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Abstract

Tax authorities worldwide are implementing voluntary disclosure schemes to recover tax on offshore investments. The US and UK, in particular, have implemented such schemes in response to bulk acquisitions of information on offshore holdings, recent examples of which are the "Paradise" and "Panama" papers. Schemes offer affected investors the opportunity to make a voluntary disclosure, with reduced fine rates for truthful disclosure. Might such incentives, once anticipated by investors, simply encourage evasion in the first place? We characterize the investor/tax authority game with and without a scheme, allowing for the possibility that some offshore investment has legitimate economic motives. We show that a scheme increases net expected tax revenue, decreases illegal offshore investment, increases onshore investment, but could either increase or decrease legal offshore investment. The optimal disclosure scheme offers maximal incentives for truthful disclosure by imposing the minimum allowable rate of fine.

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Keywords: voluntary disclosure, offshore tax evasion, tax amnesty, third-party information.

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1 Introduction

An estimated ten percent of world GDP is held in tax havens, much, though by no means all, of which goes unreported (Alstadsæter *et al.* 2018; Zucman, 2013). The loss of tax receipts due to offshore tax evasion by individuals in the United States (US) alone has been estimated at $30-40 billion per annum (Gravelle, 2009). In recent years, data breaches have allowed tax authorities around the world to acquire information on thousands of offshore investments. To recover any tax owing on these investments, tax authorities have, in many instances, offered affected investors a one-off and time-limited opportunity to make a voluntary disclosure through a bespoke facility giving overt incentives for honesty (usually in the form of a lower fine rate). We term facilities of this form Incentivized Offshore Voluntary Disclosure Schemes, or just "schemes". The net revenues arising from such schemes have been significant: in 2009 a US scheme raised $3.4 billion (GAO, 2013) and a UK scheme netted nearly £500 million (Treasury Committee, 2012: 14). The UK scheme is estimated to have cost £6 million to administer (Committee of Public Accounts, 2008: 9), implying a return of 67:1. This compares favorably with reported yield/cost ratios in the UK of around 8:1 for traditional audit-based enforcement programs (HMRC, 2006).[1]

The advent of offshore data leakages, and the associated implementation of voluntary disclosure schemes, may have come as a surprise to holders of legacy investments, but such developments are by now well understood by today's prospective offshore investors. Given that such schemes are by now largely anticipated, this raises the question of whether the continued use of such schemes is gainful to tax authorities. In particular, in offering incentives for voluntary disclosure, might such schemes simply encourage illegal offshore investment in the first place – a concern pointed to by some recent empirical evidence. We shed light on this concern.

In this paper we appraise the use of anticipated offshore disclosure schemes using game theoretic tools. The model has two key features. First, we consider disclosure schemes that are implemented retrospectively in response to an information leak, as we argue characterizes practice in the UK and US. By the time of the information leak, however, the act of illegal offshore evasion has already taken place. As it cannot influence the illegal act retrospectively, the best a tax authority can do is seek to recover any tax owed. The importance of this observation lies in the fact that, in implementing incentivized schemes to recover efficiently

[1] The ratio of 8:1 is the estimated yield/cost ratio for self-assessment non-business enquiry work in 2005-06.

tax owed from past evasion, the tax authority may inadvertently change the incentives for future acts of offshore evasion. Second, we recognize that there can be legitimate economic reasons for holding money in offshore accounts. Accordingly, not all investors who appear in data on offshore holdings owe tax. Pritchard and Khan (2005), the only published work we are aware of by tax authority insiders with unfettered access to the UK offshore data, reports that even among those entities flagged as the highest risk category in offshore data only 70 percent were expected to owe tax.

Why invest offshore if not to evade tax? As well as potential pecuniary benefits in the form of higher pre-tax rates of interest than available onshore, offshore investments can also offer legitimate tax advantages. Pension funds routinely invest via funds domiciled offshore, for they enable investors from different countries to invest in the same fund, and can also legally prevent instances of double taxation. Most major onshore hedge funds have an accompanying offshore vehicle. For US based tax-exempt organizations, such vehicles provide some legitimate relief from taxation of unrelated business income tax. As well as legitimate tax advantages, offshore investments potentially offer a range of non-pecuniary benefits: offshore providers are known to offer greater convenience and sophistication, presumably as they face lighter regulatory controls as compared with their onshore counterparts (Helm, 1997: 414).[2] Recent leakages reveal that, in early 2000s, the Queen of the United Kingdom held around £10 million of her private money offshore: such investments had no tax motivation as the Queen is exempt from UK income and capital gains taxes. DEG, a development finance institution wholly owned by the German state, is known to have used offshore accounts for a number of years, citing non-pecuniary factors it utilized for legitimate operational purposes.[3] Professional poker players, and other individuals who must transact regularly in many different currencies, are also known to make legitimate use of offshore bank accounts (see O'Reilly, 2007).

In order to appraise the impact of anticipated disclosure schemes we first model the strategic interaction between investors and the tax authority in the absence of a scheme.[4] We then

[2] Relative to their onshore counterparts in the US, Helm argues that offshore funds have greater flexibility and less procedural delays in changing the nature, structure, or operation of their products, and they face fewer investment restrictions, short-term trading limitations, capital structure requirements, and governance provisions. For evidence on the impact of these differences on the behavior of onshore and offshore financial institutions see Kim and Wei (2002).

[3] See DEG (2015) wherein accounts held in Mauritius are disclosed on p. 57. For the operational justification see `https://www.welt-sichten.org/artikel/32312/deg-ohne-offshore-geht-es-nicht`.

[4] In this paper we focus solely on efficiency. There is, however, an equity concern when offering incentives

introduce a scheme into the model and compare the results. A investor can decide to invest an exogenous lump-sum either onshore or offshore. An onshore investment must be made legally, but an offshore investment may be made either legal or illegally. As such, not all investments tax authorities observe in offshore data owe tax. If an investor invests offshore, the investment is subsequently observed by the tax authority with a positive probability. In the absence of a scheme, if an investor's offshore investment is observed, the tax authority can, if it chooses, verify whether any tax is owed, but at a cost. Following verification of a tax liability, the tax authority can recover outstanding taxes and levy fines. An equilibrium of this game is inefficient to the extent that the tax authority struggles to achieve a credible threat to verify, owing to its inability to distinguish between legal and illegal offshore investments. In the presence of a scheme, the tax authority chooses an incentivized fine rate that will apply to liabilities disclosed within the scheme, and investors decide whether or not to make a disclosure within the scheme. If an investor does make a disclosure they can either disclose their offshore investment to be illegal and pay the tax owed plus a fine at the incentivized rate, or disclose their investment as legal. The tax authority can choose to verify the investments of those investors who disclose their offshore investment to be legal (for an illegal investment might be falsely disclosed as legal). Even if an investor decides not to make a disclosure within the scheme the tax authority can nevertheless choose to verify their investment and, where appropriate, levy fines.

We find that the introduction of a disclosure scheme induces fewer investors to invest offshore illegally. Key to this finding is the idea that disclosure schemes induce endogenous decisions by investors that act to lower the marginal cost of enforcement for tax authorities. Our findings imply that the number of investors investing onshore increases, but so too may the number investing offshore legally. Thus, our model suggests that empirical evidence pointing to increased offshore investment following the introduction of a scheme may not be evidence that such schemes generate additional offshore evasion, but instead evidence that such schemes generate additional legal offshore investment. Tax authorities also benefit from schemes: expected net revenue increases due to the additional voluntary compliance that occurs when some investors switch from investing offshore illegally to investing legally. Consistent with the design of schemes in the UK, the model predicts that the optimal scheme

to tax evaders. Moreover, only a subset of evaders (i.e., those that evade through an offshore investment) benefit. See, e.g., Bordignon (1993) and Rablen (2010) for studies of the role of equity in influencing tax evasion. There are also moral and legal concerns where information on offshore investments that was obtained by illegal means has been purchased by tax authorities (see, e.g., Pfisterer, 2013).

offers the lowest allowable fine rate permitted in legislation for truthful disclosure within the scheme.

The paper proceeds as follows: Section 2 gives an overview of the use and design of disclosure schemes in the recovery of offshore tax evasion, and section 3 casts our contribution in the context of the existing literature. Section 4 presents the model, which is developed in the absence of a scheme in section 5, and in the presence of a scheme in section 6. Section 7 gives a comparative analysis of the consequences of the introduction of a scheme for investment behavior, welfare, and for tax revenue; and Section 8 concludes.

2 Offshore Disclosure Schemes

Bulk leakages of offshore holdings data have in recent decades affected investors in almost all major economies: Table 1 in Langenmayr (2017), which summarizes and updates information provided in OECD (2010), documents the use of offshore voluntary disclosure schemes to address data leakages by 40 tax authorities worldwide. Leakages have occurred through a number of channels. First, some tax authorities are aggressively exploiting legal powers that impel private financial institutions to release information relating to offshore holdings. Second, tax authorities are cooperating with whistleblowers. For instance, a list of offshore account holders of HSBC's Geneva branch – seized by French police in 2009 – has been the subject of investigation by tax authorities worldwide, as are further lists published by the International Consortium of Investigative Journalists (the "Paradise" and "Panama" papers) and the Center for Public Integrity (Center for Public Integrity, 2013).[5] Third, tax authorities are exploiting information arising from new legislation, such as occurred when the 2003 European Savings Directive (European Union, 2003) came into force. Last, tax authorities are taking steps to improve international cooperation through the signing of tax information exchange agreements, with the G20 countries leading in this regard.[6] The creation in 2013 of an OECD Common Reporting Standard (OECD, 2013) and, in 2010, the adoption in the US of the Foreign Account Tax Compliance Act (FATCA), are leading to continuing information flows regarding offshore investments.[7]

[5] A subset of the former list is the so-called "Lagarde List" – which contains 1,991 names of Greeks with accounts in Switzerland. It was passed to the Greek authorities in 2010 by the then French Finance Minister, Christine Lagarde (Boesler, 2012).

