus, we know that at least 14 percent of Scandinavians' richest households were evading taxes on the eve of the financial crisis of 2008–2009.

Second, by contrasting the probabilities to appear in the HSBC leak to the probability to voluntarily disclose hidden assets, we can study whether

[24] Including hidden wealth when ranking households seems preferable, because doing so delivers the best estimate of the amount of wealth the HSBC 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 underestimate 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 percent actually belong to the top 0.01 percent and the gradient in the probability to hide assets abroad would be even steeper than implied by the HSBC data shown on Figure 2. 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 overestimate 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.

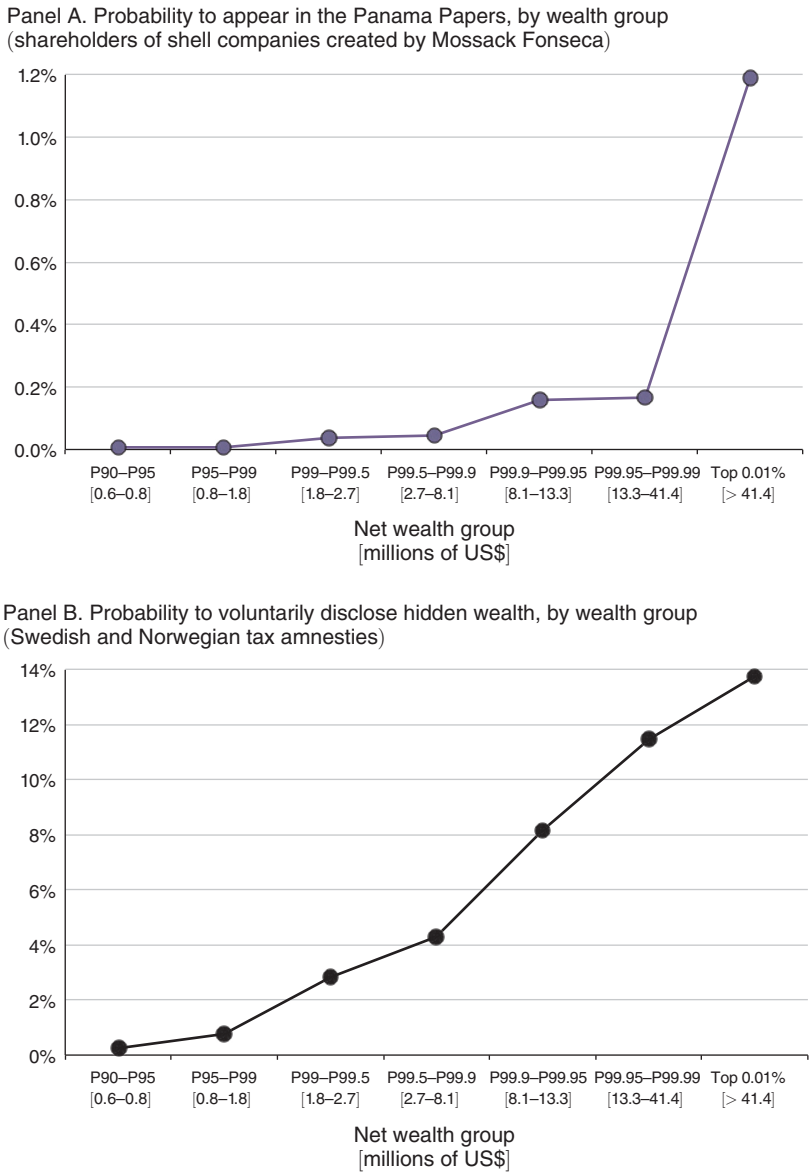

FIGURE 3. PROBABILITY TO BE IN THE PANAMA PAPERS OR USE AN AMNESTY

Notes: Panel A 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. Panel B shows the fraction of households in Norway and Sweden who declared hidden wealth in a tax amnesty over the period 2007 to 2015, by bins of 2006 wealth. In both cases, the wealth bins are defined relative to the pooled Norwegian plus Swedish population.

Source: Online Appendix Tables G.2 and F.1

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 95th and the 99.5th percentile (i.e., with net wealth between about $1 and $3 million) are relatively overrepresented 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 percent, the odds ratio drops to 20.4. Overall, however, the self-selection is not massive. As can be seen by comparing panel A of Figure 2 to panel B of Figure 3, the gradients in the probability to hide assets at HSBC versus 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 available to many tax authorities throughout the world, could be leveraged to study tax evasion and its distribution more extensively than they have so far.[25]

Third, as reported in columns 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 percent), 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 columns 11 and 12 of Table 1, 14.8 percent of the top 0.01 percent richest Norwegians and Swedish households revealed hiding wealth or were caught in the HSBC leak, a probability statistically greater than that of the next 0.04 percent (11.8 percent), which is itself greater than that of the next 0.05 percent, and so on.

III. 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 offshore by each group of the wealth distribution. We proceed in five steps:

Step 1: Using central bank macro-data, we estimate the total amount of wealth held by Scandinavians in tax havens.

Step 2: We make an assumption about what fraction of this wealth is hidden versus properly declared.

Step 3: We assume that hidden wealth is distributed in the same way as in our micro samples.

Step 4: We apply a rate of return to the wealth hidden.

