Essays on Tax Avoidance Behaviour

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Abstract

There exists a competitive "tax advice" industry supplying tax avoidance schemes which help taxpayers reduce their tax liabilities. In recent years, these "tax advice" firms have targeted the middle (rather than the top) of the income distribution, leading to a significant impact on tax revenue.

Chapter 2 develops a model that includes both demand- and supply-side considerations. Firms offer a common type of avoidance scheme in a form of two-part pricing, where a taxpayer must pay at least a minimum fee, and if the taxpayer can afford it, the avoidance scheme could be purchased at a price per unit. Legal challenges by the tax authority are taken into account to capture the taxpayer's avoidance decisions. It is found that there is an endogenous threshold income below which taxpayers do not avoid, and above which they avoid maximally, and that avoidance may drive a Laffer relationship between tax rates and tax revenue.

Chapter 3 assumes that the "tax advice" firms provide differentiated products rather than the single type of avoidance scheme assumed in Chapter 2 so that the taxpayer can diversify the risk that any one scheme is declared illegal. By using the portfolio selection method proposed by Markowitz (1952), this chapter compares the avoidance demand of the taxpayer and the supply and pricing strategies of firms, in monopoly and duopoly markets. The results indicate that both duopoly market structure and endogenous adjustments in the price of avoidance reduce the effectiveness of anti-avoidance activities by the tax authority. Additionally, the

endogenous per-unit price of avoided tax in a duopoly market is higher than in a monopoly market, as the taxpayer can spread the risk of being caught through two firms in the duopoly market. These findings suggest that, beyond legal enforcement, new approaches to anti-avoidance may be needed, such as a broader regulatory approach to raising promoter's costs of doing business.

Chapter 4 focuses on corporate tax avoidance and examines the effect of tax avoidance on firm value by using a large sample of Chinese A-share listed firms over the period from 2008 to 2020. The regression results show that there is a significantly positive relation between tax avoidance and firm value, and that the effect is conditional on corporate governance quality. The results are robust to the use of alternative tax avoidance measures and alternative estimation techniques. Heterogeneity analysis reveals that the conditionality on corporate governance quality is mostly driven by non-state-owned enterprises and younger firms. Moreover, the effect of tax avoidance on firm value by corporate governance is stronger for big companies than for small companies.

Declaration

I certify that the thesis I have presented for examination for the PhD degree of the University of Sheffield is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

I declare that my thesis contains approximately 31,000 words including appendices, references, footnotes, tables and equations and has 8 figures.

I certify that a version of Chapter 2 of this thesis has been published jointly with Matthew D. Rablen and Duccio Gamannossi Degl'Innocenti, where I contributed at least 33% of the work.

Jiao Li

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Chapter 1

Introduction

1.1 Motivation and Objectives

Tax avoidance, whether by individuals or businesses, is a serious economic issue that results in large revenue losses. The value of the tax gap - the difference between the theoretical tax liability and the actual amount of tax paid - was estimated by the UK tax authorities to be £35 billion from 2017 to 2018, representing 5.6% of tax liabilities, of which £1.8 billion was caused by tax avoidance (HMRC, 2019).

Reducing tax liability without ostensibly violating tax law usually requires the cooperation of a number of experts, such as lawyers, accountants and bankers, as well as the financial clout to defend a court case if caught by the tax authorities. Hence, tax avoidance is too complicated for non-expert individuals, and the "tax advice" industry comes into being on demand. In recent years, these "tax advice" firms have targeted the middle (rather than the top) of the income distribution, including professionals, contractors and agency workers (HMRC, 2021). Such employment-based tax avoidance schemes have become a significant source of tax erosion and thereby magnify greatly the potential for revenue loss. Specifically, in the UK alone, there were estimated to be 50–100 active promoters, marketing 324 schemes in the "tax advice" industry (NAO, 2012). An important feature of this industry is that firms (promoters) take a form of two-part pricing, where a taxpayer must pay at least a minimum fee, and if the taxpayer can afford it, avoided income could be purchased at a price per unit. For this reason, even though there are many schemes available to taxpayers in the market, some of them choose to participate in only one scheme. The objective of Chapter 2 is to develop a model to analyse both the demand and supply sides of this market, to observe taxpayer avoidance behaviour and to evaluate the impact on tax revenue.

According to HMRC statistics, over half of those participating in tax avoidance during the 2018-2020 tax year used more than one scheme (HMRC, 2022a, 2022b).

By doing so, taxpayers can spread the risk of any one scheme being declared illegal. Therefore, the objective of Chapter 3 is to develop a model to analyse both the demand and supply sides of this market when firms provide differentiated products rather than a single type of avoidance scheme in Chapter 2. Policy implications are then sought by comparing avoidance behaviour in monopoly and duopoly markets.