[6] Within eight months of the G20 summit of April 2009 tax havens had signed more than 300 treaties (Johannesen and Zucman, 2014). See Konrad and Stolper (2016) for a more general model of the problem of coordinating against tax havens.

[7] For more on the economic impact of FATCA see Dharmapala (2016).

Some tax authorities have opted to address data leakages through standing generic mechanisms for voluntary disclosure, rather than implement bespoke offshore disclosure schemes. According to Langenmayr (2017: Table 1) countries such as Australia, Canada, Germany and Japan have utilized standing mechanisms – but countries such as France, Israel, the UK, and the US, have opted for bespoke schemes. In these latter set of countries, the impetus for each scheme may be traced to specific data leakages. For instance, one of the very first schemes, the 2007 Offshore Disclosure Facility (ODF), was implemented in the UK following legal action to force five major UK banks to disclose details of the offshore accounts held by their customers. The ODF offered affected investors time-limited access to a ten percent fine rate (the minimum allowable penalty under UK civil legislation) if they made a full disclosure.

In 2009 the IRS learned, via a whistleblower, details of the offshore accounts of a number of US citizens with the Swiss bank UBS. In response, it launched the Offshore Voluntary Disclosure Program (OVDP) in the same year and later implemented the Offshore Voluntary Disclosure Initiative in 2011.[8] The UK implemented two schemes – the New Disclosure Opportunity and the Liechtenstein Disclosure Facility – in response to whistleblower information relating to (i) 100 UK citizens with funds in Liechtenstein; and (ii) all British clients of HSBC in Jersey (Watt *et al.*, 2012). Following the signing of specific bilateral tax information exchange agreements, the UK implemented the 2009 Liechtenstein Disclosure Facility, and three further schemes aimed at its dependencies The Isle of Man, Jersey and Guernsey.

3 Literature Review

To our knowledge, the only theoretical analysis dedicated to offshore disclosure schemes is found in Langenmayr (2017). In her model, the tax authority is a first mover, deciding on the incentivized fine rate before investors decide whether or not to evade tax. Treating the tax authority as a first mover is appropriate to modelling the implementation of schemes in those countries which have chosen to handle offshore data acquisitions through standing generic mechanisms for voluntary disclosure. To our knowledge, however, no existing analysis addresses practice in, e.g., the UK and US, which – as discussed previously– have implemented bespoke schemes in reaction to specific data leakages.[9] We address this la-

[8] See Table 1 and Appendix II of GAO (2013) for a full account of the background to, and operation of, these two schemes.

[9] In assuming the tax authority moves second, our model has similarities with, e.g., Graetz *et al.* (1986). Different from this analysis, however, we assume that, for the tax authority to go to the trouble of performing

cuna: in our analysis the tax authority is assumed to move after investors have made their investment choice. This case is of interest as when the tax authority is endowed with the advantage associated with moving first an optimal scheme cannot lower net revenue, but when the first-mover advantage is handed to investors the desirability of such schemes is not a priori obvious.

Two other differences relative to Langenmayr's study are worthy of mention. First, Langenmayr finds the introduction of a scheme increases offshore tax evasion. This effect arises at the discretion of the tax authority as a consequence of its revenue maximizing strategy. That is, in equilibrium, the tax authority "permits" an increase in evasion as the loss of revenue through voluntary compliance is more than recouped through additional fine payments.[10] In our model the tax authority takes evasion behavior as fixed, for it has already taken place when the scheme is conceived. In this context, these apparently perverse incentives on the part of the tax authority do not arise. Rather, we find that the introduction of a scheme unambiguously reduces illegal offshore evasion, albeit legal offshore investment could indeed be increased by a scheme). Second, while Langenmayr makes the important point that disclosure schemes may reduce the per-investor verification cost (as the investor freely supplies the necessary information) we show that a case for such schemes exists even neglecting this consideration. Instead, we highlight how the design of a scheme reduces the *number* of investments that must be verified. As a consequence, the marginal cost of increasing the probability of verification falls, for this probability applies to a smaller base of investments.

Our analysis relates to a number of other literatures. We connect to a literature on the use by tax authorities of pre-audit settlements in which investors can acquire full (e.g., Chu, 1990; Glen Ueng and Yang, 2001) or partial (Goerke, 2015) insurance from audit risk. These settlements are shown to yield a Pareto improvement relative to random auditing as (i) the tax authority captures the positive risk premium of a risk averse investor and (ii) the tax authority conducts fewer random audits. Such audit settlement schemes, however, rely on the tax authority moving first, before the investor makes the evasion choice. They are, therefore, not directly applicable in our framework. It is also notable that, even were we to allow the tax authority to move first, such settlement procedures would not induce a Pareto improvement in our framework. We consider risk neutral investors, so the tax authority is not

verification, it must be *strictly* gainful in expectation. This leads to tax authority to adopt a pure strategy, whereas Graetz *et al.* consider a mixed strategy for the tax authority.

[10] For another context in which a revenue-maximizing tax authority does not maximize voluntary compliance see Rablen (2014).

able to extract a positive risk premium; and we assume the tax authority audits optimally with and without a scheme, which rules out random auditing. In particular, in our model the tax authority does not gain from a reduction in the number of audits it performs *per se*, as it only ever audits when it is strictly gainful in expectation to do so.

As our model examines both the initial decision by the investor to evade, as well as the investor's subsequent disclosure decision, it is closely associated with the literature investigating anticipated tax amnesties, by which we mean voluntary disclosure schemes run *in the absence of new information*, which nevertheless offer investors reduced penalties if they wish to disclose an illegal offshore investment (see, e.g., Bayer *et al.* (2015) and the references therein). Empirical evidence demonstrates clearly that there exists a significant body of investors who will not disclose under an amnesty who will disclose under a scheme, presumably because the latter entails the credible threat of sanctions in the event of non-disclosure. Londoño-Vélez and Ávila-Mahecha (2018) document how participation in a pre-existing Colombian mechanism for voluntary disclosure increased more than eightfold following the publication of the Panama papers, while Johannesen *et al.* (2018) and Bethmann and Kvasnicka (2016) document similarly large effects on the use of standing voluntary disclosure mechanisms in the US and Germany respectively following offshore data leakages. Consistent with this evidence, the investors in our model would never make a voluntary disclosure in the absence of new information, but do make a disclosure when, following the receipt of information, a scheme is offered. Whereas the literature has cast doubt on the desirability to tax authorities of anticipated amnesties, our analysis of voluntary disclosure schemes arrives at more positive conclusions. An optimally designed scheme, even when anticipated, increases net revenue and reduces illegal offshore evasion.

Our work also connects to the literature on law enforcement with self-reporting (e.g., Kaplow and Shavell, 1994). In this literature truthful disclosure is induced by allowing those who report to pay a sanction equal to the certainty equivalent of the expected sanctions they would otherwise face by not self-reporting. The insights of Kaplow and Shavell are sufficient to establish that, if a tax authority moves first, then a scheme can always be made unambiguously beneficial: it can be chosen, for instance, to lower enforcement costs while holding incentives to commit evasion fixed. While our model also utilizes this insight, the key difference between our model and this literature is that the tax authority moves second, after the crime is committed. In this setting it is unclear that the desirable properties of self-reporting when the law enforcer moves first are retained.

A further related literature is that on optimal auditing in the presence of signals (e.g., Scotchmer, 1987; Macho-Stadler and Pérez-Castrillo, 2002; Bigio and Zilberman, 2011). Under a scheme both the very act of making a disclosure, as well as its content, are signals the tax authority observes before deciding whether to audit (verify). Last, as the ability of tax authorities to extract revenue from whistleblower data influences the degree to which they should incentivize such behavior, our findings inform the literature on the optimal incentivization of whistleblowing (Yaniv, 2001) and complement studies that analyze the effects on compliance of the presence of potential whistleblowers (Mealem *et al.*, 2010; Bazart *et al.*, 2014; Johannesen and Stolper, 2017).

4 Model

In this section we model offshore disclosure schemes as a strategic interaction between investors, who can invest either onshore or offshore, and the domestic tax authority.

Each investor i belonging to the set T receives a lump-sum $w_i > 0$, unobserved by the tax authority. The lump-sum is distributed across investors according to the function $W : [\underline{w}, \overline{w}] \in \mathbb{R}_{>0} \mapsto (0,1)$. Each investor should, by law, declare the lump-sum for taxation at the marginal rate $\theta \in (0,1)$. We assume, however, that investors have three possible actions (i) invest the lump-sum offshore without declaring it for domestic taxation (illegal offshore investment); (ii) declare the lump-sum for domestic taxation and invest the remaining amount $[1-\theta]\,w$ offshore (legal offshore investment); or (iii) declare the lump-sum for domestic taxation and invest the remainder onshore. In considering these actions we stress that investing money offshore is not an illegal act: what makes an offshore investment illegal in our model is the failure to previously declare the source capital for domestic taxation. Amounts invested offshore earn a rate of return $r_{OFF} > 0$, and amounts invested onshore earn a rate of return $r_{ON} > 0$.[11] Investors consume the investment (plus earned interest), upon its maturity.

