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Jiao Li, Duccio Gamannossi degl'Innocenti, Matthew D. Rablen

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Contacts:

CIFREL
Università Cattolica del Sacro Cuore
Via Necchi 5
20123 Milano
Telephone: 0039.02.7234.2976
e-mail: dip.economiaefinanza@unicatt.it
web: https://centridiricerca.unicatt.it/cifrel_index.html

Marketed Tax Avoidance Schemes: An Economic Analysis[*]

Jiao Li[†]
jli144@sheffield.ac.uk

Duccio Gamannossi Degl'Innocenti[‡,§]
duccio.gamannossi@unicatt.it

Matthew D. Rablen[†,§]
m.rablen@sheffield.ac.uk

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Abstract

Recent years have witnessed the growth of mass-marketed tax avoidance schemes aimed at the middle (not top) of the income distribution, with significant implications for tax revenue. We examine the consequences, for the structure of income tax, and for tax authority anti-avoidance efforts, of tax avoidance of this type. In a model that allows for both demand- and supply-side considerations, we find that (1) there is an endogenous threshold income below which taxpayers do not avoid, and above which they avoid maximally; (2) the per-dollar price of tax avoidance is decreasing in income under progressive taxation; (3) endogenous adjustments in the price of avoidance make supply less responsive to anti-avoidance activity than thought previously; and (4) that avoidance may drive a non-monotone (Laffer) relationship between tax rates and tax revenue. The findings suggest that new approaches to anti-avoidance, beyond legal enforcement, may be needed.

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[†]Department of Economics, University of Sheffield, 9 Mappin Street, Sheffield, S1 4DT, UK.
[‡]Department of Economics and Finance, Università Cattolica del Sacro Cuore, Via Necchi 5, 20123, Milan, Italy.
[§]Tax Administration Research Centre, University of Exeter, Exeter, UK.

1   Introduction

Taxpayers take a variety of actions to reduce their tax liabilities. We may distinguish between three types of actions: those that breach tax law (tax evasion), those that use tax law to gain an advantage that lawmakers never intended (tax avoidance), and those that use tax allowances for the purposes intended by lawmakers (tax planning). The focus of this paper is on the second of these actions: tax avoidance.[1] Although measurement is challenging, it is thought widely that tax avoidance is responsible for significant revenue loss in developed economies. For instance, Lang *et al.* (1997) estimate that tax avoidance costs the German exchequer an amount equal to around 34 percent of income taxes paid using detailed consumer survey data. This loss of revenue, and the ensuing need to devote resources to costly anti-avoidance activity, has undesirable consequences for welfare through the reduced ability of governments to provide public services. It also affects central concerns of economic policymaking such as the effectiveness of progressive taxation as an instrument of redistribution, and income inequality.

The traditional view of tax avoidance, discussed in economics at least as far back as Cross and Shaw (1981), is "...that tax avoidance is predominantly the prerogative of the rich." This notion is consistent with high net worth individuals (i) using exotic avoidance schemes involving the likes of Hollywood films and gold bullion, and (ii) employing aggressive tax preparers to disguise income within their tax returns artificially.[2]

Tax avoidance, however, comes in many guises. While there remains a significant market for "bespoke" or "boutique" avoidance schemes designed on an individual basis for the super-rich, recent years have seen a decisive shift towards employment-based avoidance schemes, mass-marketed at those with middle income, including professionals, contractors and agency workers (HMRC, 2021). Such marketed schemes, which purport to enable taxpayers reduce their tax liability legally, are the focus of this paper. In the past, the restriction of tax avoidance to the higher echelons of the income distribution was a source of comfort for tax authorities. Marketed schemes are eroding this comfort, and thereby magnify greatly the

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[1]Much of the literature on tax avoidance is concerned with whether income tax has "real" effects upon economic activity or simply leads to changes in the "form" of compensation (e.g., Slemrod and Kopczuk, 2002; Piketty *et al.*, 2014). Accordingly, in these studies, the term "tax avoidance" typically refers to all form-changing actions that reduce a tax liability. This definition overlaps with ours but is broader in the sense that it also includes actions that fall into our notion of tax planning.

[2]Recent research also reveals evidence of substantial (offshore) tax evasion (Alstadsæter *et al.*, 2019; Gould and Rablen, 2020) by the high net-worth.

potential for revenue loss.

Promoting marketed schemes is a dedicated tax avoidance industry that is, in many cases, distinct from the more traditional tax-practitioner industry studied in, e.g., Reinganum and Wilde (1991), Erard (1993), and Kaçamak (2021), which focuses predominantly on preparation of the tax return. In the UK alone, where some of the most detailed empirical evidence is available, there are estimated to be 50-100 active promoters of marketed schemes in a 2012 National Audit Office report (NAO, 2012), marketing some 324 schemes. Thus, the promoters of marketed schemes go far beyond the so-called "Big Four" global accountancy firms, which have been the focus of much prior research (e.g., Addison and Mueller, 2015).

Although only a subset of avoidance schemes, marketed schemes themselves come in many guises. As discussed in HMRC (2021), one of the most popular types of scheme – and the tacit focus in this paper – are *Employee Benefit Trust* schemes, used to avoid taxes on labour income. Instead of an employer paying an employee directly, labour income is placed in a trust set up in an offshore tax haven, which then makes loans to the employee. The loans are not taxable and, in practice, are never repaid. Variants that fall into a broader category of *Disguised Remuneration* schemes include paying workers in the form of grants, salary advances, capital payments, credit facilities, annuities, shares and bonuses, or amounts held in a fiduciary capacity. Another popular marketed scheme is the *Partnership Loss* scheme, whereby a partnership is set up which makes an (artificially inflated) loss. The participants in the partnership use the inflated loss to shelter other income from tax.[3]

Seemingly for legacy reasons, the economic literature has focused historically more on tax evasion than tax avoidance (Gamannossi degl'Innocenti and Rablen, 2017), and more on the demand side than the supply side (Slemrod, 2002, 2004).[4] Our analysis addresses both of these imbalances. In particular, we introduce supply-side considerations – relating both to entry and pricing – into the approach to modelling marketed avoidance of Gamannossi degl'Innocenti and Rablen (2017), hereafter GR (2017). These authors assume implicitly that tax avoidance technology is supplied perfectly elastically at an exogenously determined level of price, thereby eliminating a meaningful role for the supply side.

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[3]Inflation of the loss is achieved, for example, by using loans which are circular, or by deferred expenditure, which is never incurred.

[4]In particular, the first economic studies relating to tax compliance (e.g., Allingham and Sandmo, 1972; Yitzhaki, 1974) neglect the possibility of tax avoidance altogether.

On the supply side of the model, would-be promoters make a simultaneous entry and pricing decision. Entry entails the sinking of a fixed cost in, e.g., devising a scheme, a cost which may be avoided by not entering.[5] The pricing decision is to choose a two-part tariff comprising a minimum fee, and a per-dollar price for those clients willing to meet the minimum fee, a structure observed widely in the tax advice industry. The need for a minimum fee arises as promoters incur significant one-off implementation costs associated with setting up complex legal structures, e.g., offshore trusts, when admitting a new client. These costs imply that clients unwilling to pay a sufficiently high fee are unprofitable (Shackelford, 2000).

Relative to the analysis of GR (2017), allowing for supply-side considerations has two principal implications. First, the price of avoidance becomes endogenous to the model, thereby importantly altering some comparative statics predictions. For instance, whereas the GR (2017) model predicts that all avoiders will decrease their avoidance when the tax authority steps up anti-avoidance activity, in our model the private first-best level of avoidance is, in equilibrium, typically unchanged by marginal increases in anti-avoidance activity. Rather, the effect of additional anti-avoidance activity is soaked up entirely by a reduction in price. As a consequence of this finding, tackling avoidance solely through challenging the legality of schemes in the courts is likely to have less effect on supply than predicted previously. A broader regulatory approach aimed at squeezing the profits from promoting a scheme may instead be needed. To the extent such regulation goes beyond the traditional scope and expertise of tax authorities, this will demand a joined-up approach at the level of government.

The second implication is that, owing to the existence of a minimum fee requirement, not all taxpayers that demand tax avoidance in the model of GR (2017) will receive a positive supply. This consideration introduces an extensive margin into the analysis of aggregate avoidance as taxpayers endogenously enter and exit the scheme. By contrast, in GR (2017) variation in aggregate avoidance arises only at the intensive margin. Yet, we demonstrate that the effects arising at the extensive margin may dominate those at the intensive margin. As one consequence, a non-monotone (Laffer) relationship can hold at the aggregate level between tax rates and tax revenue.

We begin the analysis by examining the demand for tax avoidance for a given minimum fee and per-unit price. We establish the existence of, and characterize, a cut-off level of income

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[5]For treatments of avoidable fixed costs that do not focus specifically on marketed tax avoidance see, e.g., Sharkey and Sibley (1993) and Marquez (1997).

above which taxpayers engage in avoidance and below which taxpayers are excluded from the market for avoidance by the minimum fee. The set of avoiders can, in turn, be partitioned into those (fettered) taxpayers for whom the minimum fee is binding, and those (unfettered) taxpayers for whom the minimum fee does not bind. Promoters face a per-client set-up cost, but, once the scheme has been set-up for a client, the marginal cost of passing one extra dollar through the scheme is zero.

In equilibrium, conditional on entry by at least one would-be promoter, taxpayers above the cutoff level of income avoid maximally as a consequence of low marginal costs. The per-unit price that induces full avoidance is conditional on the income of the taxpayer. We show how this price can be implemented, despite promoters being assumed not to observe income directly, as there is a one-to-one relationship between income and the optimal fee. Conditioning the per-unit price upon the fee is therefore tantamount to conditioning upon income. In the context of this equilibrium, we analyze a range of issues of interest to academics and tax policymakers. We investigate these issues both with theory, and with a parameterized version of the model calibrated to the tax system in the UK. First, we examine how the per-unit price of avoidance varies with income. The answer to this question is endogenous to the structure of income tax. In particular, under progressive taxation, the per-unit price of avoidance is a decreasing function of income. That is, richer taxpayers buy tax avoidance technology on more favorable terms than do poorer taxpayers.

Second, we consider the aggregate relationship between tax rates and tax revenue. GR (2017) predicts that raising tax rates must raise tax revenue, yet economic policymakers document the existence of a tax avoidance Laffer curve (Papp and Takáts, 2008; Vogel, 2012). We show that the model can predict a non-monotone, and locally "hump-shaped" relationship between tax rates and tax revenue. Such non-monotonicity arises when endogenous entry into tax avoidance as a result of a tax rise causes revenue to fall.

Last, we consider the impact of tax progressivity on aggregate avoidance by comparing a progressive tax with a flat tax that implies an identical aggregate tax burden. Holding the tax burden constant in our analysis is important as, with risk averse taxpayers, income effects do play a role. We find – opposing intuitions sometimes expressed in the literature (e.g., Tanzi and Zee, 2000) – that there is no unidirectional relationship between aggregate avoidance and progressivity. Instead, we find that progressive taxation yields lower expected tax revenue at sufficiently low levels of tax, but that the opposite result holds at sufficiently high levels of tax.