Corporate tax avoidance has received significant attention in practice and academic research. It is estimated that countries worldwide lose USD 100-240 billion each year due to corporate tax avoidance, which is approximately 4-10 percent of global corporate income tax revenue; and developing countries are more severely affected as they are generally more dependent on corporate income tax than developed economies (OECD, 2021). Traditionally, tax avoidance allows corporate profits to be transferred from the state back to shareholders, reducing corporate cash outflows and thus increasing firm value. However, the effect of tax avoidance is significantly influenced by agency problems stemming from the separation between ownership and control. For example, managers may take the opportunity to retain part or all earnings generated by tax avoidance and benefit themselves if they are not properly motivated (Jensen & Meckling, 1976; Desai & Dharmapala, 2006). Accordingly, the relationship between tax avoidance and firm value becomes complex. Much of the previous research examines US and UK data to explain the effect of tax avoidance on firm value in their tax environments, and high-quality corporate governance is considered to be a good mechanism to mitigate agency problems (Wang, 2010; Inger, 2014; Hasan et al., 2021). However, research on the relationship between tax avoidance and firm value with corporate governance is relatively young and has not been thoroughly investigated in China. The objective of Chapter 4 is to fill this gap.

1.2 Overview of the Thesis

1.2.1 Chapter 2 Overview

This chapter introduces supply-side considerations of tax avoidance schemes into the approach to modelling marketed avoidance of Gamannossi degl'Innocenti and Rablen (2017). To keep the model simple, this chapter assumes that firms offer a common type of tax avoidance scheme, or exploit a common loophole. The analysis starts by examining the demand for tax avoidance for a given minimum fee and per-unit price. It is discovered that there exists an endogenous threshold income above which a taxpayer avoids maximally and below which a taxpayer is excluded from the market for avoidance by the minimum fee. Then this chapter focuses on avoiders who are not constrained by the minimum fee and finds that the tax avoidance for them is price elastic. And the simulations reveal that avoidance may drive a Laffer relationship between tax rates and tax revenue, which has been noticed by policymakers (Takáts & Papp, 2008; Vogel, 2012).

1.2.2 Chapter 3 Overview

Chapter 3 relaxes an assumption in Chapter 2 by allowing the "tax advice" firms to provide differentiated avoidance schemes so that a taxpayer can diversify the risk that any one scheme is declared illegal. By using the portfolio selection method proposed by Markowitz (1952), this chapter first analyses the taxpayer's demand for tax avoidance as well as the supply and pricing of the firm in the monopoly markets. This work is then repeated in a duopoly market. A comparison of the two models reveals that both duopoly market structure and endogenous adjustments in the price of avoidance reduce the effectiveness of anti-avoidance activities by the tax authority. In addition, the endogenous per-unit price of avoided tax in a duopoly market is higher than in a monopoly market as the taxpayer can spread the risk of being caught through two firms in the duopoly market, and is therefore willing to pay a premium for security. These findings imply that, beyond legal enforcement, new approaches to anti-avoidance may be needed, such as a broader regulatory approach to raising promoter's costs of doing business.

1.2.3 Chapter 4 Overview

This chapter focuses on corporate tax avoidance and examines the effect of tax avoidance on firm value by using a large sample of Chinese A-share listed firms over the period from 2008 to 2020. The traditional perspective of tax avoidance believes that it allows corporate profits to be transferred from the state back to shareholders, reducing corporate cash outflows and thus increasing firm value. While the perspective of tax avoidance argues that separation between ownership and control gives managers opportunities to retain part or all earnings generated by tax avoidance and benefit themselves if they are not properly motivated (Desai & Dharmapala, 2006). Therefore, the relationship between tax avoidance and firm value is ambiguous.

This Chapter uses Tobin's q as the measure of firm value, Book-Tax Difference (BTD) as one of the proxies for tax avoidance, and the fraction of the firm's shares held by institutional investors as a measure of corporate governance. The selection of control variables and econometric method refers to Desai and Dharmapala (2009); Wen et al. (2020); Bradshaw et al. (2019). The main regressions employ the fixed effects (FE) model, and the results show that there is a significantly positive relationship between tax avoidance and firm value and that the effect is conditional on corporate governance quality. The results are robust to the use of alternative tax avoidance measures and alternative estimation techniques. Analysis of heterogeneity reveals that the conditionality on corporate governance quality is mostly driven by non-state-owned enterprises and younger firms. Moreover, the effect of tax avoidance on firm value by corporate governance is stronger for big companies than for small companies.

Chapter 2

Marketed Tax Avoidance: An Economic Analysis

2.1 Introduction

Tax avoidance is a significant economic problem, which causes great losses to tax revenue. From 2017 to 2018, the value of the tax gap – the difference between the theoretical tax liability and the actual amount of tax paid – was estimated by the UK tax authority to be £35 billion, which was 5.6% of tax liabilities and £1.8 billion was caused by tax avoidance (HMRC, 2019). Individuals take a variety of actions to reduce their tax liabilities and the UK tax authority defines three different types of behaviour (NAO, 2012): (i) tax avoidance is exploiting the tax rules to gain a tax advantage that lawmakers never intended; (ii) tax evasion is an illegal activity, where registered individuals or businesses deliberately omit, conceal or misrepresent information in order to reduce their tax liabilities; (iii) tax planning involves using tax reliefs for the purpose intended by lawmakers.