We shall assume, for simplicity, that interest income accruing from investment is untaxed. That is, we focus on the evasion of tax on the source capital rather than the evasion ("sheltering") of interest income. As well as giving tractability, we note that the former is of greater

[11] In modelling $\{r_{ON}, r_{OFF}\}$ as exogenous positive constants, the model is agnostic as to the relative magnitudes of these two quantities. Under additional assumptions regarding the separate structures of the onshore and offshore industries, an arbitrage relationship might be postulated to endogeneously relate these two quantities. Our results are robust to, but do not require, such an approach.

economic significance: the amount of source capital is typically many times the annual interest flow such that only when undeclared interest has accrued over many years does the tax liability from this source become of a comparable magnitude to that on the undeclared capital.[12]

As discussed in the introduction, offshore investments may differ from onshore investments both in the pecuniary and non-pecuniary dimensions. We capture the former dimension through the separate rates of return, r_{ON} and r_{OFF}; and the latter dimension, for each investor i, by a parameter $b_i > 0$, where $b_i < 1$ signifies that the non-pecuniary benefits to i from investing offshore exceed those from investing onshore, while $b_i > 1$ signifies the reverse. b_i is independent of w_i, and is distributed across investors according to the function $B : \mathbb{R}_{>0} \mapsto (0, 1]$.

An offshore investment (legal or illegal) is subsequently observed by the tax authority with probability $p \in (0, 1)$. In the long run, p is endogenous to the efforts of tax authorities in, e.g., improving international cooperation and incentivizing whistleblowing. In the short-run, however, tax authorities must take p as fixed, as we shall suppose.

The underlying inference problem for the tax authority is as follows: if it observes an offshore investment of amount y, this could be the illegal investment of an investor with lump-sum $w = y$ or the legal investment of an investor with lump-sum $w = y/[1 - \theta]$. While the simplicity of our model confers many advantages, one disadvantage is that it might lead the reader to underestimate the practical complexities to a tax authority of making this inference: investors affected by offshore schemes are, in most cases, high net-worth individuals with often extremely complex financial arrangements, frequently involving the use of intermediary trust structures that make even mapping investments to their "true" owners a prolonged and labor-intensive process. For this demographic, the idea that the lump-sum – even when declared – will appear in a transparent and separately itemized form within the tax return for a known individual in a known tax year is in most cases unduly optimistic. Rather – as evidenced by the fact that tax authorities are routinely observed to seek external information from both the affected taxpayer and other financial institutions – tax authorities are typically unable to verify the legality of an investment solely on the basis of their internal information. Moreover, even once the lump-sum has been pinpointed, its nature (e.g., bequest, income, capital gain) must be established to verify that the correct tax

[12] See, e.g., Pritchard and Khan (2005) for a detailed discussion and empirical evidence on this point.

(inheritance, income, or capital gains tax) was applied. Bearing these points in mind, we therefore suppose the tax authority must sink a verification cost $c > 0$ to reveal the nature of an offshore investment.[13]

If a tax liability is verified, the tax authority can levy a fine on the undeclared tax at a rate $f \in [\underline{f}, \overline{f}]$, where these upper and lower bounds are interpreted as being specified in legislation. Standard arguments (e.g., Kaplow and Shavell, 1994) ensure that a revenue-maximizing tax authority will choose $f = \overline{f}$. At the fine rate $\overline{f}$, the amount an investor must pay in tax and fines on a verified illegal investment y is denoted by

$$Q(\overline{f}, y) = \theta[1 + \overline{f}]y. \tag{1}$$

To simplify aspects of the analysis we make the following assumptions:

Assumption 1 $Q\left(\overline{f}, \underline{w}\right) > c.$

Assumption 2 $p[1 + \overline{f}] > 1 > p[1 + \underline{f}].$

Assumption 1 may be interpreted as requiring the lump-sum w to be sufficiently large that it is gainful for the tax authority to verify an illegal offshore investment. Empirically, this assumption is very likely satisfied, for observed offshore investments are typically large.[14] Moreover, to the extent that some observed offshore holdings are too small to be worthwhile investigating, such holdings can be screened almost costlessly by the tax authority. Assumption 2 implies that, at the maximum fine rate, $\overline{f}$, it is not gainful (in expectation) to invest offshore illegally if the tax authority, conditional on observing the investment, will verify with certainty. Conversely, at the minimum fine rate specified under legislation, $\underline{f}$, it is gainful to invest offshore illegally even if, conditional on observing the investment, the tax authority will verify with certainty. If the former inequality is not satisfied, illegal offshore investment is a one-way bet, for it pays even when the tax authority's enforcement is maximal. If the

[13] In our analysis, the cost c applies always, irrespective of whether an investor makes a voluntary disclosure. In Langenmayr (2017), by contrast, verification is assumed to cost the tax authority less if the investor makes a voluntary disclosure. As this alternative assumption – which can be readily be introduced into our model – adds to the case for disclosure schemes, it only strengthens our results when adopted.

[14] According to Watt *et al.* (2012), the list of HSBC Jersey account holders obtained by HMRC in 2012 identifies 4,388 people holding £699 million in offshore current accounts, which implies an average holding of £159,000. The median account balance of more than 10,000 closed cases from the 2009 OVDP in the US is reported as \$570,000 in GAO (2013).

latter inequality is not met, the tax authority's enforcement is so strong that it can eliminate all offshore investment in the presence of a scheme. Note that Assumption 2 rules out the pure amnesty case $p = 0$ in which there is no threat that an illegal offshore investment will subsequently be observed.

Investors behave so as to maximize expected consumption, while the tax authority behaves so as to maximize revenue (comprising voluntary compliance, recovered tax, and fines) net of enforcement costs. While the implied risk neutrality of the tax authority is standard, the risk neutrality of investors might seem restrictive. Allowing for risk averse investors can only strengthen the case for voluntary disclosure schemes, however. In the absence of a scheme, risk averse investors would pay a premium to insure against the risk associated with possible tax authority verification. When a scheme is offered, however, investors can avoid uncertain verification by disclosing truthfully. In this way the tax authority is able to capture the investor's risk premium within the scheme. To establish an economic case for the use of such schemes it is therefore sufficient to examine the risk neutral case.

For simplicity, we de-emphasize intertemporal considerations by assuming a time preference rate of unity (for both investors and the tax authority).[15] Denote the expected consumption from choosing an investment of type k as C_k, where $k = ON$ is for onshore investment, $k = L$ is for legal offshore investment, and $k = I$ is for illegal offshore investment. We may then partition the set T into those investors that invest onshore, offshore legally, and offshore illegally, $T = T_{ON} \cup T_{OFF} = T_{ON} \cup T_I \cup T_L$, where

$$T_{ON} = i : C_{ON} \geq \max\{C_L, C_I\}; \quad T_{OFF} = i : C_{ON} < \max\{C_L, C_I\};$$
$$T_L = i \in T_{OFF} : C_L \geq C_I; \quad T_I = i \in T_{OFF} : C_L < C_I.$$

Conditional on having chosen to invest offshore, the probability that an investor who has invested an amount y chooses to do so illegally is denoted $\phi = \phi(y) \in [0, 1]$. When the tax authority chooses its enforcement parameters $\phi(y)$ is already determined, though its value is not observed by the tax authority. We suppose, however, that the tax authority forms a (rational) expectation of this quantity, $\tilde{\phi}(y)$, satisfying $\mathbf{E}(\tilde{\phi}(y)) = \phi(y)$.

[15] To the extent that tax authorities do care about the timing of tax receipts, not just their level, our results suggest implementation of schemes is beneficial. This arises as we find schemes to increase voluntary compliance, implying that more tax is paid at the time the investment is made.

5 No Scheme

In order to appraise the use of disclosure schemes, we now model the "do nothing" benchmark case in which the tax authority does not offer a scheme (NS). The game in the absence of a scheme is set out in Figure 1. At the outset, nature determines each investor's lump-sum, w_i, and his/her level of non-pecuniary benefit, b_i, but this action is unobserved by the tax authority. Next, investors make an investment choice as described previously. Offshore investors have their investment subsequently observed by the tax authority with probability $p \in (0,1)$.[16] The distribution function of observed offshore investments is denoted by $Y(\cdot)$. If offshore holdings are not observed by the tax authority, any illegal offshore investment goes undetected with probability one, and the game ends. If offshore holdings are observed by the tax authority, it will verify each offshore investment with a probability $\alpha \in [0,1]$. Verified undeclared liabilities are fined at the rate $\overline{f}$. It follows that expected investor consumption is given by

$$C_{ON} = [b_i + r_{ON}][1-\theta]w; \quad (2)$$

$$C_L = [1 + r_{OFF}][1-\theta]w; \quad (3)$$

$$C_I = [1 + r_{OFF}]\left[w - p\alpha Q(\overline{f}, w)\right]; \quad (4)$$

where implicit in this formulation is that an investor holding an illegal offshore investment must repatriate some of their investment to meet the tax and fines payable as a result of verification, and therefore do not earn interest on this amount. Note from (2) and (3) that if $r_{ON} = r_{OFF}$ and $b_i = 1$ then an investor is exactly indifferent between a legal offshore investment and an onshore investment. More generally, the balance of pecuniary and non-pecuniary benefits favors a legal offshore investment when $r_{OFF} - r_{ON} > b_i - 1$.