The only other study we are aware of to have considered marketed avoidance schemes is that of Damjanovic and Ulph (2010), hereafter DU (2010). These authors focus on supply-side considerations, with an accordingly simple approach to the demand-side that differs markedly from that proposed here. In particular – following GR (2017) – we argue, first, that taxpayers are characterized by risk aversion, whereas DU (2010) suppose risk neutrality. Risk neutrality induces all-or-nothing (plunging) behavior on the part of taxpayers and rules out a role for income effects. Second, we argue – based on empirical evidence that we shall review in the next section – that marketed avoidance is typically sold at a price per dollar of tax liability reduction, whereas DU (2010) suppose that entry to an avoidance scheme is at a fixed one-off price, regardless of the tax liability reduction on offer. A fixed price appears at odds with the interview study, HMRC (2015), which notes that "Fees appear to vary by investment value." Relative to fixed pricing, the two-part tariff we consider is desirable for promoters as it permits greater capture of the taxpayers' surplus. Last, we suppose that tax avoidance can only be observed by the tax authority through costly legal challenge, whereas in DU (2010) it can only be observed through costly audit of individual taxpayers (as with tax evasion).[6] There, the tax authority is also assumed to possess the legal authority to fine avoiders, even though they were not ostensibly breaking tax law when entering the scheme. Facets of the present analysis that deviate from both DU (2010) and GR (2017) include an analysis of entry on the part of would-be promoters, and Bertrand competition with taxpayer search costs (rather than Cournot competition with conjectural variations in DU).

The paper proceeds as follows: section 2 develops a formal model of marketed tax avoidance. Section 3 analyses aspects of the equilibrium of the model, and section 4 concludes. Proofs are collected in the Appendix, and figures are at the very rear.

2   Model

We consider a fiscal environment in which each taxpayer faces a (exogenous) tax liability $T \equiv T(W)$ where $T : \mathbb{R}_+ \mapsto \mathbb{R}_+$ is a twice differentiable and strictly increasing function with $\partial T(W)/\partial W \in (0, 1)$ for all $W > 0$ (such that $T(W) < W$) and $\partial^2 T(W)/[\partial W]^2 \geq 0$.

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[6]Tax authorities in major economies such as the UK and US operate disclosure regimes that legally oblige promoters to notify them of the schemes they market. The role of the modern tax authority is therefore to study the disclosed schemes, and decide whether they constitute tax avoidance or tax planning. (Over time this process has a somewhat ironic consequence. Owing to survivorship bias, the list of active tax avoidance schemes disclosed to a tax authority under anti-avoidance disclosure legislation largely comprises schemes that are not considered to constitute tax avoidance.)

Thus, we allow for progressive taxation, as observed in many economies, and the special case of flat taxation. $T(W)$ may be decomposed as $T = tW$, where $t \equiv t(W) \in [0, \partial T(W)/\partial W]$ is the average tax function implied by T.

There is a continuum of taxpayers. Income (wealth), $W \in \mathbb{R}_{++}$, is distributed across taxpayers according to the density function $g(W)$, where $g(W) > 0$ for all W. The associated cumulative distribution we denote by $G(W)$. A taxpayer's true income is not observed by the tax authority. Thus s/he may desire to avoid an amount of tax $A \equiv A(W) \in [0, T]$. When it is profitable to do so, this desire is facilitated by a set of promoters (firms) that each market a tax avoidance scheme. Finding ways to reduce tax liability in an ostensibly legal manner typically requires a detailed understanding of tax law and a degree of ingenuity; capabilities few taxpayers possess.[7] Remunerating the human capital of the attorneys, accountants, bankers, etc., who perform this activity comes at a (symmetric) cost $v > 0$. This cost cannot be avoided if a would-be promoter wishes to enter the market, but is avoidable by choosing not to enter the market in the first place.

As in Diamond (1971), taxpayers search across promoters, hoping to find the best deal. Search continues until the certain (but small) cost of sampling one more promoter outweighs the expected benefit from potentially finding a better deal. Each scheme does not ostensibly break tax law, and is marketed as being legal. We assume, however, that the nature of each scheme is such that the tax authority will deem it tax avoidance, and mount a legal challenge. Although the scheme offered by each promoter need not be identical, we make the simplifying assumption that each is of a common type, or exploits a common loophole. Thus, a legal challenge by the tax authority, if upheld, applies to all schemes. In this event, all promoters cease trading and the tax authority is able to seize details of the clients of each promoter. Promoters may, however, continue to promote their scheme while the legal challenge is in progress. As such, even if the tax authority eventually succeeds in shutting the promoters down, each may walk away with a profit.

Promoters utilize two-part pricing: to participate in the scheme of promoter j, a taxpayer must pay at least a minimum fee $\underline{F}_j > 0$. A study that interviews former users of various marketed avoidance schemes in the UK, HMRC (2015), finds that respondents encountered minimum fees ranging from £5,000 to £1 million. The presence of the minimum fee implies

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[7]People not only have difficulties in understanding tax law and codes, but also show poor knowledge of tax rates (Blaufus *et al.*, 2015; Gideon, 2017; Stantcheva, 2021) and basic concepts of taxation.

that, as discussed in Shackelford (2000), a feature of the equilibrium shall be that poorer taxpayers unwilling to pay the minimum fee are excluded from the market for tax avoidance. For those taxpayers willing to pay at least the minimum fee, avoided tax may be purchased at a price per-unit, $p_j \in (0,1)$. In effect, every dollar of tax avoided is split $(1 - p_j : p_j)$ between the taxpayer and the promoter. Empirically, the price, p, is found to be up to 0.2 (Committee of Public Accounts, 2013). Accordingly, if the taxpayer chooses promoter j, the total fee payable is given by

$$F = \begin{cases} 0 & \text{if } A = 0; \\ \max(\underline{F}_j, p_j A) & \text{otherwise.} \end{cases} \tag{1}$$

The timing of the model is as follows:

Stage 1. Would-be promoters make simultaneously an entry decision (enter or not-enter) and a pricing decision $\{\underline{F}, p\}$;

Stage 2. Conditional on entry, taxpayers search optimally for a promoter, choosing so as to maximize expected utility. The tax authority mounts a legal challenge;

Stage 3. Conditional on entry, the legal challenge of the tax authority is upheld or not-upheld.

We proceed to analyze the model by backwards induction. As stage 3 involves only a move by nature, however, we pick up analysis of the model at Stage 2.

2.1 Stage 2

In stage 2 taxpayers search for a scheme, and avoid optimally within their chosen scheme.[8] We first consider optimal avoidance taking as given the chosen scheme – as characterized by the pair $\{\underline{F}, p\}$.

In choosing avoidance, taxpayers behave as if they maximize expected utility, where utility is denoted by $U(z) = \log(z)$.[9] If a taxpayer does not engage in avoidance they receive a (legal) net disposable income $X \equiv X(W) = W - T$. If, in stage 3, the tax authority's legal

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[8]This is without loss of generality in the present context, which precludes diversifcation of risk from avoiding via more than one scheme. We return to this point in the conclusion.

[9]Thus, taxpayers have a constant (unit) coefficient of relative relative risk aversion. We adopt the logarithmic form as it is both tractable analytically and supported empirically (see, e.g., Chiappori and Paiella, 2011).

challenge is upheld – an outcome which occurs with probability $\rho \in (0,1)$ – it will observe all clients of the promoter and has the legal authority to recover the tax, A, that each client had sought to avoid. In this event, a taxpayer cannot recover any fee paid to the promoter, however. Thus, the monetary risk associated with legal challenge to the scheme is borne by the taxpayer, a point in keeping with empirical evidence from the UK in Committee of Public Accounts (2013). Entering a tax avoidance scheme is therefore a risky choice on the part of the taxpayer.[10] Nonetheless, as taxpayers are not ostensibly violating tax law at the time of entering the scheme, the tax authority cannot levy a fine on the avoided tax.

Given the above, the expected utility of taxpayer i is

$$EU = \rho \log (W^u) + [1 - \rho] \log (W^s) \tag{2}$$

where

$$W^u = X - F; \qquad W^s = W^u + A; \tag{3}$$

are, respectively, a taxpayer's income when avoidance is unsuccessful, and when successful. As a necessary condition to observe a positive demand for avoidance we assume that avoidance is profitable in expectation: $\rho < 1 - p$. This assumption appears innocuous, at least at the present time.

Let $A^* \in [0, T]$ denote the first-best choice of avoidance. Taxpayers who engage in avoidance may be partitioned into two sets: one set (*unfettered*) for whom the first-best meets the minimum fee ($pA^* \geq \underline{F}$), and a set (*fettered*) for whom the first-best is infeasible ($pA^* < \underline{F}$). The set of fettered taxpayers may itself be bifurcated. First, consider the subset of fettered taxpayers for whom $T \geq \underline{F}/p$. Such taxpayers choose – as a second-best outcome – to avoid just enough tax to meet the minimum fee, $A = \underline{F}/p \geq A^*$, in preference to not avoiding tax at all ($A = 0$). The difference between the utility from choosing $A = \underline{F}/p$ and from choosing $A = 0$ we denote by

$$D_0'(W) = \mathbf{E}(U)|_{A=\underline{F}/p} - \mathbf{E}(U)|_{A=0}.$$

Accordingly, avoidance $A = \underline{F}/p$ is preferred to avoidance $A = 0$ when $D_0'(W) > 0$. The subset of taxpayers with $T \geq \underline{F}/p$ for whom also $D_0'(W) > 0$ are termed *fee-constrained*.

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[10]By contrast, much early literature treats tax avoidance as a riskless activity. See, e.g., Alm (1988) and Alm *et al.* (1990).

Next, consider the subset of fettered taxpayers for whom $pT < \underline{F}$. When avoiding their full tax liability, such taxpayers still do not meet the minimum fee. With the second-best outcome, $\underline{F}/p$, infeasible, to participate in the scheme, such taxpayers must opt for the third-best outcome $A = T < \underline{F}/p$, while still paying the minimum fee $\underline{F}$. As a result, such taxpayers pay a higher implied per-unit price $\underline{F}/T > p$ for avoidance technology. The difference between the utility when choosing $A = T$ and the utility when choosing $A = 0$ we denote by

$$D_0''(W) = \mathbf{E}\,(U)\,|_{A=T,F=\underline{F}} - \mathbf{E}\,(U)\,|_{A=0}.$$

Accordingly, avoidance $A = T$ is preferred to avoidance $A = 0$ when $D_0''(W) > 0$. The subset of taxpayers with $T < \underline{F}/p$ for whom also $D_0''(W) > 0$ are termed *wealth-constrained*. All remaining taxpayers – i.e., those that are neither fettered nor unfettered – choose $A = 0$ and are said to be *excluded*.