Step 5: Using a tax simulator, we estimate the amount of evaded tax on hidden wealth in each bin of the wealth distribution.

[25] Data from US state amnesties were analyzed by Mikesell (1986); Fisher, Goddeeris, and Young (1989); and Crane and Nourzad (1990). These studies did not address the effect of tax evasion on US income or wealth inequality.

We discuss each of these steps in turn, before presenting robustness tests based on changing one, several, or all of these assumptions at the same time.

A. *The Macro Stock of Offshore Wealth*

First, the available evidence suggests that Scandinavians held in total around 1.6 percent of their wealth (the equivalent of 4.2 percent 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, such as assets owned by mutual funds operating in Luxembourg.

The methodology used to arrive at this figure is the following. We start with Zucman's (2013) estimate, based on a systematic investigation of the international statistics, that households held $5.6 trillion in tax havens globally in 2007. We then allocate this total across countries by using statistics recently 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. Using these new statistics, Alstadsæter, Johannesen, and Zucman (2018a) allocate the global amount of offshore wealth to each country and thoroughly discuss the data and methodology involved. We take their estimate for Scandinavian countries, which we report in the third line of Table 2, with no modification whatsoever.

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 a similar estimate with a simple "bottom-up" approach (reported in the fourth line of Table 2) that scales up the wealth held by Scandinavians at HSBC Switzerland by the ratio between the global stock of offshore wealth ($5.6 trillion) and the offshore wealth managed in that Swiss bank ($118.4).[26] 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 percent of amnesty participants hid assets in other offshore banks.[27] If anything, our estimate of Scandinavians' offshore wealth is likely to be conservative. Both our bottom-up

[26] The ratio equals 47.5 (i.e., HSBC Switzerland managed a bit more than 2 percent of the world's offshore wealth in 2007). Applying 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 (i.e., $1,013 million) delivers an estimated amount of total offshore wealth belonging to Scandinavians equal to $48 billion, or 1.5 percent of Scandinavia's wealth, very close to our benchmark estimate of 1.6 percent. This similarity is not so surprising in light of our earlier finding, shown in Figure 1, that country shares from HSBC and the full Swiss banking sector line up along a 45-degree line.

[27] 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 percent of the total assets disclosed during the amnesty (about 1.2 percent). Note that 1.2 percent is less than what we estimate was the share of Scandinavians' offshore wealth held at HSBC (2.0 percent). This suggests that we may underestimate 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.

Table 2—Offshore Wealth at HSBC, in All Swiss Banks, and in All Tax Havens, 2007

	World	Scandinavia	Sweden	Norway	Denmark
Panel 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
Panel B. Wealth held offshore (*percent 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 online 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 online Appendix A.

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.[28]

In the second step of our estimation procedure, 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 percent of the macro stock of Scandinavians' offshore wealth was duly declared to tax authorities in 2006, and 90 percent hidden.

B. *The Distribution of Offshore Wealth*

In a third step, we distribute 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 percent of it belongs to the top 0.1 percent richest households, 52 percent belongs to the 0.01 percent, etc., which are the fractions observed in these two micro datasets (panel A of Figure 4).

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

[28] 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, p. 5) 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 nonfinancial assets.

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 percent evaders does not account for much compared to that owned by the top 0.1 percent. While the top 0.01 percent owns only about 5 percent 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 percent of Scandinavia's offshore wealth belongs to the top 0.01 percent, which is the arithmetic average of 55.3 percent, observed in the HSBC sample, and 47.8 percent, observed in the amnesty sample. See online Appendix Table J.1.).

C. *Taxes Evaded on Offshore Assets*

Fourth, we apply a rate of return to the wealth hidden. Based on the observed composition of offshore wealth and the returns on global securities markets and deposits in 2006, we apply a 4.5 percent taxable rate of return to the wealth hidden.[29]

The last step involves computing how much tax each group of the wealth distribution evades offshore. 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, we 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. We apply these empirical marginal tax rates to the amounts of income and 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.[30] For instance, we find that the average marginal tax rate on capital income for the top 0.01 percent richest Scandinavians was 49 percent in 2006 (taking into account both income taxes and wealth taxes expressed as a fraction of taxable capital income). This is the rate that we apply to the hidden income of the top 0.01 percent (i.e., to 4.5 percent of their estimated hidden wealth). 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 intergenerational transmissions of hidden assets.

[29] The average interest rate paid by Swiss banks on their term deposits was 4.3 percent in 2006; the US Federal fund rate was in range of 4.3 percent to 5.25 percent; the total nominal return (dividends reinvested) was 13.4 percent for the S&P500 and 20.65 percent for the MSCI World (see online Appendix Table J.4). Contrary to a widespread view, most of the wealth held offshore if invested in global financial markets, so returns on offshore accounts are no lower than returns earned in domestic financial institutions. As shown in Zucman (2013), about 75 percent 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.

[30] In Denmark, share income is taxed at a lower rate, 42 percent versus 48 percent for interest at the top.