Figure 1 – see p. 29

[16] We assume here, for simplicity, that the tax authority acquires offshore data at zero cost, as was indeed the case in many of the schemes discussed in the Introduction. Even when payments were made, the amounts involved – where known – appear relatively modest in relation to the revenue generated. Bradley Birkenfeld, a UBS employee who acted as an IRS informer, received a payment of $104 million, but in the context of some $3.4 billion that was eventually raised by the resulting scheme (GAO, 2013). The UK tax authority is reported to have paid a former Liechtenstein bank employee a fee of just £100,000 for information regarding more than £100 million of offshore funds (Oates, 2008). Clearly, however, any amount paid to acquire information must be set against any revenue accruing from the scheme.

The expected net revenue the tax authority will generate from the members of T is given by:

$$R_T(\alpha;\phi) = \int\int_{T_{ON}\cup T_L} \theta w \; \mathrm{d}W \mathrm{d}B + pR_{OFF}(\alpha;\phi), \tag{5}$$

where the first term is the revenue generated through voluntary compliance, and the second term,

$$R_{OFF}(\alpha;\phi) = \int\int_{T_{OFF}} \left\{\phi\alpha\left[Q(\overline{f},y) - c\right] - [1-\phi]\,\alpha c\right\} \; \mathrm{d}Y\mathrm{d}B,$$

is the expected net revenue from verifying investors in OFF. Importantly, however, the tax authority only observes ex-post the realized investment amount y of each member of the set T_{OFF}. It therefore takes as fixed the level of voluntary compliance, the total size of the set T_{OFF}, and the decomposition of T_{OFF} between investors who have invested offshore legally and illegally. Accordingly, choosing α to maximize $R_T(\alpha;\phi)$ becomes simply equivalent to choosing α to maximize $R_{OFF}(\alpha;\phi)$, i.e., the net revenue from verifying the investments of investors in T_{OFF}. Differentiating $R_{OFF}(\alpha;\phi)$ with respect to α we obtain

$$\frac{\partial R_{OFF}(\alpha;\phi)}{\partial\alpha} = \int\int_{T_{OFF}} \left[\phi Q(\overline{f},y) - c\right] \; \mathrm{d}Y\mathrm{d}B.$$

Hence, when observing an offshore investment of amount y, the tax authority chooses

$$\alpha(y;\phi) = \begin{cases} 0 & \text{if } \phi \leq \frac{c}{Q(\overline{f},y)}; \\ 1 & \text{otherwise}; \end{cases} \tag{6}$$

where here we adopt the convention that, if the tax authority is indifferent between verifying and not-verifying, it does not verify. Equation (6) captures an important intuition of the model: if the propensity to invest offshore illegally, ϕ, is sufficiently high then the tax authority will always choose to verify ($\alpha = 1$). If, however, ϕ, is sufficiently low that the expected gain from verification, $\phi Q(\overline{f},y) - c$, falls to (or below) zero, the tax authority does not find it gainful to verify an observed offshore investment, hence $\alpha = 0$. As shall become clear, the discreteness of the tax authority's verification strategy induces some risk neutral investors to commit offshore evasion probabilistically as part of a mixed strategy.

It follows from (6) that expected consumption, conditional on choosing to invest offshore, can be written as

$$C_{OFF}^{NS}(\phi, w) = \begin{cases} [1 + r_{OFF}]\{\phi w + [1-\phi][1-\theta] w\} & \text{if } \phi \leq \frac{c}{Q(\overline{f}, w)}; \\ [1 + r_{OFF}]\{\phi [w - pQ(\overline{f}, w)] + [1-\phi][1-\theta] w\} & \text{otherwise.} \end{cases} \tag{7}$$

We depict $C_{OFF}^{NS}(\phi, w)$ in Figure 2. We see that, when $\phi \leq c/Q(\overline{f}, w)$ the investor's payoff in (7) is strictly increasing in ϕ for, from (6), the tax authority will choose not to verify. Immediately above $\phi = c/Q(\overline{f}, w)$ the payoff C_{OFF}^{NS} jumps downward discretely, however, for at this higher level of ϕ the tax authority will verify. As a consequence of Assumption 2, once the tax authority can commit to verify, it is no longer gainful in expectation to invest offshore illegally. Accordingly, increases in ϕ above $c/Q(\overline{f}, w)$ are seen in Figure 2 to only reduce the payoff C_{OFF}^{NS} further. Thus, C_{OFF}^{NS} is maximized with respect to ϕ where

$$\phi(w) = \frac{c}{Q(\overline{f}, w)}, \tag{8}$$

at which point the tax authority is exactly indifferent between verifying and not-verifying.

Figure 2 – see p. 30

Substituting (8) into (7) we obtain

$$C_{OFF}^{NS}(w) = [1 + r_{OFF}] \frac{c + [1-\theta][1+\overline{f}]w}{1+\overline{f}}. \tag{9}$$

The payoff in (9) to investing offshore is strictly preferred to the payoff from investing onshore in (2) if

$$b < \frac{C_{OFF}^{NS}(w)}{[1-\theta] w} - r_{ON} \equiv \tilde{b}^{NS}(w).$$

Proposition 1 *In the absence of a scheme, if* $b_i < \tilde{b}^{NS}(w_i)$ *an investor* $i \in T$ *invests offshore illegally with probability* $\frac{c}{Q(\overline{f}, w_i)}$ *and offshore legally with probability* $\frac{Q(\overline{f}, w_i) - c}{Q(\overline{f}, w_i)}$; *and invests onshore with probability one otherwise.*

A hallmark of the equilibrium outcome is that, owing to its inability to distinguish between legal and illegal offshore investments, the tax authority is only able to cap the propensity for illegal offshore investment at $\phi(w_i) = c/Q(\overline{f}, w_i)$. Below this propensity it is unable to sustain a credible verification threat.

6 The Scheme

We now suppose the tax authority offers a scheme in the event that offshore investments are observed. The game is set out in Figure 3. The initial hidden action by nature and the subsequent investment decision are modelled in the same way as in the absence of a scheme. If offshore investments are observed, however, the tax authority chooses the terms of a scheme it then announces to investors.[17,18] Investors then choose either to enter or not-enter the scheme. If the investor enters s/he discloses a type $d \in \{L, I\}$. An investor disclosing $d = I$ (illegal) accompanies their disclosure with a payment to the tax authority of $Q(f_S, y)$, where $f_S \in [\underline{f}, \overline{f}]$ is termed the "incentivized" fine rate. An investor disclosing $d = L$ (legal) makes no accompanying payment. The tax authority verifies the disclosure $d = L$ with probability $\alpha_S \in [0, 1]$ and never verifies the disclosure $d = I$. Verification reveals the nature of an offshore investment with certainty: if the tax authority finds an investor to have disclosed falsely it levies a fine at the (maximum) rate $\overline{f}$. When an investor chooses to not-enter the scheme the tax authority verifies their investment with probability $\alpha_O \in [0, 1]$. If an illegal investment is verified, the investor is fined at the rate $f_O \in [\underline{f}, \overline{f}]$. Standard arguments ensure that the tax authority will set $f_O = \overline{f}$.

Figure 3 – see p. 30

Owing to the revelation principle, attention may be confined to schemes (mechanisms) in which investors disclose truthfully. Consider the subgame that arises when an investor enters the scheme. If an investment is illegal, falsely disclosing $d = L$ results in an expected payment of $\alpha_S Q(\overline{f}, y)$, whereas disclosing $d = I$ results in a sure payment of $Q(f_S, y)$. Hence truthful

[17]Thus the investor faces uncertainty as to whether their investment will be observed, but know a scheme will be offered if the investment will be observed. The model can be generalized to allow the tax authority to implement a scheme with a given probability in the event that information is observed. As, however, this probability turns out to be exactly one in equilibrium we omit this step without loss of generality.

[18]In practice a tax authority may also face a second choice as to the set of investors with whom it communicates the scheme. For instance, prior to the OVDP in the US, the Swiss authorities agreed to hand the IRS the names of approximately 4,450 US clients with accounts at UBS. The IRS then had the choice of (i) requiring UBS to write to affected clients informing them that the details of their offshore holding had been handed to the IRS; or (ii) requiring UBS to write to a wider set of its clients (up to the set of all UBS clients with offshore holdings) informing them that the details of their offshore holding *might* have been handed to the IRS. In actuality, the IRS chose the second option, and – to prevent investors from inferring whether their information had been handed over – negotiated a confidentiality clause with the Swiss that concealed the criteria by which the accounts were selected until after the OVDP deadline had passed (GAO, 2013). We abstract from this issue here, but note it as a potentially interesting avenue for future research.

disclosure requires f_S to satisfy $Q(f_S, y) \leq \alpha_S Q(\overline{f}, y)$.[19] As, in equilibrium, the tax authority will never find it optimal to set f_S below that required to achieve truthful disclosure, it follows that

$$Q(f_S, y) = \alpha_S Q(\overline{f}, y). \tag{10}$$

If it observes the set of offshore investments the tax authority chooses the parameters of the scheme, $\{\alpha_S, f_S\}$, as well as the analogous parameters for investors who choose to not-enter the scheme $\{\alpha_O, f_O\}$, to maximize the expected net revenue raised from investors belonging to T_{OFF}.