Proposition 1 *For a given $\{\underline{F}, p\}$, let W_1 to be the unique W for which $T(W_1) = \underline{F}/p$, i.e., $W_1 = T^{-1}(\underline{F}/p)$. Then*

(i) *There exists a unique W, $W = W_2 \geq W_1$, such that taxpayers with $W \geq W_2$ are unfettered. At an interior optimum, $A = A^* \in [0, T]$, an unfettered taxpayer will seek to avoid an amount of tax*

$$A^* \equiv A^*(W) = \frac{1}{p}\left[1 - \frac{\rho}{1-p}\right] X(W) > 0.$$

(ii) *If $D_0''(W_1) > 0$ there exists a unique W, $W = W_0'' \in (0, W_1)$, such that taxpayers with $W \leq W_0''$ are excluded, taxpayers with $W \in (W_0'', W_1]$ are wealth-constrained, and taxpayers with $W \in (W_1, W_2)$ are fee-constrained.*

(iii) *If $D_0''(W_1) \leq 0$ there exists a unique W, $W = W_0' \in [W_1, W_2)$, such that taxpayers with $W \leq W_0'$ are excluded, the set of wealth-constrained taxpayers is empty, and taxpayers with $W \in (W_0', W_2)$ are fee-constrained.*

Proposition 1 characterizes the intervals of income for which taxpayers are unfettered, fee-constrained, wealth-constrained, and excluded. In general there are two possibilities, depending upon whether the marginal fettered taxpayer (at the exclusion margin) is wealth- or fee-constrained. Figure 1 depicts the results in Proposition 1: panel (a) depicts the case

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in which the marginal fettered taxpayer is wealth-constrained, such that part (ii) of the proposition applies; and panel (b) depicts the case in which the marginal fettered taxpayer is fee-constrained, such that part (iii) of the proposition applies.

Summarizing the implications of Proposition 1, a taxpayer's avoidance demand writes as

$$A\left(W\right) = \begin{cases} A^*\left(W\right) & \text{if } W \in \mathcal{U}; \\ \min\left(\underline{F}/p, T\left(W\right)\right) & \text{if } W \in \mathcal{F}; \\ 0 & \text{otherwise.} \end{cases} \qquad (4)$$

where $\{\mathcal{U}, \mathcal{F}\}$ are, respectively, the set of incomes belonging to unfettered taxpayers and fettered taxpayers, as set out in the proposition.

Writing $A\left(W\right)$ in (4) more completely as $A\left(W; \underline{F}, p\right)$, substitution of $A\left(W; \underline{F}, p\right)$ into expected utility in (2) defines the indirect expected utility $\mathbf{E}\left(U^*\left(W, \underline{F}, p\right)\right)$ obtained by a taxpayer of income W from choosing a scheme $\{\underline{F}, p\}$. Therefore, among the sample of schemes searched, taxpayers choose the scheme j that maximizes indirect expected utility $\mathbf{E}(U^*(W, \underline{F}_j, p_j))$. Taxpayers – who observe the distribution of the $\{\underline{F}_j, p_j\}$ costlessly (though not the individual $\{\underline{F}_j, p_j\}$) – search until the expected increment to $\mathbf{E}(U^*(W, \underline{F}_j, p_j))$ from sampling one more promoter falls below a (small) search cost $c > 0$.

Before continuing, we consider the implications of Proposition 1 for the comparative statics of endogenous parameters. First, the comparative statics properties of A^* we summarize in the following Remark:

Remark 1 *The avoidance demanded by unfettered taxpayer, A^*, is increasing in income, W, and decreasing in the probability of the legal challenge being upheld, ρ, and in the per-unit price of avoidance, p. A^* is linear in income under a flat tax, and strictly concave in income under a progressive tax.*

Second, we consider the comparative statics of the threshold incomes $\{W_0, W_1, W_2\}$, of which those for W_0 are by far the most significant for the predictions of the model, for it regulates the extensive margin of avoidance. Herein, let $W_0 \in \{W_0', W_0''\}$ denote the exclusion threshold

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income: $W_0 = W_0''$ when part (i) of Proposition 1 applies and $W_0 = W_0'$ when instead part (ii) applies.[11]

Lemma 1 *Consider the exclusion threshold income, W_0, such that taxpayers with $W > W_0$ engage in avoidance:*

(i) *W_0 is strictly increasing in the minimum fee, $\underline{F}$, and the probability of successful challenge, ρ; and weakly increasing in the per-unit price of avoidance, p.*

(ii) *If $W_0 = W_0''$ there exists a critical value of the average tax rate t_0,*

$$t_0 = 1 - \frac{\underline{F}}{[1 - \rho] W_0} \in \left(\frac{1}{2}, 1 \right),$$

such that W_0 decreases in the average tax rate for $t(W_0) < t_0$, and increases in the average tax rate for $t(W_0) > t_0$. Otherwise ($W_0 = W_0'$), W_0 increases in the average tax rate.

The effects of $\{\underline{F}, \rho\}$ on W_0 in part (i) of Lemma 1 are intuitive as both variables make avoidance less attractive to fettered taxpayers. The effect of the per-unit price, p, is marginally more complex, however. When $W_0 = W_0''$ the marginal avoider with $W \downarrow W_0$ is wealth-constrained, with avoidance demand $A = T$. The avoidance demand of this taxpayer is, therefore, independent of price ($\partial A / \partial p = 0$) and so also $\partial W_0 / \partial p = 0$. In contrast, when $W_0 = W_0'$, the marginal avoider with $W \downarrow W_0$ has avoidance demand $\underline{F}/p$, such that $\partial A / \partial p < 0$ and $\partial W_0 / \partial p > 0$.[12]

Part (ii) of Lemma 1 considers how the extensive margin of avoidance, as regulated by W_0, responds to a proportional increase in taxes (a shift in the average tax function). Following the proposition, we focus here on the case $W_0 = W_0''$, which shall hold in equilibrium. In this case, an increase in taxes has competing income and substitution effects on the marginal wealth-constrained taxpayer with $W = W_0$. The substitution effect, which acts to increase

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[11]When $\{W_0', W_0''\}$ both exist it is straightforward to show that $W_0 = \max(W_0', W_0'')$. We do not dwell on this point further, however, as it shall transpire that part (iii) of Proposition 1 does not apply in equilibrium.

[12]The comparative statics of $\{W_1, W_2\}$ are, in respect of sign, those of W_0, with the exception that (i) both W_1 and W_2 are strictly (rather than weakly) decreasing in the per-unit price of avoidance; and (ii) both unambiguously increase with a proportional increase in taxes. As these results are derived straightforwardly, we omit a proof.

avoidance, arises as a shift in tax decreases the effective per-unit price $\underline{F}/T(W_0)$. On the other hand, the taxpayer becomes poorer, which generates an income effect. This income effect acts to decrease avoidance, for log utility implies decreasing absolute risk aversion. The lemma clarifies that, for average tax rates in the (realistic) range below one-half, the substitution effect dominates. Above one-half, however, there exists a threshold point above which it is instead the income effect that dominates.

2.2 Stage 1

Having completed our analysis of the demand side of the market for avoidance, which arises in stage 2 of the model, in this section we now turn to supply-side considerations, which arise in stage 1.

There are $N > 1$ would-be promoters. If a would-be promoter does not enter it receives a payoff of zero. If, alternatively, a would-be promoter chooses to enter the market in stage 1 they must bear a fixed entry cost $\upsilon > 0$. Also, as motivated in Introduction, a promoter will, in stage 2, face a (symmetric) one-off set-up (implementation) cost, $\tau > 0$, for each client that they admit to the scheme. As such, when output is increased at the extensive margin (by taking on new clients) the set-up cost acts as a variable cost. But, when output is increased at the intensive margin, the set-up cost acts as a fixed cost. Owing to this set-up cost any taxpayer only willing to pay a fee $F < \tau$ is loss-making for the promoter. Hence, it is gainful for promoters to utilize a minimum fee provision, as supposed in the model. Once the scheme has been set up for a client, however, the marginal cost of passing an additional dollar through the scheme is very small. Accordingly, the marginal cost of avoidance at the intensive margin we set to zero.

Conditional on entry, let the set of taxpayers who, in stage 2, choose to avoid with promoter j be denoted Θ_j. This set may be further partitioned – by fettered and unfettered taxpayers – as $\Theta_j = \Theta_{j\mathcal{U}} \cup \Theta_{j\mathcal{F}}$. The avoidance purchased in stage 2 by unfettered taxpayers from promoter j is denoted A_j. The payoffs to would-be promoter j we may therefore write as

$$\pi_j = \begin{cases} 0 & \text{if not-enter} \\ \underline{F}_j \left| \Theta_{j\mathcal{F}} \right| + \mathbf{E}_{\Theta_{j\mathcal{U}}} \left(p_j A_j \right) \left| \Theta_{j\mathcal{U}} \right| - \tau \left| \Theta_j \right| - \upsilon. & \text{if enter.} \end{cases} \tag{5}$$

Promoters observe the distribution of income, but cannot observe directly the income of a

particular taxpayer.[13] Despite this, we will nevertheless show that, in equilibrium, promoters are able to segment unfettered taxpayers by income. The intuition for this result is that, for unfettered taxpayers, there is a one-to-one relationship between income, W, and the optimal fee, F^*. Thus, conditioning the per-unit price upon the (observed) fee F^* is tantamount to conditioning it on W. Specifically, we suppose that promoters condition the per-unit price upon the fee paid, i.e., $p = p(F)$. As $F^* = pA^*$ for an unfettered taxpayer, Proposition 1(i) yields that, for such taxpayers,

$$A^* = \frac{F^*}{p}, \tag{6}$$

where

$$F^* \equiv F^*(W) = \left[1 - \frac{\rho}{1-p}\right] X(W). \tag{7}$$

The relationship in (7) implies that the optimal fee, F^*, is increasing in income W. Thus, for $W \geq W_2$, $W = F^{*-1}(F)$ exists and is unique. Accordingly, although the taxpayer is presented with price as a function of the fee, $p(F)$, the equilibrium mapping from F^* to W relates p to W uniquely. In DU (2010), by contrast, F is identical across all avoiders by assumption, thereby ruling out the possibility that it may be used to infer W.

2.3 Equilibrium

Conditional on entry in stage 1, a promoter j chooses $\{\underline{F}_j, p_j\}$ to maximize profit in (5), taking as given the $\{\underline{F}_j, p_j\}$ of the other promoters. In the absence of taxpayer search costs, a case we rule out, a promoter gains the entire market by undercutting the others. In this case, a would-be promoter would only enter in stage 1 with positive probability if they expected to be a monopolist in stage 2. To allow for multiple entrants we allow for small but positive search costs à la Diamond (1971).