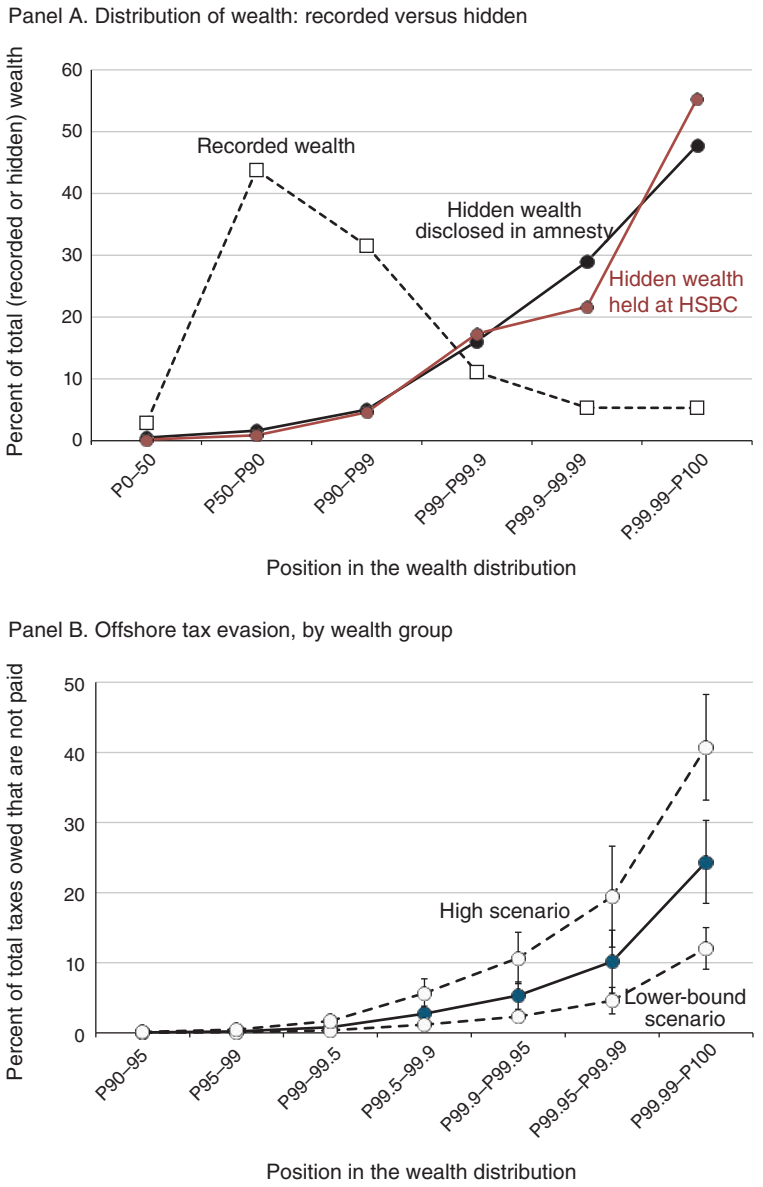

FIGURE 4. THE DISTRIBUTION OF OFFSHORE WEALTH AND OFFSHORE TAX EVASION

Notes: Panel A 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. Panel B 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 percent confidence intervals based on bootstrapped standard errors.

Source: Online Appendix Tables A.2, J.1, J.3, J.3b, and J.3c

D. *How Offshore Tax Evasion Varies with Wealth*

Panel B of Figure 4 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 percent evades 25 percent of its true tax liability through tax havens.

What drives the high evasion rates we estimate at the top? It is not the macro stock of wealth hidden by Scandinavians offshore: a mere 1.4 percent of total household wealth (90 percent of 1.6 percent), significantly less than what is found for Continental European countries, the United States, let alone Latin American or African countries. It is the concentration of offshore wealth revealed by the leaked and amnesty data. As we saw in Section II, top 0.01 percent households are much more likely to hide assets, and, conditional on doing so, hide a lot (about 40 percent of their total wealth in the HSBC sample). This explains why offshore tax evasion is orders of magnitude higher in the top 0.01 percent (25 percent of taxes owed) than in the overall population (a mere 0.6 percent). A second factor drives the sharp gradient displayed in panel B of Figure 4: at the very top, the vast majority of income derives from wealth. So when a top 0.01 percent taxpayer hides 40 percent of her wealth, she hides close to 40 percent 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 percent of her taxes.[31] For a less wealthy evader who hides 40 percent of his assets, the taxes evaded offshore will account for a smaller fraction of his tax bill, because a large fraction of taxes owed arise from labor income.[32]

One might wonder how the presence of a wealth tax in Sweden and Norway affects our results. In an accounting sense, it does not: when computing the ratio of taxes evaded to taxes owed, wealth taxes enter both the numerator and denominator; absent such taxes, rich Scandinavians would still evade a similarly high fraction of their tax liability (albeit a smaller amount in absolute terms). From an economic perspective, however, wealth taxes might have a causal effect on tax evasion. To analyze this issue, it is useful to consider the overall tax rate on capital income in Scandinavia. With a 4.5 percent rate of return, a wealth tax of 1.2 percent (as in Sweden) is equivalent to a tax on capital income at a rate of 27 percent, a wealth tax of 0.9 percent (as in Norway) to a tax on capital income of 20 percent.[33] All

[31] The 4.5 percent return we assume in our benchmark scenario is slightly higher than the realized taxable return observed on non-hidden wealth (about 3.5 percent for the top 1 percent 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 percent Scandinavians includes a large fraction (around 50 percent) 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.