An investor with an illegal offshore investment faces a sure payment $Q(f_S, w) = \alpha_S Q(\overline{f}, w)$ if they enter the scheme, and an expected payment $\alpha_O Q(\overline{f}, w)$ if they choose to not-enter. We assume that, in the case of perfect indifference, investors enter the scheme. Accordingly, an investor with an illegal offshore investment will enter the scheme if $\alpha_O \geq \alpha_S$. An investor with a legal offshore investment is indifferent between entering and not-entering the scheme, so will enter also.

To emphasize a key intuition of the model we focus on the case in which investors choose to enter the scheme ($\alpha_O \geq \alpha_S$), in which case – and using the equality in (10) – expected net revenue generated within the scheme is

$$\int \int_{T_{OFF}} \phi \alpha_S Q(\overline{f}, y) - [1 - \phi] \, \alpha_S c \; \mathrm{d}Y \mathrm{d}B. \tag{11}$$

Focusing on the second term in the integral in (11), which is the cost of verification, note that the verification probability α_S applies only to the proportion $1 - \phi$ of offshore investors who have chosen to invest offshore legally, and therefore disclose $d = L$ (the remaining proportion ϕ of offshore investors who invest illegally truthfully disclose $d = I$). Conversely, in the absence of a scheme, the verification probability α applies to *all* offshore investors. Verification costs therefore fall by a factor $[1 - \phi]$ as fewer investments need to be verified. A consequence of this observation is that the *marginal cost* of increasing the verification probability also falls by a factor $[1 - \phi]$ under a scheme. As we shall see, this generates a set of values of ϕ for which the tax authority is able to maintain a credible verification threat in the presence of a scheme, but is unable in the absence of a scheme.

[19] If an offshore investment is legal, falsely disclosing $d = I$ results in a sure loss of $[1 - \theta] \, Q(\hat{f}, y)$, whereas disclosing $d = L$ results in no loss. Hence, truthful disclosure by investors in T_L is assured in equilibrium.

Establishing the equilibrium of the game in the presence of a scheme proceeds through the same set of steps as performed in Section 5. Matters are made more complicated, however, by the existence of two distinct verification probabilities $\{\alpha_O, \alpha_S\}$ that are chosen by the tax authority simultaneously. Taxpayers again invest so as to make the tax authority indifferent between verifying and not-verifying, but – in light of the discussion above – this now occurs at a new threshold given by

$$\phi^S(w) = \frac{c}{c + Q(\overline{f}, w)}. \tag{12}$$

Relegating the proof to the Appendix, we arrive at the following:

Proposition 2 *In the presence of a scheme, if* $b_i < \tilde{b}^S(w_i)$ *an investor* $i \in T$ *invests offshore illegally with probability* $\frac{c}{c+Q(\overline{f},w_i)}$*, and offshore legally with probability* $\frac{Q(\overline{f},w_i)}{c+Q(\overline{f},w_i)}$*; and invests onshore with probability one otherwise.*

7 Analysis

7.1 Verification

A result that underlies all of the remaining findings we shall present is that the introduction of a scheme enhances the ability of the tax authority to sustain a credible threat to verify, leading to a lower threshold value of ϕ at which the tax authority becomes indifferent between verifying and not-verifying:

Proposition 3 $\phi^S(w) < \phi^{NS}(w)$.

The underlying intuition for Proposition 3 is that, as noted previously, a scheme lowers the marginal cost of raising the verification probability above zero. In particular, an increase in ϕ applies only to offshore investors who disclose $d = L$, whereas it applies to all offshore investors in the absence of a scheme. To ensure that verification is not gainful in expectation for the tax authority, investors therefore become obliged to invest offshore illegally with a lower probability.

7.2 Investment and Evasion – Onshore and Offshore

By comparing the respective equilibria in the absence (Proposition 1) and presence (Proposition 2) of a scheme, we now analyze the consequences of introducing a scheme for both onshore and offshore investment volumes, and for the decomposition of offshore investments between those that are legal, and those that are illegal.

Let us denote the expected proportion of investors choosing an investment type $m \in \{ON, L, I\}$ as $\left|T_m^k\right|$, where $k \in \{NS, S\}$. Similarly, let $\left|m^k\right|$ denote the expected aggregate level of investment type m.

Proposition 4

(i) $\left|T_{OFF}^S\right| < \left|T_{OFF}^{NS}\right|$ *and* $\left|T_{ON}^S\right| > \left|T_{ON}^{NS}\right|$;

(ii) $\left|T_I^S\right| < \left|T_I^{NS}\right|$ *but* $\left|T_L^S\right| \gtrless \left|T_L^{NS}\right|$;

(iii) $\left|OFF^S\right| < \left|OFF^{NS}\right|$ *and* $\left|ON^S\right| > \left|ON^{NS}\right|$;

(iv) $\left|OFF_I^S\right| < \left|OFF_I^{NS}\right|$ *but* $\left|OFF_L^S\right| \gtrless \left|OFF_L^{NS}\right|$.

Parts (i) and (ii) of Proposition 4 focus on the proportion of investors who invest offshore with and without a scheme. The proof of part (i) demonstrates that the enhanced verification threat present under a scheme causes a fall in the critical level of relative non-pecuniary benefits required to induce investors to invest onshore, i.e., $\tilde{b}^S(w) < \tilde{b}^{NS}(w)$. This implies that the introduction of a scheme induces a set of investors – those with characteristics belonging to the shaded set in Figure 4 – to switch from investing offshore to investing onshore.[20] According to part (ii), the introduction of a scheme also unambiguously reduces the proportion of investors who invest offshore illegally. As, however, both T_{OFF} and T_I shrink, the proportion of investors who invest offshore legally could either increase or decrease. In particular, if T_I shrinks proportionately more than does T_{OFF}, then T_L expands. Parts (iii) and (iv) of Proposition 4 show that analogous results to those in parts (i) and (ii) hold also for aggregate investment. In part (iii) the introduction of a scheme causes aggregate investment to fall – simply because some investors switch from investing w offshore illegally, to instead investing the reduced amount $[1-\theta]w$ onshore legally. The fall of total investment, coupled with an increase of onshore investment, implies that offshore component of investment must fall. While the illegal component of offshore investment falls, the legal component may increase or decrease.

[20] The restriction that the density function $B(\cdot)$ takes strictly positive values for $w > 0$ ensures that there will always exist a positive mass of investors belonging to the shaded space indicated in Figure 4.

Figure 4 – see p. 31

The possibility that the legal component of offshore investment could be observed to increase following the introduction of a scheme is consistent with the evidence of Langenmayr (2017), who observes an increase in officially recorded offshore investments by US citizens following the introduction of the 2009 OVDP. Within Langenmayr's framework – which does not allow for legal offshore investment – an increase in offshore investment can only be interpreted as an increase in illegal offshore evasion. Our model, which allows for legal offshore investment for legitimate economic purposes, offers an alternative interpretation of this finding.

7.3 Tax Revenue

Does the introduction of a scheme increase the expected net revenue of the tax authority?

Proposition 5 *The expected net revenue collected by the tax authority from the set of investors T is increased by the introduction of a scheme: $R_T^S > R_T^{NS}$.*

The intuition for Proposition 5 is that the increased propensity to invest legally raises the level of voluntary compliance. This increase in expected revenue from voluntary compliance is not offset by lower net revenues arising on amounts disclosed within the scheme (on account of the lower incentivized fine rate being applied), for – both with and without a scheme – the first-mover advantage enjoyed by investors permits them to make choices that leave the tax authority just indifferent between verifying and not-verifying. When this occurs the expected yield in tax and fines from verification is exactly offset by its cost.

Were we to have assumed that the tax authority could choose the scheme parameters before investors make their investment choice, the finding that net revenue increases under a scheme would be unsurprising. As, however, we take the tax authority to move second, the implications for net revenue were initially uncertain. It is notable, therefore, that even when moving second, voluntary disclosure schemes still increase net revenue.[21]

[21] Whereas we consider a tax authority unfettered in its choice of fine rate from the interval $[\underline{f}, \overline{f}]$, in many cases it is only in prescribed circumstances that the tax authority can levy the highest allowable fine rate. In the UK, for instance, the fine rate that is applied is conditional upon the "behavioral" nature of the observed non-compliance: the lower bound applies if the non-compliance is judged to be through "careless error", whereas the upper bound applies to "deliberate and concealed" inaccuracies (HMRC, 2012). A further potential benefit of schemes, therefore, is that they may provide the legal grounds to apply a higher rate in cases where an investor either fails to respond to a disclosure opportunity, or makes a false disclosure within the scheme.

7.4 Investor Welfare

We now examine the impact of a scheme for expected investor consumption (utility):

Proposition 6 *For investors belonging to*

(i) $T_{ON}^{NS} \cup T_{ON}^{S}$, $C^{NS} = C^{S}$;

(ii) $T_{OFF}^{NS} \cup T_{OFF}^{S}$, $C^{NS} > C^{S}$;

(iii) $T_{OFF}^{NS} \cup T_{ON}^{S}$, $C^{NS} > C^{S}$.