Proposition 2 *Define the net revenue in stage 2 of the representative promoter as*

$$\mathcal{R}(N) = \frac{1}{N} \left\{ \underline{F}\left[G(W_2) - G(W_0)\right] + \int_{G(W_2)}^1 p^*(W) T(W) \ dG(W) - \tau\left[1 - G(W_0)\right] \right\},$$

where $\{\underline{F}, p^*(W)\}$ shall be defined below.

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[13]Treating income as private appears the most prudent assumption. A promoter may solicit this information within the client-advisor relationship, but there is no guarantee that clients will disclose truthfully.

1. *If fixed costs υ are sufficiently small, i.e., $\upsilon \leq \mathcal{R}(N)$, then there is a unique equilibrium in which:*

   (i) *In stage 1, all N would-be promoters choose to enter; and in stage 2, each earns a non-negative profit $\pi_j = \pi \geq 0$;*

   (ii) *Taxpayers search for a single $\{\underline{F}_j, p_j\}$. Those with $W > W_0$ avoid maximally, and taxpayers with $W \leq W_0$ do not avoid:*

   $$A(W) = \begin{cases} T(W) & \text{if } W > W_0; \\ 0 & \text{otherwise;} \end{cases}$$

   where $W_0 = W_0''$.

   (iii) *Each promoter sets a symmetric minimum fee $\underline{F} > \tau$, satisfying*

   $$\underline{F} = \tau + \frac{G(W_2) - G(W_0)}{\frac{\partial W_0(\underline{F})}{\partial \underline{F}} g(W_0)}.$$

   (iv) *Each promoter sets a symmetric per-unit price schedule, $p^*(F)$, that implements $A = T$ for unfettered taxpayers. $p^*(F)$ solves, for every $F \geq \underline{F}$,*

   $$T^{-1}\left(\frac{F}{p^*(F)}\right) = F^{*-1}(F; p^*(F)),$$

   such that the per-unit price paid by an unfettered taxpayer with income $W \geq W_2$ is

   $$p^*(W) = 1 - \frac{T(W) - X(W) + \sqrt{[T(W) - X(W)]^2 + 4\rho T(W) X(W)}}{2T(W)} < 1 - \rho.$$

2. *If $\mathcal{R}(N) < \upsilon \leq \mathcal{R}(1)$ then there exists an $\tilde{N} \in [1, N)$ such that $\upsilon = \mathcal{R}(\tilde{N})$. In the unique equilibrium, would-be promoters in stage 1 enter with probability $\tilde{N}/N$ and do not enter with probability $[N - \tilde{N}]/N$. Entrants make an expected profit of zero in stage 2. Parts (ii)-(iv) of part 1 continue to hold in stage 2.*

3. *If $\upsilon > \mathcal{R}(1)$ no entry occurs in stage 1 and aggregate tax avoidance is zero.*

Proposition 2 characterizes the equilibrium of the model. Part 1 of the proposition considers the case in which fixed costs are sufficiently low (or anti-avoidance efforts sufficiently weak)

that if all N would-be promoters enter each is profitable in the equilibrium played out in stage 2. As we discuss later, this is arguably the best description of the present situation in most developed economies. Part 1(i) clarifies that, as stage 2 is profitable with N promoters, all would-be promoters will enter. Part 1(ii) characterizes equilibrium search. The intuition is straightforward. Suppose the equilibrium set of $\{\underline{F}_j, p_j\}$ is symmetric across promoters. Given this, taxpayers optimally search for just one price. As, a priori, all promoters are searched by a taxpayer with equal probability, the $\{\underline{F}_j, p_j\}$ will be symmetric, consistent with the initial supposition.

Part 1(ii) also characterizes optimal avoidance behavior. Taxpayers with $W \leq W_0$ are excluded from tax avoidance. Taxpayers with $W > W_0$ avoid maximally, yet still fall into two categories: taxpayers with $W \in (W_0, W_2)$ are wealth-constrained, avoiding all tax at a constrained optimum; whereas taxpayers with $W \geq W_2$ also avoid all tax, but as a first-best choice.[14] The set of fee-constrained taxpayers is empty as W_1 and W_2 are coincident. This "corner" equilibrium for avoidance in stage 2 – which arises from a combination of price-elastic demand and the absence of marginal costs – is distinctive from the "interior" market equilibria that characterize equilibrium outcomes in industries with (higher) marginal costs. In the context of the tax avoidance industry, such a corner equilibrium fits the empirical observation that promoters place lower bounds on the fee, but do not constrain supply by imposing upper bounds. For example, in the context of employee benefit trust schemes, it is standard practice for the full employment income to be paid through the scheme, rather than having part of earnings paid as untaxed loans, and part paid as taxable wages. The principal exception to this point arises only when some intrinsic feature of tax law bounds the amount of tax it is feasible to avoid through a given scheme.

Parts 1(iii) and 1(iv) of the proposition give equilibrium pricing, $\{\underline{F}, p\}$, which is joint profit maximizing among the stage 1 entrants. The result follows as, when taxpayers only search one price, promoters do not lose custom from an (out of equilibrium) price increase. Importantly, however, as avoidance is already maximal at the joint profit maximizing $\{\underline{F}, p\}$, it will necessarily remain unchanged at the maximal level at any lower pricing level. As the analyses of the next section shall rely on the comparative statics of price, but not its level, our findings are therefore robust to a range of pricing outcomes. Part 1(iii) gives the common

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[14]The existence of a threshold income below which taxpayers are excluded from the tax avoidance market chimes with DU (2010). In our approach exclusion arises from the cost structure of the promoter. In DU, by contrast, it is a consequence of an assumed fixed fee for avoidance.

equilibrium minimum fee: it is increasing in the per-client set-up cost, τ, and satisfies $\underline{F} > \tau$. This inequality implies that promoters exclude some profitable clients in order to harvest greater profits from the (fettered) taxpayers they do take. Part 1(iv) characterizes the equilibrium per-unit price, both as a function of the fee, $p(F)$, and of income, $p(W)$. $p(F)$ cannot be written explicitly; the implicit definition in the proposition derives when replacing W in the equality $A^* = T(W) = F^*(W)/p$ with $W = F^{*-1}(F)$.

Part 2 of Proposition 2 considers the case in which the equilibrium in stage 2 cannot support profitably all N would-be promoters, but can profitably support a monopoly promoter. In this case there is some intermediate number of promoters $\tilde{N}$, $1 \leq \tilde{N} < N$, that can sustain a zero-profit equilibrium in stage 2. A would-be promoter is, therefore, indifferent between choosing not-enter or enter if it expects $\tilde{N}$ promoters to compete in stage 2. This forms the basis of a mixed strategy for entry in which would-be promoters enter with probability $\tilde{N}/N < 1$. Part 3 of Proposition 2 considers the case in which fixed costs are sufficiently high (or anti-enforcement sufficiently strict) that a would-be promoter will not enter even if it expects to be a monopolist in stage 2. Thus, there is no entry.

3 Analysis

3.1 Price of Avoidance

We first consider the comparative statics properties of the equilibrium per-unit price:

Proposition 3 *The equilibrium per-unit price facing unfettered taxpayers, $p^*(W)$, is decreasing in the probability of successful legal challenge, ρ. Under a flat income tax, $p^*(W)$ is independent of W, while, if income taxes are progressive, richer taxpayers pay a lower per-unit price than do poorer taxpayers, i.e.,*

$$\frac{\partial p^*(W)}{\partial W} \lesseqgtr 0 \Leftrightarrow t'(W) \gtreqless 0.$$

The first result in Proposition 3 clarifies that the price of avoidance falls when tax authority enforcement increases. The ramifications of this result we take up in the next section. The second result in Proposition 3 is that the per-unit price is (weakly) decreasing in income. $p(W)$ is illustrated in Figure 2(a) for a parameterized version of the model calibrated to the UK. We approximate the UK marginal tax rate structure, as described in IFS (2021), by

$$\frac{\partial T\left(W\right)}{\partial W} = c_0 \left[1 - e^{-\gamma W}\right], \tag{8}$$

with $c_0 = 0.45$ and $\gamma = 0.00004$.[15] So as to examine the mediating influence of tax structure, we also include in Figure 2 the per-unit price schedule under a flat tax that generates an identical aggregate tax burden to the progressive tax structure implied by (8). To do this, we specify $g\left(W\right)$ to be lognormal, $\log\left(W\right) \sim N\left(\mu, \sigma^2\right)$. According to ONS (2020), mean (median) income in the UK (2017-18) is £34,210 (£28,418). Calibrating to these statistics gives $\mu = 10.25$ and $\sigma = 0.61$.[16]

In Figure 2(a), note that the price function is kinked around W_2, being $p^*\left(W\right)$ as in Proposition 2 for (unfettered) taxpayers with income $W \geq W_2$, and $\underline{F}/T$ otherwise. As illustrated in the figure, under a flat tax, all unfettered taxpayers face an identical per-unit price. Under progressive taxes, however, the per-unit price faced by unfettered taxpayers is a decreasing function of income. This result chimes with the sentiments of Cross and Shaw (1981) that tax avoidance is especially attractive to the rich. It also accords with DU (2010), in which per-unit prices are decreasing. However, whereas the structure of per-unit prices in the DU model is an automatic implication of the assumptions of the model (the scheme has a fixed price, but yields greater avoidance the richer the taxpayer), in our analysis the structure of per-unit price is instead endogenous, depending, in particular, on the structure of income taxation.

In respect of the *level* of the per-unit price, Figure 2a illustrates that a burden-neutral move from a flat tax to a progressive tax can have complex effects, increasing the per-unit price faced by avoiders below a threshold level of income, but decreasing the per-unit price faced by avoiders above this threshold income. This finding is driven by the income effect induced by a change in the level of taxation. The shift to progressive taxation lowers the tax burden of some poorer avoiders, who thereby become richer. Richer taxpayers are less risk averse, and so value avoidance more highly, causing the price to rise. For the richest of avoiders,

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[15]The tax function corresponding to (8) is given by $T\left(W\right) = c_0[W - \left[1 - e^{-\gamma W}\right]/\gamma]$.

[16]The remaining parameter values are $\rho = 0.15$ and $\tau = 4800$. The qualitative findings of this section are insensitive to variation of these values.

however, the tax burden is increased by a shift to progressive taxation. Accordingly, they value tax avoidance less highly, resulting in a lower per-unit price.

Comparing $p^*(W)$ in panel (a) of Figure 2 with $p^*(F)$, as illustrated in panel (b), indicates that the schedules are qualitatively similar. This arises because the underlying relationship between income and the optimal fee, omitted for brevity, is close to linear above W_2, even in the case of non-linear (progressive) taxation.

3.2   Effectiveness of Anti-Avoidance Activity

The finding that, in equilibrium, avoidance is maximal at incomes above the exclusion threshold, has an important implication for enforcement. To discuss this it is helpful to decompose the effects on avoidance of a shift in one of the exogenous parameters of the model into a *direct* or "mechanical" effect – which arises when holding fixed the set of excluded taxpayers – and an *indirect* or "behavioral" effect that arises from endogenous entry-to and exit-from the avoidance market.