[32] To reconcile the estimates of the rates of evasion shown in panel B of Figure 4 with the patterns of evasion in the micro-data studied in Section II, consider the following simplified computation. As reported in Figure 2, about 1 percent of top 0.01 percent richest Scandinavians hid assets at HSBC Switzerland, and they held there about 40 percent of their wealth. Assuming that HSBC Switzerland accounts for 2 percent of all offshore tax evasion (and that HSBC customers do not hide assets in other offshore banks, and vice versa), this implies that 50 percent of top 0.01 percent Scandinavians hid assets abroad and that the top 0.01 percent concealed 20 percent of its total wealth offshore. The fraction of taxes eschewed is slightly larger than 20 percent in our benchmark scenario, because the return we assume on hidden wealth is slightly higher than on non-hidden wealth.

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

included, the marginal tax rate on capital income reaches 57 percent in Sweden and 48 percent in Norway, slightly higher than Denmark (42 percent 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 percent marginal tax rate on interest income and 36 percent 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.[34]

The skewed distribution of offshore wealth also implies that top wealth shares increase substantially when accounting for unreported assets. As reported in online Appendix Figure B.3, including offshore wealth increases the top 0.1 percent Norwegian wealth share significantly: from 8.4 percent to 9.8 percent on average over the 2000–2009 period. For the top 0.01 percent, a group that includes about 300 Norwegian households in 2010, reported wealth increases by about 25 percent (online Appendix Figure B.4). That is, these households own about 20 percent of their wealth in tax havens. These results highlight the need to move beyond tax records to capture income and wealth at the very top, even in countries where tax compliance is generally high.[35]

E. *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, and e in online Appendix Tables J.1, J.2, and J.3), the fraction of offshore wealth that is hidden from the tax authorities (online Appendix Table J.1), the distribution of offshore assets (columns 9, 10, and 11 in online Appendix Tables J.1, J.2, and J.3), and/or the rate of return on hidden wealth (online 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 random audits. For all plausible scenarios, it is in a range of 20 percent to 30 percent.

In panel B of Figure 4, 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

[34] The evidence reported in Table 2 shows that Denmark, where wealth taxation was abolished in 1997 and the overall marginal tax rate on capital is slightly lower, seems to hide a smaller fraction of its wealth than Norway and Sweden. However, given the uncertainties involved, we caution against drawing strong conclusions from this difference. In our view, tax evasion is better analyzed at the level of Scandinavia as a whole; at the micro level, small sample sizes do not allow us to detect any statistically significant differences across countries. We leave to future research the task of investigating the causal effect of wealth taxation on capital flight using micro-data and within-country variation. For cross-country comparisons of marginal and average tax rates in Scandinavia, see online Appendix Figures J.1, J.2, and J.3.

[35] In Alstadsæter, Johannesen, and Zucman (2018a) we investigate the implications of hidden wealth for inequality in ten countries, which account for close to one-half of world GDP, assuming that offshore wealth is as concentrated in the other countries as in Scandinavia. The results show that inequality increases even more than in Norway (as other countries typically own a higher fraction of their wealth offshore than Norway).

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 percent, however, still evades 12 percent of its tax bill, which is, as we shall see below, three times higher than the amount of evasion detected at the top 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 one-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 percent then rises to 40 percent of taxes owed.

IV. Beyond Offshore Tax Evasion: Distributional Tax Gaps

Offshore evasion is just one form of evasion, and it is not too surprising that it is concentrated among the rich. In this section, we contrast and combine offshore tax evasion with the evasion detected in random audits. The interesting and non-obvious result of our research is that at the top, offshore tax evasion (25 percent of taxes owed) is much larger than the forms of tax evasion detected in random audits, the current gold standard in the literature. This suggests that to have a good measure of tax evasion, combining different data sources is critical.

A. *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 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 oversampled. 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 online Appendix H.

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

[37] Overall, 0.15 percent 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 percent of the distribution (0.53 percent); our sample includes 663 taxpayers in the top 1 percent of the wealth distribution. See online Appendix Table H.2.

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 misreporting 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.

By construction, the rates of evasion measured in the random audits exclude offshore evasion, for the following reason. 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. Moreover, despite the richness of the information available to SKAT, the random audits are likely to miss some forms of evasion throughout the distribution, especially when no information trail exists.

B. *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 percent of all taxpayers are found making mistakes. As shown by Figure 5, this probability rises sharply with wealth, to more than 35 percent for the 0.5 percent richest households. This trend reflects the facts that the probability to earn self-employment income rises a lot with wealth (to close to 50 percent in the top 0.5 percent), and that the error rate is much higher among the self-employed (around 60 percent, with no trend across the wealth distribution) than among wage-earners and retirees (around 10 percent, with no trend either); see online Appendix Figure H.4. Conditional on evading, around 10–20 percent of income is misreported, with a declining trend across wealth bins. These fractions are modest, and hence the overall tax gap is small: 2.2 percent of personal taxes owed are found to be dodged in total. This number rises a little bit from the ninetieth to the ninety-ninth percentile, but in no wealth group does evaded tax exceeds 5 percent of taxes owed.[38]

In the United States, the IRS estimates that a larger fraction of taxes is evaded, about 11 percent (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

[38] These figures include all mistakes found during the audit, whether deemed voluntary or not. In online 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 percent of audited taxpayers are found deliberately evading taxes, a fraction rising to 5.4 percent in the top 1 percent; see online Appendix Figure H.5), but the average amount of income misreported increases by a factor of 5 (online Appendix Figure H.6), so that taxes deliberately evaded account for about half of all unpaid taxes. The distributional patterns are similar (online Appendix Figure H.7).