Part (i) of Proposition 6 is for investors who invest onshore irrespective of the provision of a scheme: such investors are wholly unaffected. Part (ii) states that investors who invest offshore irrespective of the provision of a scheme lose consumption in the presence of a scheme. This loss arises as the probability ϕ^{S} that an offshore investor chooses to invest illegally is lower in the presence of a scheme. Thus, the investor loses expected consumption on account of paying tax on the lump-sum with a greater probability. Part (iii) is for investors for whom the introduction of a scheme induces a switch from investing offshore to investing onshore. Such investors move from the higher payoff C_{OFF}^{NS} in the absence of a scheme to the lower payoff C_{ON} in the presence of a scheme (continuing to invest offshore would yield the still lower payoff $C_{OFF}^{S} < C_{ON}$). That those investing offshore illegally lose utility appears desirable – after all, it is a consequence of a reduction in incentives for breaking tax law. More generally, were we to model explicitly the benefits from taxation in the form of the public services it pays for, the increased tax revenue generated by schemes would generate utility for all investors through increased provision.

7.5 Optimal Incentivized Fine Rate

For tax authorities seeking to understand the optimal design of disclosure schemes it is of interest to highlight a feature of the optimal scheme relating to the question of how to set the incentivized fine rate for those that enter the scheme. We have the following result:

Proposition 7 *In the optimal scheme it holds that* $f_S = \underline{f}$.

According to Proposition 7, the incentivized fine rate is the lowest fine rate allowed under legislation. This is consistent with the design of disclosure schemes in the UK, which have offered those who disclose the minimum ten percent penalty permitted in law. The Netherlands – which implemented bespoke schemes in 2009 and 2013 – has a minimum fine of zero ($\underline{f} = 0$), and, consistent with our finding, implemented its schemes on a no-fine basis. The result in Proposition 7 may initially seem surprising as choosing a lower fine rate would seem to reduce net revenue through a reduction in fine revenue. This is not so, however, for although fine revenue indeed falls, net revenue is left unchanged. Lowering the incentivized fine rate makes truthful disclosure more attractive to investors, meaning that the tax authority can achieve truthful disclosure with less verification. The reduction in verification costs achieved in this way exactly offsets the loss in fine revenue (as a consequence of the tax authority being indifferent between verifying and not-verifying), leaving net revenue constant. In this way, the same level of net revenue is achieved with least verification activity by setting the incentivized fine rate minimally.[22]

8 Conclusion

Tax authorities around the world are using incentivized voluntary disclosure schemes to recover tax on offshore investments. Such schemes offer discounted fine rates for those who voluntarily disclose (albeit in the shadow of subsequent enforcement against those who do not). International initiatives such as the OECD Common Reporting Standard are expected to result in their continued use. As, however, the use of such schemes by tax authorities in response to data leakages is by now anticipated, the stellar returns observed for the earliest such schemes should not be expected to continue. As our model highlights, rational investors who anticipate being offered a scheme behave in a such a manner as to make the tax authority indifferent between verifying offshore investments and not. In this paper we examined whether indeed such anticipated schemes continue to be of value to tax authorities, or could actually be incentivizing offshore evasion in the first place.

We consider an environment in which investors can invest a lump-sum onshore or offshore. Should they choose to invest offshore, they may do so legally or illegally – neither is offshore investment in itself illegal, nor is all offshore investment driven by illegal tax motives. After investments have been made, the tax authority may potentially observe the offshore investments, but does not observe which were made legally, and which illegally. Investors

[22] A further factor that might account for the use of the minimum fine rate, albeit one that lies outside of our model, is the salience to investor of a low headline incentivized fine rate. For nascent studies of taxpayer salience see, e.g., Chetty *et al.* (2009) and Krishna and Slemrod (2003).

make their investment decision knowing that, if they invest offshore and the investment is subsequently observed a scheme will be offered. The terms of the scheme, however, are determined only after the investment is observed, as we have argued characterizes the schemes operated in the UK, US and elsewhere.

In this context, we find that the tax authority can increase its expected net revenue by implementing a disclosure scheme, rather than by simply using its regular verification regime. A hallmark of the optimal disclosure scheme is that it offers the minimum allowable fine rate in law to those that disclose truthfully. The particular benefit the implementation of a scheme affords tax authorities in our model is a reduction in the base of investments that require costly verification. This lowers the marginal cost of verification, permitting the tax authority to present investors with a stronger threat to enforce the tax law. Although the implementation of disclosure schemes is consistent with a rise in legal offshore investment, importantly our model predicts that the illegal component of offshore investment always falls. Thus, in a sense our model helps makes precise, it is possible to offer ex-post inducements for truthful disclosure without simply incentivizing the underlying criminal activity.

We offer the following suggestions for future research. One extension would be to would be to extend the model to allow for the possible sheltering of interest in offshore accounts, alongside the possibility of tax evasion on the source capital. Second, imperfect verification technology might be allowed for, as in Rablen (2014). Third, communication between affected investors through a network, as in Hashimzade *et al.* (2014), might be introduced. Last, Johannesen *et al.* (2018) find that many US investors did not make use of the 2009 OVDP scheme but chose to make "quiet" disclosures through standing voluntary disclosure mechanisms following the leak of offshore data. The model could be extended to allow for this possibility as one of the investors' choices. While each of these avenues must await a dedicated treatment, we hope to have shed some further light on the economic effects and optimal design of disclosure schemes.

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Appendix

Proof of Proposition 1. The proof follows immediately from the arguments set out in the text. ■

Proof of Proposition 2. As discussed in the text, an investor with an illegal offshore investment will enter the scheme if $\alpha_O \geq \alpha_S$. An investor with a legal offshore investment is indifferent between entering and not-entering the scheme, so will enter also. Denote the expected net revenue raised from investors belonging to T_{OFF} by $R_{OFF}(\alpha_S, \alpha_O, y; \phi)$. Using the equality in (10) $R_{OFF}(\cdot)$ writes as

$$\int\int_{T_{OFF}} \phi\{\alpha_S \mathbf{1}_{\alpha_S \leq \alpha_O} + \alpha_O \mathbf{1}_{\alpha_S > \alpha_O}\} Q(\overline{f}, y) - \{[1-\phi]\,\alpha_S \mathbf{1}_{\alpha_S \leq \alpha_O} + \alpha_O \mathbf{1}_{\alpha_S > \alpha_O}\}\, c \;\mathrm{d}Y \mathrm{d}B; \tag{A.1}$$

where $\mathbf{1}_A$ takes the value one if condition A is true, and the value zero otherwise. Proceeding by backwards induction, we begin with the tax authority's choice of $\{\alpha_S, \alpha_O\}$. To deduce the optimal choice of $\{\alpha_S, \alpha_O\}$ we first consider the optimal choice of α_O conditional upon a given α_S. If $\phi > c/Q(\overline{f}, y)$ then verification is strictly gainful for $\alpha_O < \alpha_S$. At $\alpha_O = \alpha_S$ $R_{OFF}(\alpha_S, \alpha_O, y; \phi)$ jumps upwards discretely, and is then independent of α_O on the interval $\alpha_O \in [\alpha_S, 1]$. Hence, in this case, $R_{OFF}(\alpha_S, \alpha_O, y; \phi)$ is maximized w.r.t. α_O at $\alpha_O = \alpha_S$. If $\phi \leq c/Q(\overline{f}, y)$ then $R_{OFF}(\alpha_S, \alpha_O, y; \phi)$ is instead decreasing in α_O for $\alpha_O < \alpha_S$. Hence, $R_{OFF}(\alpha_S, \alpha_O, y; \phi)$ is maximized w.r.t. α_O at either $\alpha_O = 0$ or at $\alpha_O = \alpha_S$. To determine the conditions under which these two local maxima are global maxima note that, at $\alpha_O = 0$, we have $R_{OFF}(\alpha_S, 0, y; \phi) = 0$, and at $\alpha_O = \alpha_S$ we have $R_{OFF}(\alpha_S, \alpha_S, y; \phi) = \alpha_S \int\int_{\Omega_{OFF}} \{\phi Q(\overline{f}, y) - [1-\phi]\, c\}\; \mathrm{d}Y \mathrm{d}B$. The latter is strictly positive (and therefore the global maximum) if, at each y, $\phi > c[c + Q(\overline{f}, y)]^{-1}$. Noting that $c[c+Q(\overline{f}, y)]^{-1} < c/Q(\overline{f}, y)$, if $\phi \leq c[c + Q(\overline{f}, y)]^{-1}$ the global maximum is instead at $\alpha_O = 0$. It therefore holds that

$$\alpha_O(\alpha_S; \phi) \begin{cases} = 0 & \text{if } \phi \leq \frac{c}{c+Q(\overline{f}, y)}; \\ = \alpha_S & \text{otherwise.} \end{cases} \tag{A.2}$$

It follows from (A.2) that we may rewrite $R_{OFF}(\alpha_S, \alpha_O, y; \phi)$ at the optimal α_O as

$$R_{OFF}(\alpha_S, y; \phi) = \int\int_{T_{OFF}} \{\phi \alpha_S Q(\overline{f}, y) - [1-\phi]\,\alpha_S c\}\, \mathbf{1}_{\phi > c/[c+Q(\overline{f}, y)]}\; \mathrm{d}Y \mathrm{d}B.$$