We consider the (3-phase) transition of aggregate avoidance outcomes as anti-enforcement efforts – summarized by the probability, ρ, that the challenge to the avoidance schemes is upheld – is increased. First, consider a sufficiently low level of enforcement at which – as in part 1 of Proposition 2 – these efforts are insufficient to restrict entry (for a given level of fixed cost). This case seems to us the closest to present reality. In the UK, for instance, Committee of Public Accounts (2013) speaks of promoters "running rings" around HMRC, the British tax authority, while NAO (2012) concludes that "...HMRC cannot currently demonstrate that [the present] level of litigation provides an effective deterrent." In this case, as equilibrium avoidance, T, is independent of ρ, the direct effect of an increase in legal enforcement is exactly zero. This arises as, in response to an increase in ρ, price adjusts downwards per Proposition 3 such that quantity $A = T$ is unaffected. The result is very different to that in GR (2017), where price is assumed fixed, such that an increase in ρ is reflected entirely in quantity (negatively).

For tax authorities, this finding carries the sobering implication that investments to raise the probability of effective legal challenge, ρ, will impact aggregate avoidance only through the indirect effect. The indirect effect, however, acts only on avoiders who are marginal with respect to W_0 (which is increasing in ρ per Lemma 1). The richest taxpayers, those who are

supra-marginal with respect to W_0, are therefore untouched by the indirect effect, and yet avoid the most tax.

Continuing with the transition, at higher levels of enforcement, the revenues of the representative promoter fall sufficiently that part 2 of Proposition 2 applies. In this case, the tax authority's anti-enforcement efforts do now restrict entry at the margin. Importantly, however – noting that the equilibrium pricing $\{\underline{F}, p\}$ in Proposition 2 is independent of N – the reduction in the number of entrants does not in itself impose a downwards force on aggregate avoidance. Instead, those would-be promoters that do enter simply enjoy a higher market share. The direct effect continues to be zero and the only effect on avoidance behavior is via the indirect effect.

It is only when ρ becomes sufficiently high that the marketed tax avoidance industry ceases to be viable commercially – even when comprising of a monopoly promoter – that a discrete fall of aggregate avoidance to zero occurs. This is the case given in part 3 of Proposition 2.[17] If, as we suspect, achieving the no-entry equilibrium in part 3 of Proposition 2 through raising ρ alone may be infeasible operationally, then anti-avoidance strategy may need to look beyond recourse to legal challenges. In particular, broader regulatory measures that act to increase promoter's fixed costs, υ, such as requiring costly operating and/or entry permits, would help to choke the supply-side. To the extent that preventing tax avoidance need to be seen as a broader regulatory problem that may fall beyond the remit and expertise of tax authorities, a wider government approach may be required.

3.3 Tax Revenue and the Structure of Income Tax

In the analysis of GR (2017), in which tax avoidance technology is supplied perfectly elastically at an exogenously determined level of price, a proportional increase in taxes always lowers individual, and therefore also aggregate, avoidance. This arises as an increase in tax generates a pure income effect, which acts to increase risk aversion when absolute risk aversion is decreasing in income; a finding related closely to the well-known Yitzhaki puzzle (Yitzhaki, 1974). Yet, such a finding is it odds with a widespread belief among policymakers of a tax avoidance Laffer curve (e.g., Papp and Takáts, 2008; Vogel, 2012). This belief entails that, as tax rates increase, there exists a level beyond which tax revenue ceases to increase,

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[17]Note that, owing to positive fixed costs $\upsilon > 0$, at the critical value of ρ above which part 3 applies, and entry does not occur, sales (avoidance) remain positive. Thus, tax authorities need not choke entirely the demand for avoidance to shutdown the industry.

owing to offsetting increases in avoidance. The income effect discussed above also applies in our model when tax is increased, at least for unfettered taxpayers. We show here, however, that, owing to endogenous variation in the set of excluded taxpayers, a form of tax avoidance Laffer curve may nevertheless emerge from our analysis.

The equilibrium expected tax revenue of the tax authority is given by

$$\mathbf{E}\left(R\right) = \int_0^{G(W_0)} T\left(W\right)\,\mathrm{d}G\left(W\right) + \rho \int_{G(W_0)}^1 T\left(W\right)\,\mathrm{d}G\left(W\right),$$

where the the first term is the (certain) revenue from excluded taxpayers, and the second term is the expected revenue from avoiders. Consider a proportional increase in taxes, i.e., a pivot anti-clockwise in the tax function $T\left(W\right)$ around the origin. The comparative statics effects of such a proportional increase on expected revenue we write – in a mild abuse of notation – as $\partial\mathbf{E}\left(R\right)/\partial T$. (This is shorthand for rewriting $T\left(W\right)$ as $[1 + \varepsilon]\,T\left(W\right)$, differentiating with respect to ε, and then taking the limiting value of the derivative as $\varepsilon \downarrow 0$.) Thus, we obtain

$$\frac{\partial\mathbf{E}\left(R\right)}{\partial T} = \underbrace{\mathbf{E}\left(R\right)}_{\text{direct effect}} + \underbrace{[1 - \rho]\,\frac{\partial W_0}{\partial T}g(W_0)T(W_0)}_{\text{indirect effect}}. \tag{9}$$

The direct effect in (9) is positive, but the indirect effect is the sign of the response of W_0 to a proportional increase in taxes, denoted in (9) by $\partial W_0/\partial T$. The implication of Lemma 1, part (ii), is that a proportional increase in taxes decreases W_0 when taxes are sufficiently low (in particular, when the average tax rate at income W_0 is less than one-half), but increases W_0 at higher levels of tax.[18] Accordingly, starting from a sufficiently high level of taxation, a proportional increase in taxes assuredly raises additional revenue. But, when starting from a sufficiently low level of taxation, the sign of $\partial\mathbf{E}\left(R\right)/\partial T$ hinges on the relative magnitudes of the opposing direct and indirect effects.

Define a metric of the aggregate level of taxation as

$$\frac{\mathbf{T}}{\mathbf{W}} = \frac{\int T\left(W\right)\,\mathrm{d}G\left(W\right)}{\int W\,\mathrm{d}G\left(W\right)},$$

i.e., the average tax payment as a proportion of average income. Under a flat tax this measure coincides with the constant marginal tax rate. In Figure 3(a) we depict expected

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[18]Strictly speaking, $\partial W_0/\partial T$ in (9) includes the effect of equilibrium adjustments in $\underline{F}$, whereas the comparative statics result in Lemma 1(ii) treats $\underline{F}$ as exogenous. As will become apparent in Figure 3(b) below, however, the equilibrium variation in $\underline{F}$ does not alter qualitatively the message of Lemma 1(ii) on the interval we consider.

revenue at different levels of taxation ($\mathbf{T}/\mathbf{W}$), focusing on the empirically plausible range $\mathbf{T}/\mathbf{W} \in (0, 0.5)$. As previously, we draw expected revenue under the progressive schedule for the UK implied by (8) and under a flat tax that generates an identical aggregate tax burden.[19] Panel (b) of the Figure, which we include for interpretability, shows the location of the exclusion threshold, W_0, in the distribution of income as a function of the tax level $\mathbf{T}/\mathbf{W}$.

In Figure 3a, it is seen that the model is consistent with a non-monotone relationship between tax rates and (expected) tax revenue. Under a flat tax, revenue initially rises for $\mathbf{T}/\mathbf{W} < 0.15$, where the direct effect dominates, but subsequently begins to fall in a region where the indirect effect dominates. The direction and magnitude of the indirect effect is driven by the endogenous variation of W_0 in panel (b). It is seen that W_0 is decreasing in $\mathbf{T}/\mathbf{W}$ throughout almost all the figure, indicating that the indirect effect is almost everywhere negative on the interval depicted. Entry into avoidance is at its greatest where $G(W_0)$ falls most steeply, corresponding with the region in which tax revenue is decreasing in panel (a). Endogenous entry into the avoidance market is seen to slow for $\mathbf{T}/\mathbf{W}$ above 0.15, resulting in revenue once again increasing in taxation in panel (a).

Another feature of Figure 3 is that the non-monotone pattern of tax revenues observed under the flat tax is not present under the progressive tax schedule. This finding can be traced to the observation that, in the progressive case, W_0 is less sensitive to changes in the level of taxation (panel b). This weaker indirect effect is explained, in turn, by noting that, in the progressive case, the incidence of an increase in taxes is disproportionately on the rich, who are supra-marginal with respect to the exclusion threshold W_0. It is also worth clarifying that, even in the case of a flat tax, a monotone relationship between tax rate and tax revenue emerges if the probability of effective legal challenge, ρ, is raised sufficiently above the level $\rho = 0.15$ used to draw the figure. Whether the model predicts non-monotone effects, therefore, depends importantly on the level of legal enforcement and on the structure of income taxes.

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[19]The two tax functions in the figure are of the form $T(W) = c_0[W - (1 - e^{-\gamma W})/\gamma]$ in the progressive case and $T(W) = c_1 W$ in the flat tax case. Points in the figure correspond to $c_1 \in [0.07, 0.9]$. At each c_1 evaluated, we solve numerically for the c_0 that equates the aggregate tax burden under $g(W)$.

A further consideration in respect of the effects of tax progressivity is that there is no straightforward relationship between revenue loss due to tax avoidance and the progressivity of income tax. In Figure 3a, although both tax schedules imply the same aggregate tax burden, the progressive tax generates a higher expected revenue (lower avoidance) at intermediate levels of taxation, but the opposite applies at low and high levels of taxation. This finding is driven by the interplay of two effects with regard to the revenue raised from excluded taxpayers, i.e., the first component of expected revenue in (9). Evidently, it is favorable to aggregate compliance if the (fully compliant) group of excluded taxpayers bear a disproportionately high share of the tax burden. Yet, as the excluded are located in the lower tail of the distribution of income, the opposite property holds under progressive taxation. This effect explains the lower revenues under progressive taxation in Figure 3a at low levels of taxation. A second effect which, however, runs counter to this first effect, is that at higher tax levels, the set of excluded taxpayers is larger under progressive taxation, which acts to raise compliance. This is seen in panel (b), where W_0, having been lower in the progressive case at low levels of taxation, switches to being higher (relative to under a flat tax) at higher levels of taxation. The predominance of this second effect accounts for the higher revenues under progressive taxation at intermediate tax levels. To account, finally, for the lower revenues under progressive taxation seen at high levels of taxation, note that the second effect discussed above begins to wane at the far right-side of panel (b), such that the first effect once again dominates.