[39] As shown by online 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 percent.

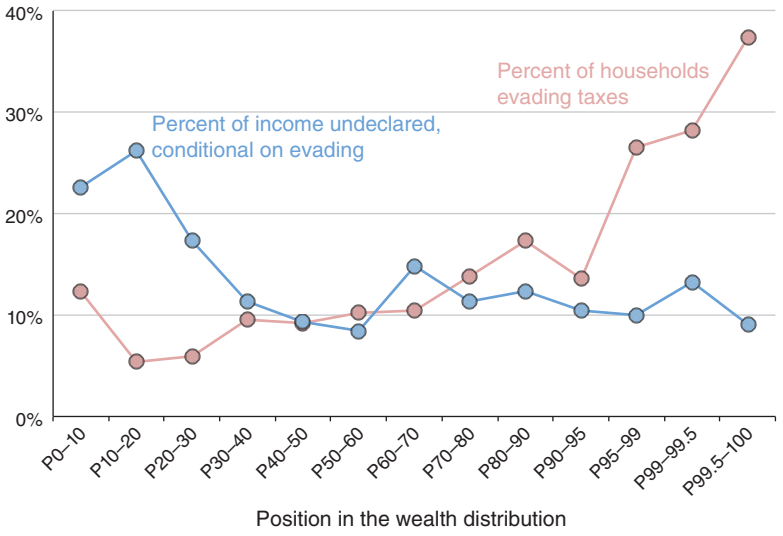

FIGURE 5. TAX EVASION FOUND IN STRATIFIED RANDOM AUDITS

Notes: The blue curve shows the probability to be found evading taxes in random audits, by wealth groups. The pink curve shows the ratio of income undeclared to true income, conditional on evading taxes. Tax evasion includes all mistakes found by the examiner, whether deemed deliberate or not.

Source: Online Appendix H.3 and H.4

factor of about three, contrary to SKAT which does not correct the results found in its random audit program. 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 percent of factor-cost GDP versus 6 percent. As shown by online 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 percent) and France (6 percent). In countries such as Greece and Italy, the self-employed generate a higher fraction of output (about 20 to 25 percent); 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 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.

C. *Combining Offshore Evasion with Random Audits*

Figure 6 contrasts our estimates of offshore tax evasion with the tax evasion detected in random audits. For most of the population (up to the

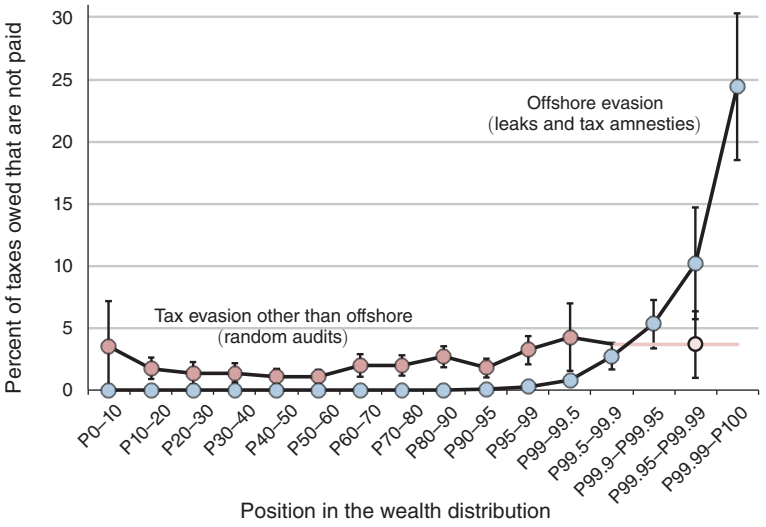

Figure 6. Taxes Evaded as a Percent of Taxes Owed, by Wealth Group

Notes: The pink curve shows the fraction of taxes owed which are evaded as detected in 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 percent). The blue curve shows our benchmark estimate of taxes evaded offshore from panel B of Figure 4.

Source: Online Appendix Table J.5

99.5th percentile), only detected evasion matters and estimated evaded taxes are small. But at the very top, offshore tax evasion swamps all forms of evasion detected in random audits; wealth concealment seems widespread and total evasion becomes large. Adding both forms of evasion, we find that 2.8 percent of total taxes go unpaid and that tax evasion appears to rise sharply with wealth (online Appendix Table J.5). We stress, however, that because random audits are unlikely to uncover all forms of tax evasion, there is uncertainty in the slope of the evasion gradient. Our main finding is that at the top, offshore evasion is large compared to the evasion detected in audits. 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. But more research is needed to improve the measurement of tax evasion in all segments of the distribution.[40]

One implication of our results is that the personal tax rate effectively paid by the wealthiest Scandinavians is substantially lower than implied by the tax law. Online Appendix Figure J.4 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 percent richest Scandinavians would pay about 45 percent of their income in taxes. In

[40] Moreover, Figure 5 only includes evasion on payroll, personal income, and net wealth taxes. It excludes evasion on the value-added tax (VAT), the corporate tax, real estate taxes, and excise duties. These forms of tax evasion are significant (see Skatteverket 2014, for Sweden), but are harder to allocate across the wealth distribution, a task we leave to future research.

practice, the rate effectively paid reaches 35 percent for the top 0.01 percent. This rate remains a bit higher than the rate paid by the bottom 95 percent. But tax evasion erodes the progressivity of the tax system, and, accordingly to our estimates, makes it regressive at the top.