Differentiating $R_{OFF}(\alpha_S, y; \phi)$ with respect to α_S we obtain that

$$\frac{\partial R_{OFF}(\alpha_S, y; \phi)}{\partial \alpha_S} = \int\int_{T_{OFF}} \{\phi Q(\overline{f}, y) - [1-\phi]\, c\} \mathbf{1}_{\phi > c/[c+Q(\overline{f}, y)]}\; \mathrm{d}Y \mathrm{d}B.$$

If ϕ is sufficiently low, i.e., $\phi \leq c[c + Q(\overline{f}, y)]^{-1}$ then $\partial R_{OFF}(\alpha_S, y; \phi)/\partial \alpha_S \leq 0$, so the tax authority will not verify. It follows that, in this case, $R_{OFF}(\alpha_S, y; \phi)$ obtains a maximum at the lowest value of α_S consistent with the truthtelling restriction $Q(f_S, y) = \alpha_S Q(\overline{f}, y)$. Hence $\alpha_S = [1 + \underline{f}][1 + \overline{f}]^{-1}$. If $\phi > c[c + Q(\overline{f}, y)]^{-1}$ then verification is strictly gainful, so

$R_{OFF}(\alpha_S, y; \phi)$ achieves a maximum at $\alpha_S = 1$. Hence

$$\alpha_O(y;\phi) = \begin{cases} 0 & \text{if } \phi \le \frac{c}{c+Q(\overline{f},y)}; \\ 1 & \text{otherwise;} \end{cases}$$
$$\alpha_S(y;\phi) = \begin{cases} \frac{1+\underline{f}}{1+\overline{\overline{f}}} & \text{if } \phi \le \frac{c}{c+Q(\overline{f},y)}; \\ 1 & \text{otherwise.} \end{cases} \tag{A.3}$$

With the nature of enforcement now determined, we analyze the investor's investment decision. Expected consumption, conditional upon investing offshore illegally with probability $\phi \in [0,1]$, can be written using (A.3) as

$$C_{OFF}^S(\phi, w) = \begin{cases} [1+r_{OFF}]\{\phi[w - pQ(\underline{f}, w)] + [1-\phi][1-\theta]w\} & \text{if } \phi \le \frac{c}{c+Q(\overline{f},w)}; \\ [1+r_{OFF}]\{\phi[w - pQ(\overline{f}, w)] + [1-\phi][1-\theta]w\} & \text{otherwise.} \end{cases} \tag{A.4}$$

The shape of $C_{OFF}^S(\phi, w)$ as a function of ϕ has the same qualitative features as the equivalent function in the absence of a scheme shown in Figure 2. In particular, for $\phi \le c/[c + Q(\overline{f}, w)]$ the investor's payoff is strictly increasing in ϕ, as the tax authority cannot credibly commit to verification. For $\phi > c/[c + Q(\overline{f}, w)]$ the investor's payoff initially falls discreetly, and becomes strictly decreasing in ϕ thereafter, as the tax authority will now verify. It follows that $C_{OFF}^S(\phi)$ obtains a maximum in ϕ at

$$\phi(w) = \frac{c}{c + Q(\overline{f}, w)}. \tag{A.5}$$

We may now determine equilibrium. Substituting (A.5) into (A.4), equilibrium consumption when investing offshore is

$$C_{OFF}^S(w) = \frac{[1+r_{OFF}]w}{c + Q(\overline{f}, w)}\{c + [1-\theta]\,Q(\overline{f}, w)\}. \tag{A.6}$$

The payoff $C_{OFF}^S(w)$ in (A.6) to investing offshore is strictly preferred to the payoff from investing onshore in (2) if

$$b < \frac{C_{OFF}^S(w)}{[1-\theta]\,w} - r_{ON} \equiv \tilde{b}^S(w),$$

from which the Proposition follows. ■

Proof of Proposition 3. We have

$$\phi^S(w) = \frac{c}{c + Q(\overline{f}, w)} < \frac{c}{Q(\overline{f}, w)} = \phi^{NS}(w).$$

■

Proof of Proposition 4. The expected proportion of investors with lump-sum w who invest offshore legally, $\tau_L(w)$, and illegally, $\tau_I(w)$, are given, respectively, by

$$\tau_L^k(w) = \left[1 - \phi^k\right] B(\tilde{b}^k(w)); \qquad \tau_I^k(w) = \phi^k B(\tilde{b}^k(w));$$

where $k \in \{NS, S\}$, and ϕ^k is the value of ϕ in state k. Hence, in aggregate, the expected proportions of investors choosing each investment type are given by

$$\begin{array}{ll} \left|T^k_{ON}\right| = \int[1-\tau^k_L(w)-\tau^k_I(w)]\ \mathrm{d}W; & \left|T^k_{OFF}\right| = \int[\tau^k_L(w)+\tau^k_I(w)]\ \mathrm{d}W; \\ \left|T^k_L\right| = \int \tau^k_L(w)\ \mathrm{d}W; & \left|T^k_I\right| = \int \tau^k_I(w)\ \mathrm{d}W. \end{array}$$

Expected aggregate net onshore and offshore investment are given by

$$\begin{aligned} \left|ON^k\right| &= [1-\theta]\int w[1-B(\tilde{b}^k(w))]\ \mathrm{d}W; \\ \left|OFF^k\right| &= \int w\{1-\theta[1-\phi^k(w)]\}B(\tilde{b}^k(w))\ \mathrm{d}W; \end{aligned}$$

where the latter may be further decomposed into its legal and illegal components:

$$\begin{aligned} \left|OFF^k_I\right| &= \int w\phi^k(w)\, B(\tilde{b}^k(w))\ \mathrm{d}W; \\ \left|OFF^k_L\right| &= [1-\theta]\int w[1-\phi^k(w)][1-B(\tilde{b}^k(w))]\ \mathrm{d}W. \end{aligned}$$

Next, we establish that $\tilde{b}^S(w) < \tilde{b}^{NS}(w)$:

$$\begin{aligned} \tilde{b}^S(w) < \tilde{b}^{NS}(w) \quad &\Leftrightarrow \tfrac{c+[1-\theta]Q(\overline{f},w)}{c+Q(\overline{f},w)} < \tfrac{\theta c+[1-\theta]Q(\overline{f},w)}{Q(\overline{f},w)}; \\ &\Leftrightarrow \tfrac{Q(\overline{f},w)}{c+Q(\overline{f},w)} > \tfrac{Q(\overline{f},w)-c}{Q(\overline{f},w)}; \\ &\Leftrightarrow 0 > -c^2. \end{aligned}$$

We may now prove the Proposition. (i) $\left|T^S_{OFF}\right| = \int B(\tilde{b}^S(w))\ \mathrm{d}W < \int B(\tilde{b}^{NS}(w))\ \mathrm{d}W = \left|T^{NS}_{OFF}\right|$ and $\left|T^S_{ON}\right| = 1 - \left|T^S_{OFF}\right| > 1 - \left|T^{NS}_{OFF}\right| = \left|T^S_{ON}\right|$; (ii) $\left|T^S_I\right| = \int \phi^S B(\tilde{b}^S(w))$ $\mathrm{d}W < \int \phi^{NS} B(\tilde{b}^{NS}(w))\ \mathrm{d}W = \left|T^{NS}_I\right|$ but $\left|T^S_L\right| = \int[1-\phi^S]B(\tilde{b}^S(w))\ \mathrm{d}W \gtrless \int[1-\phi^{NS}]B(\tilde{b}^{NS}(w))\ \mathrm{d}W = \left|T^{NS}_I\right|$; (iii) $\left|OFF^S\right| = \int w\{1-\theta[1-\phi^S(w)]\}B(\tilde{b}^S(w)) < \int w\{1-\theta[1-\phi^{NS}(w)]\}B(\tilde{b}^{NS}(w))\ \mathrm{d}W = \left|OFF^{NS}\right|$ and $\left|ON^S\right| = [1-\theta]\int w[1-B(\tilde{b}^S(w))]\ \mathrm{d}W > [1-\theta]\int w[1-B(\tilde{b}^{NS}(w))]\ \mathrm{d}W = \left|ON^{NS}\right|$; (iv) $\left|OFF^S_I\right| = \int w\phi^S(w)\, B(\tilde{b}^S(w))\ \mathrm{d}W < \int w\phi^{NS}(w)\, B(\tilde{b}^{NS}(w))\ \mathrm{d}W = \left|OFF^{NS}_I\right|$ but $\left|OFF^S_L\right| = [1-\theta]\int w[1-\phi^S(w)]B(\tilde{b}^S(w))]$ $\mathrm{d}W \gtrless [1-\theta]\int w[1-\phi^{NS}(w)]B(\tilde{b}^{NS}(w))]\ \mathrm{d}W = \left|OFF^{NS}_L\right|$. ■

Proof of Proposition 5. As the choices of investors in T_{OFF} make the tax authority indifferent between verifying and not-verifying (both with and without a scheme), it is straightforward to show that, in equilibrium, $R^S_{OFF}(y) = R^{NS}_{OFF}(y) = 0$. Hence, using (5) and (A.1), we have

$$R^k_T = \int\int_{T^k_{ON}\cup T^k_L} \theta w\ \mathrm{d}W\mathrm{d}B = \theta\int w[1-\phi^k(w)\, B(\tilde{b}^k(w))]\ \mathrm{d}W,$$

where $k \in \{NS, S\}$. The result then follows from the inequalities in Proposition 3. ■