The tax policy literature sometimes intuits that avoidance will necessarily be higher under progressive taxation, as such taxation places a disproportionate burden on the rich (Tanzi and Zee, 2000). Our finding of a complex relationship between tax avoidance and tax progressivity, casts doubt on this intuition. Instead it echoes DU (2010), who also report a complex relationship. Complexity in the DU analysis arises as progressivity both (i) makes tax avoidance more attractive to the wealthy at a fixed price; and (ii) makes the price of tax avoidance higher. When the former effect dominates progressivity increases tax avoidance, and thereby reduces revenue, whereas the opposite occurs when the latter effect dominates. By contrast, in our analysis, tax avoidance is cheaper for the wealthy (in a per-unit sense) under progressive taxation (Figure 3a). The potential for complexity instead arises from the nature of the endogenous adjustments in the exclusion income threshold W_0.

4 Conclusion

Tax avoidance is thought to be responsible for significant losses of tax revenue in developed countries. In recent years the potential scale of revenue losses due to avoidance has been magnified greatly by the emergence of mass-marketed schemes targeted at the middle (rather than the top) of the income distribution. In this study we added supply-side considerations – both in respect of entry and pricing – to the demand-side model of marketed avoidance schemes in Gamannossi degl'Innocenti and Rablen (2017). An important consequence of introducing supply-side considerations we draw attention to is that the price of avoidance becomes endogenous. In respect of anti-avoidance activity (in the form of challenging the legality of avoidance schemes), we find that the marginal effect of an increase in enforcement is felt entirely in price for all but marginal avoiders. Thus, models that treat the price level as exogenously fixed importantly overstate the ability of tax authority anti-avoidance activity to drive down observed levels of tax avoidance. The policy implication of this finding is that a focus on challenging the legal basis of avoidance schemes may be insufficient to eliminate profit opportunities (and thereby entry) from promoting marketed schemes. A broader regulatory approach to raising promoter's costs of doing business may be called for, which may require expertise beyond that found currently in tax authorities.

A second feature we have sought to highlight is the potential importance for aggregate outcomes of the (endogenously determined) threshold of income below which taxpayers are excluded from the tax avoidance market. Exclusion arises from a minimum fee arrangement, which, in turn, is driven by the existence of a set-up cost per client entered into a scheme. Endogenous variation in the exclusion threshold as, e.g., taxes are raised and lowered, or made more or less progressive, reflects competing income and substitution effects. These effects are not considered fully, in some cases at all, in prior research yet can drive potential non-monotonicities in the relationship between tax rates and tax revenue, and complicate the implications of tax progressivity. In particular, increased tax progressivity is not an automatic driver of increased tax avoidance. Thus, to the extent that economic policymakers may have been reticent about increasing tax progressivity on the grounds that the hoped for reductions in inequality might be largely or wholly reversed by endogenous tax avoidance responses, our findings tend to undermine such reticence.

Future research seeking to extend the modelling framework may consider the implications of allowing taxpayers to use multiple differentiated avoidance schemes as a form of diversi-

fication against the risk that any one scheme is declared illegal. In equilibrium, one would anticipate a form of "efficient frontier" for avoidance schemes in which the riskiest schemes also offer the highest expected returns. In such an environment it may be interesting to also endogenize the nature of tax authority enforcement, such that the tax authority chooses optimally which schemes to challenge, given a resource constraint. We hope the present contribution will stimulate such research developments.

Appendix

Proof of Proposition 1. (i) For an unfettered taxpayer we have $F = pA$ and so W^u in (3) writes as $W^u = X - pA$. Substituting in (2) and differentiating with respect to A we obtain the first order condition

$$\frac{[1-\rho][1-p]}{W^s} = \frac{\rho p}{W^u}.$$

Solving for A yields

$$A^* = \frac{1-\rho-p}{p[1-p]}X. \tag{A.1}$$

For an unfettered taxpayer it must hold that $pA^*(W) > \underline{F}$. As the left-side is increasing at least linearly in W, and the right-side is constant, there exists a unique $W = W_2$ such that $pA^*(W_2) = \underline{F}$. Thus, $W > W_2 \Leftrightarrow pA^*(W_2) > \underline{F}$. $W_2 \geq \underline{F}/p$ since $W_2 \geq A^*(W_2) = \underline{F}/p$. (ii) Let $\underline{W} = T^{-1}(\underline{F}) > 0$. Then $D_0''(\underline{W}) = -\rho[\log(X) - \log(X - \underline{F})] < 0$. As $D_0''(W_1) > 0$, continuity ensures that there exists one or more points $W_0'' \in (\underline{W}, W_1)$, which is a subinterval of $(0, W_1)$, such that $D_0'' = 0$. To see the uniqueness of W_0'' note that, for $W \in (0, W_1)$,

$$\frac{\partial D_0''}{\partial W} = \frac{[1-p]T[T-A^*] + [\frac{F}{p} - T][W - pT - \underline{F}]}{X[X-\underline{F}][W-\underline{F}]}\left[1 - \frac{\partial T(W)}{\partial W}\right]p + \frac{1-\rho}{W-\underline{F}}\frac{\partial T(W)}{\partial W} > 0. \tag{A.2}$$

The sign of (A.2) follows as (a) for D_0'' to be well-defined the term $\log(X - \underline{F})$ must be well-defined, which implies $X - \underline{F} > 0$. Then, as $W \geq X$, it must also hold that $W - \underline{F} > 0$. Also, as $W - pT = X + [1-p]T \geq X$, it must also hold that $W - pT - \underline{F} > 0$; (b) We have $A^* \leq T$, hence $T - A^* \geq 0$; and (c) $W_i < W_1$ implies $T < \underline{F}/p$, so $\underline{F}/p - T > 0$. It follows from (A.2) that W_0'' is unique and $D_0'' \gtreqless 0 \Leftrightarrow W \gtreqless W_0''$. Noting that (a) $D_0''(W_1) = D_0'(W_1) > 0$ and that (b) for $W \in (W_1, W_2)$,

$$\frac{\partial D_0'}{\partial W} = \frac{\underline{F}(1-p)[\frac{F}{p} - A^*]\left[1 - \frac{\partial T(W)}{\partial W}\right]}{X[X-\underline{F}]\{X + \frac{F}{p}[1-p]\}} > 0, \tag{A.3}$$

it holds that $D_0'(W)|_{W \geq W_1} > 0$. Thus the constraint for participation in the avoidance market is met on this interval. Taxpayers for whom $W \in (W_1, W_2)$ are therefore fee-constrained. As $D_0''(W_1) > 0$, it must be that $W_0'' < W_1$. There is therefore a non-empty set of taxpayers for whom $W \in (W_0'', W_1]$ that are wealth-constrained. If $D_0'' \leq 0$, as occurs for $W \leq W_0''$ then

the constraint for participation in the avoidance market is not met. Thus, taxpayers for whom $W \leq W_0''$ are excluded. (ii) As $D_0''(W_1) = D_0'(W_1)$, if $D_0''(W_1) \leq 0$ then also $D_0'(W_1) \leq 0$. By the construction of W_2 it holds that $\mathbf{E}(U)|_{A=A^*, W=W_2} - \mathbf{E}(U)|_{A=\underline{F}/p, W=W_2} = 0$. We know $\mathbf{E}(U)|_{A=\underline{F}/p, W=W_2} > \mathbf{E}(U)|_{A=0, W=W_2}$ because $A = \underline{F}/p$ is the first-best choice of A at $W = W_2$. Hence $D_0'(W_2) = \mathbf{E}(U)|_{A=\underline{F}/p, W=W_2} - \mathbf{E}(U)|_{A=0, W=\tilde{W}_2} > 0$. It follows, by continuity, that there exists one or more points $W_0' \in [W_1, W_2)$ such that $D_0'(W_0') = 0$. By (A.3), W_0' must be unique. Also by (A.3), $D_0' > 0$ for all $W \in (W_0', W_2)$, so taxpayers for whom $W \in (W_0', W_2)$ are fee-constrained. All taxpayers for whom $W \leq W_0'$ are excluded. This follows for taxpayers with $W \in [W_0', W_1]$ from $\partial D_0'/\partial W > 0$, and for taxpayers with $W \in [0, W_0')$ from $D_0''(W_1) = D_0'(W_1)$ and $\partial D_0''/\partial W > 0$. $\blacksquare$

Proof of Remark 1. Using the definition of A^* in Proposition 1, we have

$$
\frac{\partial A^*}{\partial W} = \frac{A^*}{X}\left[1 - \frac{\partial T(W)}{\partial W}\right] > 0; \tag{A.4}
$$

$$
\frac{\partial A^*}{\partial p} = -\frac{1}{p}\left[A^* + \frac{\rho X}{[1-p]^2}\right] < 0;
$$

$$
\frac{\partial A^*}{\partial \rho} = -\frac{X}{p[1-p]} < 0.
$$

$\blacksquare$

Proof of Lemma 1. (i) If $W_0 = W_0'$ then, for an arbitrary exogenous variable z, we have $\partial W_0/\partial z = -\left[\partial D_0'/\partial z\right]/\left[\partial D_0'/\partial W\right]|_{W=W_0}$. As $\partial D_0'/\partial W > 0$ from (A.3) it follows that the sign of $\partial W_0/\partial z$ is the opposite of the sign of $\partial D_0'/\partial z$. We have

$$
\frac{\partial D_0'}{\partial p} = -\frac{\underline{F}}{p}\frac{1-p}{pX_i + \underline{F}[1-p]} < 0; \tag{A.5}
$$

$$
\frac{\partial D_0'}{\partial \rho} = \log(X - \underline{F}) - \log\left(X + \frac{\underline{F}}{p}[1-p]\right) < 0; \tag{A.6}
$$

$$
\frac{\partial D_0'}{\partial \underline{F}} = -\frac{[1-p][\frac{\underline{F}}{p} - A^*]}{[X - \underline{F}]\{X + \frac{\underline{F}}{p}[1-p]\}} < 0. \tag{A.7}
$$

If $W_0 = W_0''$ then, by similar arguments to above, the sign of $\partial W_0/\partial z$, for an arbitrary exogenous variable z, is the opposite of the sign of $\partial D_0''/\partial z$. We have

$$
\frac{\partial D_0''}{\partial p} = 0; \tag{A.8}
$$

$$
\frac{\partial D_0''}{\partial \rho} = \log(X - \underline{F}) - \log(W - \underline{F}) < 0; \tag{A.9}
$$

$$
\frac{\partial D_0''}{\partial \underline{F}} = -\left[\frac{\rho}{X - \underline{F}} + \frac{1-\rho}{W - \underline{F}}\right] < 0. \tag{A.10}
$$

Combining the results in (A.5)-(A.7) and (A.8)-(A.10), we therefore have $\partial W_0/\partial p \geq 0$; $\partial W_0/\partial \rho > 0$; and $\partial W_0/\partial \underline{F} > 0$. (ii) If $W_0 = W_0''$, the effect of a pivot of the tax function is given by

$$
\frac{\partial D_0''}{\partial T} \equiv \lim_{\varepsilon \to 0} \frac{\partial D_0''}{\partial \varepsilon}\bigg|_{T=(1+\varepsilon)T(W)} = \frac{[1-\rho]X - \underline{F}}{X[X - \underline{F}]}T(W) \gtrless 0 \Leftrightarrow [1-\rho]X - \underline{F} \gtrless 0.
$$