V. Explaining Tax Evasion among the Rich

How can we explain the high rates of evasion we find at the top? The canonical Allingham and Sandmo (1972) model predicts that the very rich should evade little, because they are likely to be (nonrandomly) audited by the tax authority. Yet our results show the opposite: in all our leaked and amnesty micro-samples, tax evasion rises with wealth at the top; top 0.01 percent households are much more likely to hide assets abroad than households in the bottom of the top 1 percent. 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.[41]

To explain our findings, it is important to consider the supply of tax evasion services instead of its demand only as in the literature so far. There is an industry that sells wealth concealment services, and this industry primarily targets very wealthy customers. Think of a representative Swiss bank.[42] It derives revenue by levying fees on the wealth it helps concealing and faces penalties in case it is caught helping tax evaders. The more clients the bank serves the more revenue it makes, but the higher the probability it is caught breaking the law (e.g., because the probability that a leak occurs rises). Internalizing this cost, a rational bank will target very wealthy individuals, who are few in number but own a large fraction of world wealth (because of the multiplicative and cumulative processes that govern wealth accumulation). In practice, private wealth management banks typically select customers by requiring them to have a minimum amount of assets (e.g., $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 (see, e.g., Harrington 2016). In the online Appendix, we provide a model along these lines that can rationalize why tax evasion is sizable at the top in equilibrium, as observed in our data. The model yields a number of additional insights.

[41] 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.

[42] Swiss banks supplied the vast majority of cross-border wealth management services until the 1980s, before financial liberalization in the United Kingdom and the emergence of new offshore centers. They historically had a cartel agreement, the Convention IV of the Swiss Bankers Association, which strictly regulated fees; see Zucman (2015, chapter 1). In the online Appendix, we also consider a model with competition in the market for wealth concealment; the key intuitions of the model with a single provider of tax evasion services carry over.

The most important insight is that government policies have a critical role to play to reduce tax evasion. Increasing penalties for tax evaders has not proved to be a very practical way to curb tax cheating so far. 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 tax evasion services (instead of tax evaders themselves) could help overcome this problem. If policymakers were willing to systematically put out of business the financial institutions found facilitating evasion, then the supply of evasion services would shrink, and tax evasion at the top could be reduced dramatically. In turn, a lower equilibrium level of tax evasion would make it possible, everything else equal, to increase effective tax rates on the rich and hence ultimately may contribute to reducing inequality.[43] While there is a view that taxing the rich is not possible in a globalized world (e.g., Landier and Plantin 2017), with proper enforcement, progressive taxation might be more sustainable than previously thought.

This insight also shows that tax enforcement and financial regulation policies are intertwined. It is easier to close small financial institutions than systematically important ones. Since 2009, 80 Swiss banks have admitted helping US persons to evade taxes; 16 others have been under criminal investigation by the Department of Justice. But the US government has been able to shut down only three relatively small institutions (Wegelin, Neue Zürcher Bank, and Bank Frey). By contrast, in 2014, Credit Suisse was able too keep its US banking license despite pleading guilty of a criminal conspiracy to defraud the IRS; in 2012, US authorities similarly decided against indicting HSBC despite evidence that the bank had enabled Mexican drug cartels to move money through its American subsidiaries. If financial regulation ensures no bank is so big that it cannot be shut down, then tax evasion could be curbed significantly.[44]

Our model can also explain some of the key observed trends in top-end evasion. In our model, the size and distribution of tax evasion are endogenous to the wealth distribution. The higher inequality, the lower the number of people who evade. The intuition for that result is simple: when inequality is high, relatively few 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.

This inequality effect could explain why on top of ultra-rich households, we also observe a number of moderately wealthy, old evaders in the HSBC leak and

[43] Of course, should government be successful at reducing tax evasion, other behavioral margins might be affected. For instance, because they have access to many opportunities for legal avoidance, the rich may simply start avoiding more whenever they are compelled to evade less. In Alstadsæter, Johannesen, and Zucman (2018b), we study how the participants in the Norwegian tax amnesty changed their avoidance decisions after disclosing their previously hidden assets. We find no substitution between illegal tax evasion and legal tax avoidance: the taxes paid by amnesty participants rise 30 percent at the time of disclosure; the rise is sustained over time; and the use of the key avoidance techniques documented in the Norwegian context does not seem to increase.