Proof of Proposition 6. (i) Immediate from (2); (ii) In equilibrium $C_L = C_I - [1 + r_{OFF}]\,\theta w$. Hence $C_{OFF}\left(\phi^k\right) = \phi^k C_I + [1-\phi^k]\{C_I - [1 + r_{OFF}]\,\theta w\} = C_I - [1-\phi^k]\,[1 + r_{OFF}]\,\theta w$. It follows that $C_{OFF}\left(\phi^S\right) < C_{OFF}\left(\phi^{NS}\right) \Leftrightarrow \phi^S < \phi^{NS}$, where the right-side holds by Proposition 3; (iii) As C_{ON} is unaffected by a scheme, investors who invest offshore in the absence of a scheme but switch to investing onshore in the presence of a scheme must switch to a lower payoff. ■

Proof of Proposition 7. Using the relationship $Q(f_S, y) = \alpha_S Q(\overline{f}, y)$ established in (10), and substituting $\alpha_S = [1 + \underline{f}][1 + \overline{f}]^{-1}$ from (A.3), the result obtains. ■

Figures

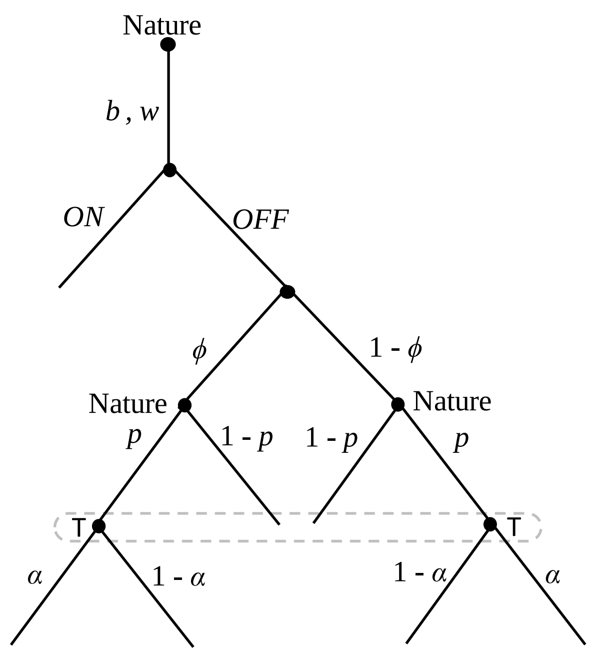

Figure 1: The offshore evasion game in the absence of an offshore voluntary disclosure scheme.

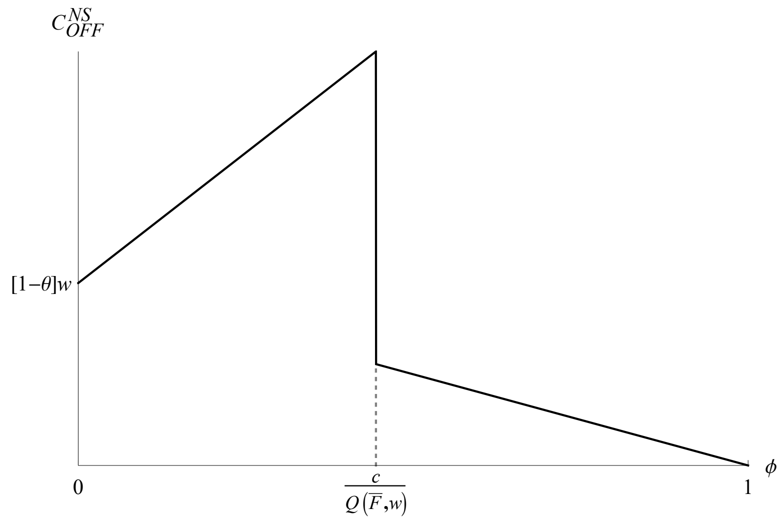

Figure 2: Expected consumption as a function of ϕ.

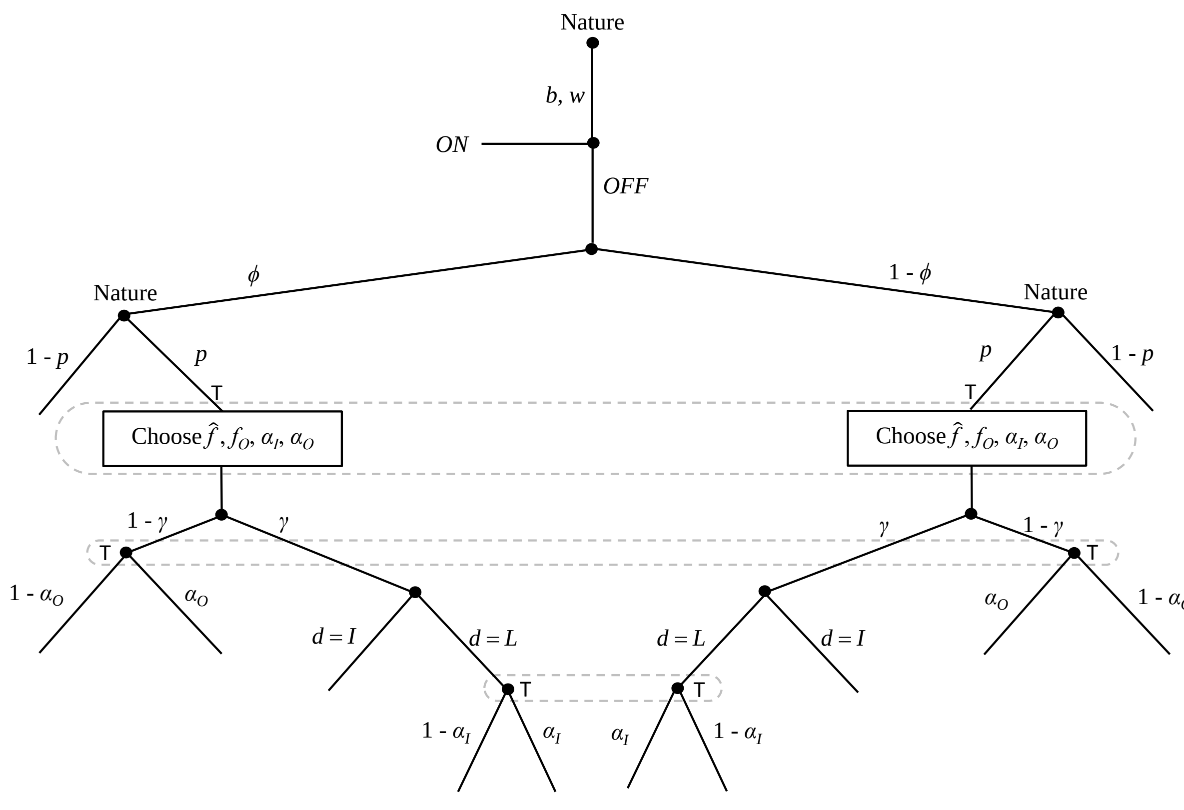

Figure 3: The offshore evasion game in the presence of an offshore voluntary disclosure scheme.

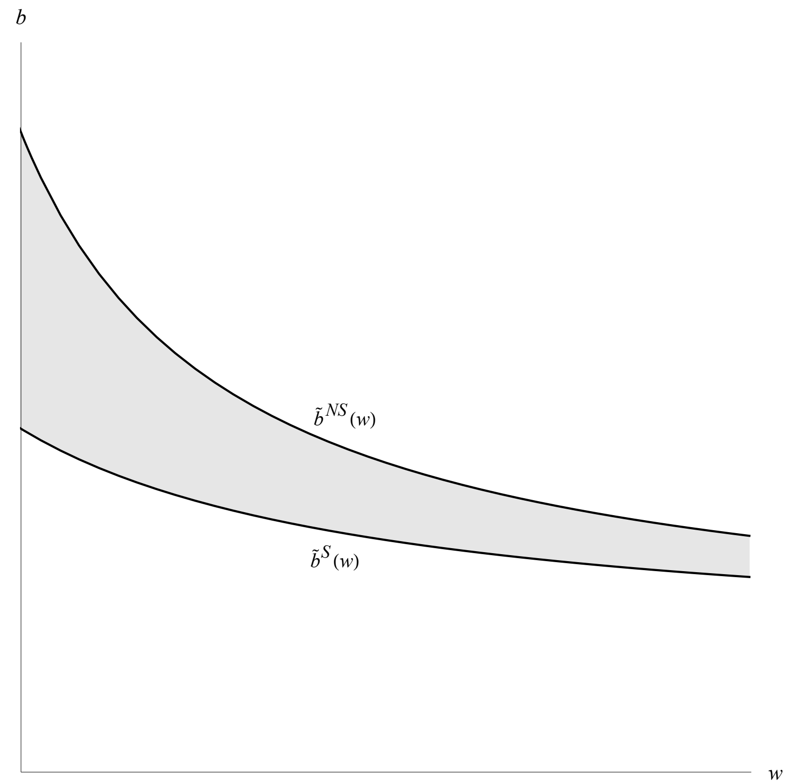

Figure 4: The critical values $\tilde{b}^{NS}(w)$ and $\tilde{b}^{S}(w)$ at which an investor is indifferent between investing onshore or offshore.