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If $t(W_0'') = t_0 = 1 - \underline{F}/[1-\rho]W_0''$ then $[1-\rho]X(W_0'') - \underline{F} = 0$. As X is decreasing in T, we have $[1-\rho]X(W_0'') - \underline{F} \gtrless 0$ as $t(W_0'') \lessgtr t_0$ and so $\partial D_0''/\partial T \gtrless 0 \Leftrightarrow t(W_0'') \lessgtr t_0$. This in turn implies (from part i) that $\partial W_0/\partial T \gtrless 0 \Leftrightarrow t(W_0'') \gtrless t_0$. To prove that $t_0 > 1/2$ note, by strict concavity, that

$$\log\left(X(W_0'') - \underline{F} + [1-\rho]T(W_0'')\right) > \rho\log\left(X(W_0'') - \underline{F}\right) + [1-\rho]\log\left(W_0'' - \underline{F}\right) = \log\left(X(W_0'')\right).$$

Hence, $X(W_0'') - \underline{F} + [1-\rho]T(W_0'') > X(W_0'')$, which is equivalent to $[1-\rho]T(W_0'') - \underline{F} > 0$. As $X \gtrless T \Leftrightarrow t \lessgtr \frac{1}{2}$, if $t(W_0'') \leq 1/2$ then $[1-\rho]X(W_0'') - \underline{F} \geq [1-\rho]T(W_0'') - \underline{F} > 0$. It must therefore be that $1 - \underline{F}/[1-\rho]W_0'' > 1/2$ when $[1-\rho]X(W_0'') - \underline{F} = 0$. If $W_0 = W_0'$, the effect of a pivot of the tax function is given by

$$\frac{\partial D_0'}{\partial T} \equiv \lim_{\varepsilon \to 0} \frac{\partial D_0'}{\partial \varepsilon}\bigg|_{T=(1+\varepsilon)T(W)} = -\frac{\partial D_0'}{\partial W} < 0.$$

∎

Proof of Proposition 2. (1) Assume all would-be promoters enter. Following the insights of Diamond (1971), when search costs are positive, the unique Bertrand equilibrium for N symmetric firms selling a homogeneous product implements the joint profit maximizing price. We now establish the joint profit maximizing price, which will be that arising under a monopoly. Under monopoly we have $|\Theta_{j\mathcal{F}}| = G(W_2) - G(W_0)$ and $\mathbf{E}_{\Theta_{j\mathcal{U}}}(p_j A_j)|\Theta_{j\mathcal{U}}| = \int_{G(W_2)}^{1} p(W)A^*(p(W))\,dG(W)$. At levels of price consistent with $A^* < T$ the effect of a marginal increase in $\{\underline{F}, p\}$ on monopoly profit is therefore given by

$$\frac{\partial \pi}{\partial \underline{F}} = G(W_2) - G(W_0) + [\tau - \underline{F}]\frac{\partial W_0}{\partial \underline{F}}g(W_0); \tag{A.11}$$

$$\frac{\partial \pi}{\partial p} = -[\underline{F} - \tau]\frac{\partial W_0}{\partial p}g(W_0) + \int_{\mathcal{U}}[1 - \varepsilon_{A^*,p}(W)]A^*(W)\,dG(W); \tag{A.12}$$

where $\varepsilon_{A^*,p}(W) \equiv -[p/A^*(W)][\partial A^*(W)/\partial p] > 0$ is the price elasticity of demand for avoidance (of unfettered taxpayers with income W). Setting $\partial \pi/\partial \underline{F} = 0$ in (A.11) and rearranging for $\underline{F}$, we obtain the expression in part 1(iii) of the proposition. Noting that $\underline{F} > \tau$ the first term in (A.12) takes the sign of $-\partial W_0/\partial p \leq 0$ (Lemma 1). It follows that, if $\varepsilon_{A^*,p}(W) > 1$ then $\partial \pi/\partial p < 0$. We now prove this

Claim 1 *At each level of income, W, the demand for avoidance of an unfettered taxpayer is price elastic, $\varepsilon_{A^*,p}(W) > 1$.*

Proof. From the definition of A^* in Proposition 1 we have

$$pA^* = X - \frac{\rho}{1-p}X.$$

It follows that $\partial[pA^*]/\partial p = -\rho X/[1-p]^2 < 0$. But, noting that $\partial[pA^*]/\partial p$ also writes (by the product rule) as $\partial[pA^*]/\partial p = A^*[1 - \varepsilon_{A^*,p}]$, for $\partial[pA^*]/\partial p < 0$ it must be that $\varepsilon_{A^*,p} > 1$. ∎

It follows from Claim 1 that, at levels of price consistent with $A^* < T$, a monopoly promoter can always increase profit by lowering the price, i.e., $\partial \pi/\partial p < 0$. Once, however, price is

sufficiently low that $A^* = T$, further reductions in price cease to increase avoidance. It follows that, for each market segment, W, a monopoly promoter sets price to just induce full avoidance: $A^* = T$. Note that $A^* = T$ implies $W_1 = W_2$ and $W_0 = W_0''$. Thus, taxpayers with income $W \in (W_0, W_2]$ are wealth-constrained and taxpayers with income $W > W_2$ are unfettered. Both the wealth-constrained and unfettered taxpayers avoid all tax, hence part 1(ii) of the proposition. The income W of an unfettered taxpayer who optimally chooses $F = F^*$ at a given per-unit price $p^*(F)$ is given by $F^{*-1}(F; p^*(F))$. It follows that the price schedule $p^*(F)$ that induces full avoidance by unfettered taxpayers satisfies $A^*(F; p^*(F)) = T(F^{*-1}(F; p^*(F)))$. Using (6) to replace $A^*(F; p^*(F))$ with $F/p^*(F)$, we obtain the expression in part 1(iv) of the proposition. Finally, inverting (A.1) for p and setting $A^* = T$ we obtain the expression for $p^*(W)$ in part 1(iv) the proposition (the other quadratic root does not lie in the unit interval). $p^*(W) > 1-\rho$ as it is straightforward to show that $p^*(W) > 1-\rho \Leftrightarrow -4\rho[1-\rho]T^2 < 0$. To be consistent with the initial supposition that all would-be promoters enter, we require the additional restriction that, with N promoters, the representative promoter is profitable ($\pi \geq 0$) when pricing is optimal. This restriction may be written as, $\upsilon \leq \mathcal{R}(N)$, as given in the proposition. (2) If $\upsilon > \mathcal{R}(N)$ then, with N promoters, the stage 2 equilibrium yields profits $\pi < 0$. Thus, a pure strategy for entry cannot be part of equilibrium. If $\upsilon \leq \mathcal{R}(1)$ then there exists an $\tilde{N} > 1$ such that $\mathcal{R}(\tilde{N}) = \upsilon$. Accordingly, if would-be promoters each enter with probability $\tilde{N}/N$, each is indifferent in expectation between not entering or entering and making zero profit. (3) If $\upsilon > \mathcal{R}(1)$ then it is gainful to not enter even when a would-be promoter expects to operate in stage 2 as a monopolist. Accordingly, no would-be promoter will enter. ∎

Proof of Proposition 3. First, we establish the sign of $W - 2T(W)p^*(W)$. To do this rewrite the expression for $p^*(W)$ in Proposition 2 as

$$T(W) + X(W) - 2T(W)p^*(W) = \sqrt{[T(W) - X(W)]^2 + 4\rho T(W) X(W)}.$$

Noting that $T(W) + X(W) - 2T(W)p^*(W) = W - 2T(W)p^*(W)$, this implies that

$$W - 2T(W)p^*(W) = \sqrt{[T(W) - X(W)]^2 + 4\rho T(W) X(W)} > 0.$$

Then, applying the implicit function theorem to the expression for $p^*(W)$ in Proposition 2, we obtain

$$\frac{\partial p^*(W)}{\partial \rho} = -\frac{X(W)}{W - 2T(W)p^*(W)} < 0;$$
$$\frac{\partial p^*(W)}{\partial W} = -\frac{W[1 - p^*(W)^2 - \rho] t'(W)}{W - 2T(W)p^*(W)}. \tag{A.13}$$

The expression for $\partial p^*(W)/\partial W$ in (A.13) takes the sign of $-t'(W)$, as $1 - p^*(W)^2 - \rho > 1 - p^*(W) - \rho > 0$. Hence, $\partial p^*(W)/\partial W \lesseqgtr 0 \Leftrightarrow t'(W) \gtreqless 0$. ∎

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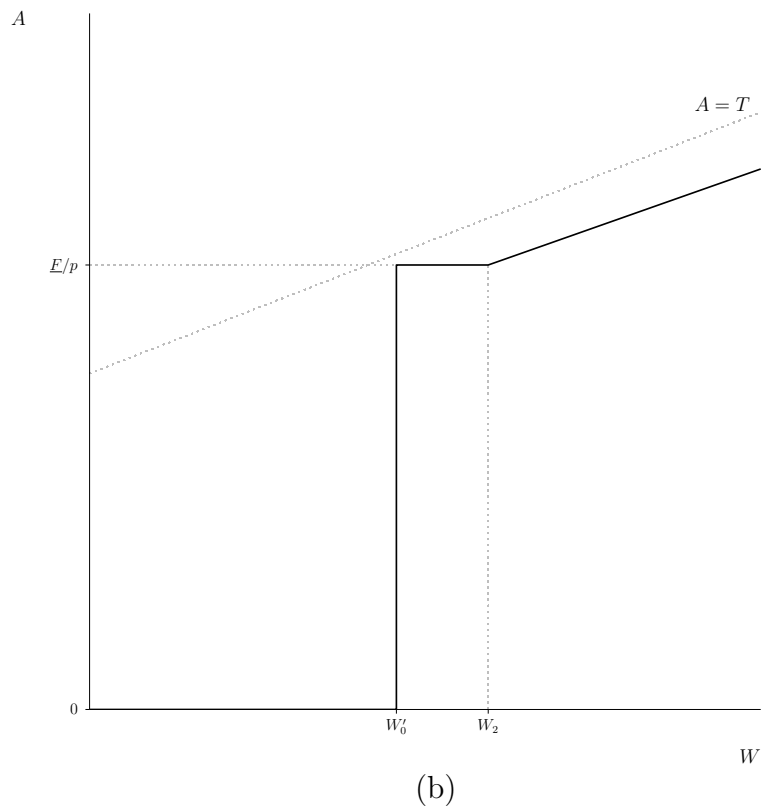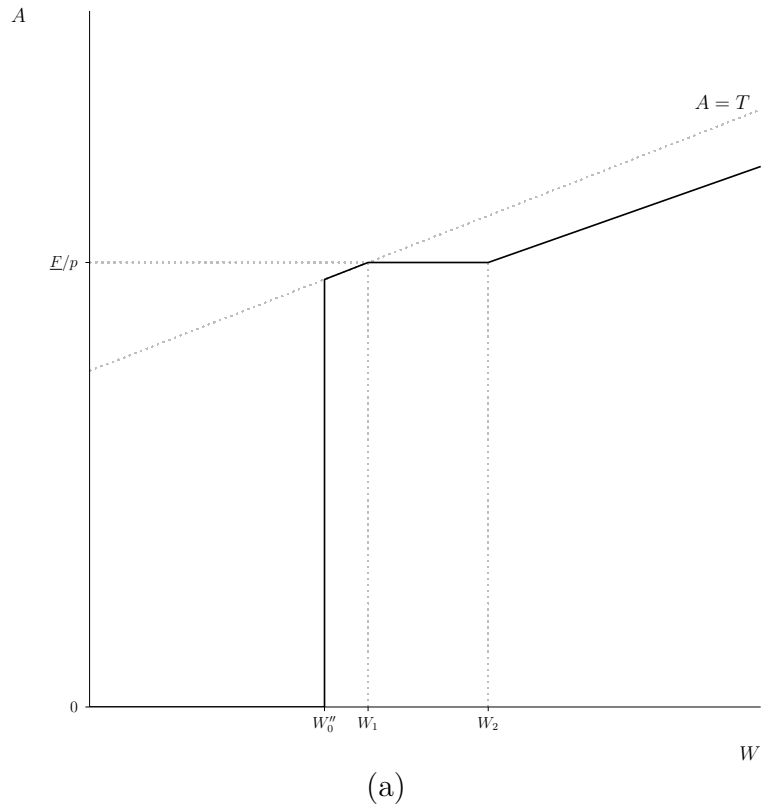
Figures