[44] In recent years, governments have compelled tax haven financial institutions to provide bank information to foreign countries' tax authorities (Johannesen and Zucman 2014, Zucman 2015, Johannesen et al. 2018). Information reporting coupled with large sanctions for the providers of tax evasion services could prove effective in reducing top-end evasion in the years ahead. But our analysis suggests that information reporting alone is unlikely to be enough if offshore financial institutions have insufficient incentives to report truthfully.

the amnesty data. In the 1950s and 1960s, following the destructions of World War II, nationalizations in Europe, and a number of other anti-capital policies, wealth inequality was at a historically low level. Swiss banks may have chosen to serve a broader segment of the population back then. Conversely, the number of clients of Swiss banks seems to have declined over the last ten years; as shown by online Appendix Figure E.6, it has been divided by three at HSBC Switzerland over the 2006–2014 period.[45] Part of the fall probably owes to improvement in the information available to the tax authorities, to technological change making leaks easier, and to increases in the rewards offered to whistleblowers (see Johannesen and Stolper 2017). But one other contributing factor might be the rise in global wealth concentration (Alvaredo et al. 2018b). Indeed, while the number of HSBC clients fell, the average account value increased 80 percent, from $3.7 million in 2006 to $6.6 million in 2014; the offshore wealth managed by Swiss banks has also increased significantly since 2000 (Zucman 2015). As the world becomes more unequal, offshore banks might choose to serve fewer but wealthier clients, making tax evasion even more concentrated at the top. Looking forward, we hope to study this issue using data from new leaks and tax amnesties throughout the world.

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[45] In the specific case of HSBC, part of this fall probably owes to the Falciani leak.

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Online Appendix: Theory

K A Model of Tax Evasion and Inequality

K.1 Baseline Model

To keep things simple, assume that there is a single firm—say, a Swiss bank—that sells wealth concealment services.[19] 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

[19] 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.[20] 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:[21]

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

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.[22]

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

[20] 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).

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

[22] 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.[23] 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

[23] 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.[24] 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.[25] 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

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

[25] 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.

Section K.3. below shows that introducing competition in our model does not affect the comparative statics summarized in Proposition 2. 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. But introducing competition 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.

K.2 Proof of proposition 2

Proof. By definition $k(s) = \int_{z \geqslant y} zf(z)dz$ and $s = 1 - F(y) = \int_{z \geqslant y} f(z)dz$, therefore $k'(s) = y$ and

$$\frac{1}{\epsilon_k(s)} = \frac{1}{sk'(s)/k(s)} = \frac{\int_{z \geqslant y} zf(z)dz}{(1 - F(y))y}$$

When y is Pareto distributed above wealth y_{min} with Pareto coefficient a, then the probaility density function is $f(y) = ay_{min}^a/y^{1+a}$, the survival function is $1 - F(y) = (y_{min}/y)^a$, and straightforward integration shows that

$$\int_{z \geqslant y} zf(z)dz = \frac{a}{a-1} y(1 - F(y))$$

Therefore:

$$\frac{1}{\epsilon_k(s)} = \frac{a}{a-1}$$

That is, the Pareto distribution has the unique property that ϵ_k is constant and equal to one over the inverted Pareto-Lorenz coefficient $a/(a-1)$. □

K.3 Competition in the supply of tax evasion services

We extend the formal model presente above to include several offshore banks that compete in the market for wealth management. We assume that the number of offshore banks B is large enough for banks to behave as price-takers. Households are assumed to be perfectly mobile across banks.

The expected profit function of the representative offshore bank i can be written as:

$$\pi_i = \int yp(y)s_i(y)f(y)dy - \lambda s_i \phi k_i \tag{5}$$

where $s_i(y)$ is the share of households at wealth level y with an account in bank i; s_i is the total number of households with an account in this bank, $s_i \equiv \int s_i(y)f(y)dy$; and k_i is the total wealth under management in this bank, $k_i \equiv \int ys_i(y)f(y)dy$. The first term of eq. (5) captures the revenue of bank i: at a given wealth level y, there are $s_i(y)f(y)$ households who each pay the bank $yp(y)$ for its wealth management services. The second term captures the expected penalty of bank i: with probability λs_i the bank pays a penalty equal to a fraction ϕ of its assets under management.

The representative bank takes prices $p(y)$ for given and maximizes expected profits over the number of customers it serves at each wealth level. The first-order condition at a given wealth level, $\partial\pi/\partial s_i(y) = 0$, can be restated as:

$$yp(y) = \lambda\phi \left\{ys_i + k_i\right\} \tag{6}$$

The left-hand side expresses the revenue generated by the marginal customer at wealth level y while the right-hand side expresses the increase in expected penalties. Expected penalties increase when the bank adds a customer both because the penalty applies to a larger stock of wealth in case of detection (first term) and because the probability of detection rises with the number of customers (second term).

We are searching for a market equilibrium: a distribution of prices $p(y)$ and a symmetric allocation of customers across banks satisfying that (i) all banks maximize profits with respect to the number of customers at each wealth level and (ii) all households who desire an offshore account at the market price applying to their wealth level are offered such an account.

In such an equilibrium, the first-order condition eq. (6) must hold for customers at different wealth levels simultaneously. This implies that equilibrium prices differ across customers with different wealth. Specifically, for given values of s_i and k_i, eq. (6) implicitly defines the value of $p(y)$ that is consistent with equilibrium at each wealth level. It follows directly that wealthier

customers pay lower unit prices. Intuitively, each new customer raises the expected penalties associated with existing customers by the same amount $\lambda\phi k_i$; hence, in order for banks to be indifferent between customers at different wealth levels, they need to be associated with the same expected revenue $y(p(y) - \lambda\phi s_i)$. This shows that $p(y)$ is higher at lower levels of y.