(a)

(b)

Figure 1: Optimal avoidance as a function of income, when the marginal fettered taxpayer (at the exclusion margin) is (a) wealth-constrained; and (b) fee-constrained.
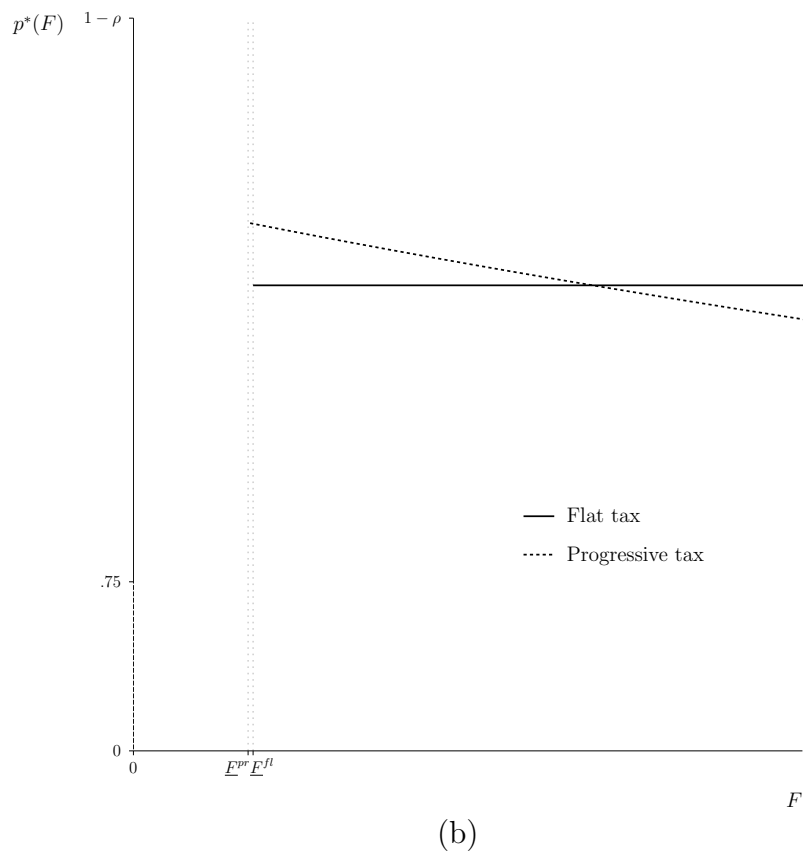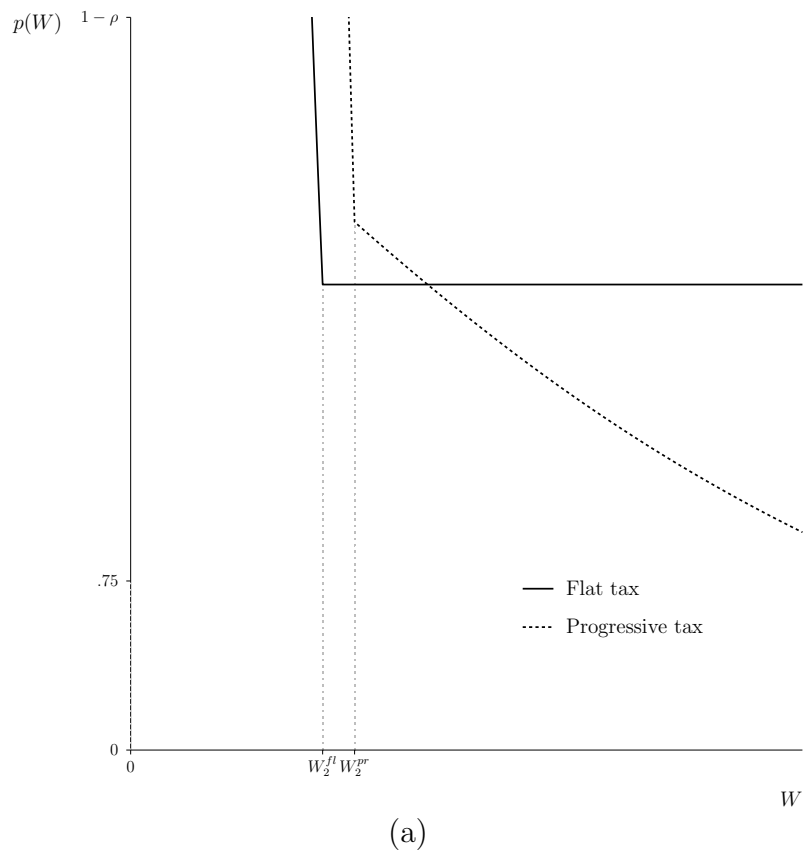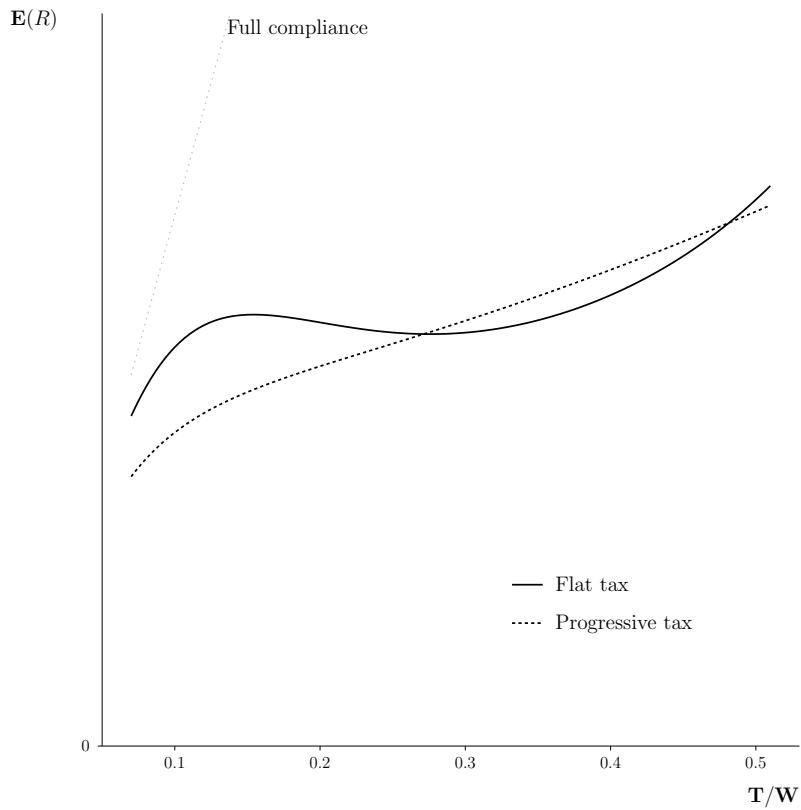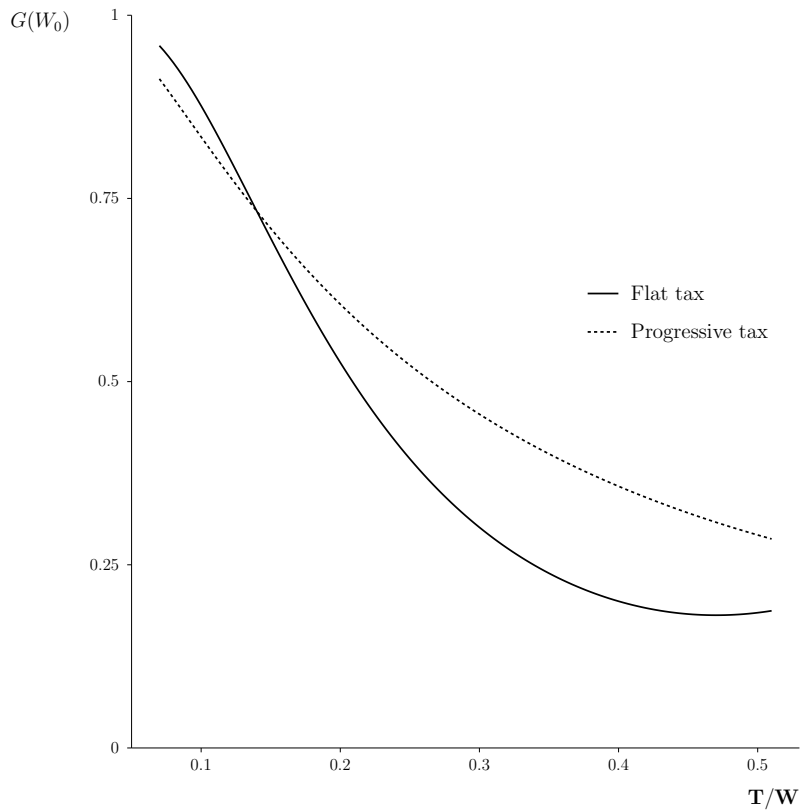
Figure 2: Equilibrium per-unit price of tax avoidance (a) as a function of income, W; (b) as a function of the fee, F.

Figure 3: (a) The relationship between expected revenue and the level of taxation. (b) The relationship between the exclusion threshold income level, W_0 (as measured by $G(W_0)$, its position in the income distribution), and the level of taxation.