Who holds an offshore bank account in the equilibrium? For a given distribution of prices $p(y)$, households choose to hold an offshore bank account when the unit price applying to their wealth level is equal to or below their willingness to pay θ. Since unit prices are decreasing in wealth, there is a wealth level $\widetilde{y}$ above which all households have an offshore bank account and below which no household has an offshore bank account.

Note that eq. (6) determines the distribution of prices $p(y)$ given values of s_i and k_i, which in turn depend on $\widetilde{y}$. With a symmetric allocation of customers across banks, each bank has $1/B$ of the customers at each wealth level so that:

$$s_i = \frac{1}{B}\int_{\widetilde{y}}^{\infty} f(y)dy \tag{7}$$

$$k_i = \frac{1}{B}\int_{\widetilde{y}}^{\infty} yf(y)dy \tag{8}$$

The unique value of $\widetilde{y}$ that closes the model is the value satisfying that the marginal customer with wealth $\widetilde{y}$ faces a price that is exactly equal to the willingness to pay θ:

$$p(\widetilde{y}) = \theta \tag{9}$$

To see that such a value exists, note that as $\widetilde{y} \to \infty$, s_i and k_i both approach zero implying that $p(y)$ approaches zero for all wealth levels such that $p(\widetilde{y}) < \theta$. Conversely, as $\widetilde{y} \to 0$, s_i and k_i become very large implying that $p(y)$ becomes large at all wealth levels such that $p(\widetilde{y}) > \theta$ for plausible values of θ. Since s_i and k_i are monotonous functions of $\widetilde{y}$ and $p(y)$ at any given wealth level is monotonous functions of s_i and k_i, there is a unique value $\widetilde{y}$ securing that $p(\widetilde{y}) = \theta$.

Having solved the model for a fixed number of banks, we note that banks earn positive profits in the equilibrium: the marginal customer generates no profits in expectation, but infra-marginal customers do. We may think of B as being endogenously determined as the highest number of banks that allow expected profits to cover the fixed costs of entry on the banking market.

It follows directly from this analysis that also in a setting with many banks and perfect competition, offshore banks serve all households above a wealth threshold. The main qualitative differences are that banks do not appropriate the full economic rent associated with offshore tax evasion and that unit prices for wealth management are declining in the wealth level of

the customers. Intuitively, prices for customers with more wealth are competed further down because they generate more revenue for the banks while adding the same detection risk as customers with less wealth.

To study how the penalty rate and the probability of detection shape the equilbrium, we differentiate the system consisting of eq. (6) evaluated at $\widetilde{y}$ and eq. (7)-(9) with respect to ϕ, λ and $\widetilde{y}$ and rearrange to obtain:

$$\frac{d\widetilde{y}}{(d\lambda + d\phi)} = \frac{\widetilde{y}s_i + k_i}{p(\widetilde{y}) - \lambda\phi s_i + \lambda\phi\widetilde{y}\frac{1}{B}f(\widetilde{y}) + \lambda\phi\frac{1}{B}\widetilde{y}f(\widetilde{y})}$$

which is unambiguously positive since $p(\widetilde{y})$ must be strictly larger than $\lambda\phi s_i$ in order for eq. (6) to hold. Hence, consistent with our previous findings, the model with perfect competition on the market for offshore banks predicts that increasing the penalty rate and the probability of detection induces banks to serve a narrower segment of households.

To study how inequality affects the equilibrium, we let $\overline{y}$ denote the highest wealth level and derive how an increase in this wealth level propagates in the model. Differentiating the same system of 4 equations with respect to $\overline{y}$ and $\widetilde{y}$ and rearranging, we obtain:

$$\frac{d\widetilde{y}}{d\overline{y}} = \frac{\lambda\phi\left\{\frac{1}{B}f(\overline{y})\right\}}{\left\{p(\widetilde{y}) - \lambda\phi s_i + \lambda\phi\widetilde{y}\frac{1}{B}f(\widetilde{y}) + \lambda\phi\frac{1}{B}\widetilde{y}f(\widetilde{y})\right\}}$$

which is unambiguously positive since $p(\widetilde{y})$ must be strictly larger than $\lambda\phi s_i$ in order for eq. (6) to hold. Hence, consistent with our previous findings, the model with perfect competition on the market for offshore banks predicts that increasing inequality induces banks to serve a narrower segment of households.

Finally, to study how the number of banks affects the equilibrium (for instance through a change in the entry costs), we differentiate the same system of 4 equations with respect to $\widetilde{y}$ and B and rearrange to obtain:

$$\frac{d\widetilde{y}}{dB} = -\frac{\widetilde{y}s_i + k_i}{B\left\{p(\widetilde{y}) - \lambda\phi s_i + \frac{\widetilde{y}}{B}f(\widetilde{y}) + \frac{1}{B}f(\widetilde{y})\right\}}$$

which is unambiguously negative since $p(\widetilde{y})$ must be strictly larger than $\lambda\phi s_i$ in order for eq. (6) to hold. Hence, this is a new result showing that an increase in the number of offshore banks, increases the segment of households engaged in offshore tax evasion. Intuitively, with the market shared by more banks, each bank has a smaller balance sheet and thus faces a smaller increase in the expected penalty by taking on additional customers. This lowers equilibrium prices for offshore banking and induce more households to evade taxes.