We recognise the existence of a competitive "tax advice" industry providing schemes which help taxpayers reduce their tax liability. In this paper, we model both sides of the tax avoidance market. For the demand side, we develop the portfolio model of evasion and avoidance (Gamannossi degl'Innocenti & Rablen, 2017) to analyse whether taxpayers avoid their tax liabilities when they are allowed to buy tax avoidance schemes in the market and get the aggregate tax avoidance function. For the supply side, we assume that a single firm makes profits by selling the tax avoidance scheme to taxpayers who can afford the minimum avoidance fee. Combining the demand function and supply function, we get the equilibrium solutions and economic insights in seeking to understand tax avoidance behaviour.

The first economic studies relating to tax non-compliance mainly discuss tax evasion. Allingham and Sandmo (1972) present the canonical portfolio model of tax evasion decision in which individual taxpayers choose whether to evade and, if so, how much to evade under uncertainty. There is a trade-off between a gain if the evasion is undetected and a loss if the evasion is detected and penalised taking account of the tax rate, the probability of detection and the penalty rate imposed on evaded income. Ambiguous results are derived for declared income and tax rate because of the risk aversion types and the income and substitution effects; but unambiguous results are also derived that an increase in the penalty rate and the probability of detection will lead to a larger amount of declared income. In addition, if the fine is imposed on evaded tax, then the evaded income decreases as the tax rate increases because there is only an income effect, which is called the 'Yitzhaki Puzzle'. Under the assumption of penalty being a function of the proportion of understated income to actual income and the probability of detection being independent of the level of income, Srinivasan (1973) shows that, compared with proportional tax structure, progressive tax function results in more losses in tax revenue due to tax evasion. Subsequent theoretical work has extended the basic analysis to consider alternative penalty and tax functions and endogenous income (Yitzhaki, 1974; Pencavel, 1979; Cowell, 1990). Ambiguities in the theoretical results have led to numerical and econometric analysis of individual tax evasion behaviour.[1] Study of individual-choice problem has also generated work on optimal government choice of taxes, penalties, and probabilities of detection in a world with tax evasion.[2]

Avoidance models follow evasion models. Alm (1988) recognises that there is another legal channel for tax reduction —— tax avoidance. He analyses individual behaviour when avoidance and evasion are simultaneously available and government behaviour when individuals have these options. In his model, the individual is allowed to

[1] Friedland et al. (1978) for a simulation study of evasion; Econometric analysis of evasion behaviour is performed by Clotfelter (1984), Slemrod (1985), and Witte and Woodbury (1985).

[2] See Singh (1973), Christiansen (1980), Sandmo (1981), and Polinsky and Shavell (1984). The work by Graetz et al. (1986) and Reinganum and Wilde (1985) analyzes optimal government policy in a world in which the individuals and the collection agency interact with one another in a game theory context.

report, avoid and evade income given the fixed endowment of income; tax avoidance activity is riskless but has a participation cost while evasion is risky. This is because the individual might be audited by the tax authorities with a fixed probability and if detected, the individual will be fined an amount which is subject to the amount of evasion income. The marginal tax rate, the participation cost function of avoidance and the penalty function of evasion are positive and increasing. The avoidance choice alters many of the conclusions of the simpler evasion literature. First, a higher probability of detection and an increase in the marginal penalty cost and the marginal tax rate could decrease the amount of evasion but do not mean that the tax base will increase as there are now two channels to reduce tax liabilities and evasion can flow to avoidance. Second, the cost function of avoidance plays an important role, for example, if the marginal cost is decreasing, then an increase in the probability of detection unambiguously reduces taxable income even though evasion declines. Third, social welfare maximisation leads government to set its instruments at lower levels than when it is only interested in net revenues maximisation, and the government gains tax revenues from tax complexity because the size of the tax base increases with greater complexity. Alm and McCallin (1990) apply the portfolio theory (return-mean and risk-variance) to the avoidance-evasion decision and consider both avoidance and evasion as risky activities. Given this assumption, a different conclusion is drawn that an increase in the fine rate increases the taxable income but similar conclusions are also drawn such as the government gains from tax complexity. Econometric analysis of tax compliance behaviour has been performed as well. Alm et al. (1990) estimate individuals' tax compliance behaviour including evasion and avoidance by using the Tobit maximum likelihood estimation based on the individual-level data in Jamaica in 1983, which take account the payroll tax contributions and benefits. The results indicate that evasion and avoidance are substitutes and both are effective vehicles for reduction in tax liability. So better enforcement will not necessarily increase the tax base and the tax base rises with higher benefits for payroll tax contributions.

Most of the previous theoretical work allow taxpayers to make decisions under uncertainty while Cowell (1990) analyses the cost of sheltering and evasion using a certainty-equivalent model which specifies the cost-of-concealment function a priori. He concludes that the rich who are risk averse will choose the sheltering (riskless but costly) option and the poor could only choose evasion because they cannot afford the fee of tax concealment schemes; under these circumstances, it is the poor who end up paying the penalty for getting caught in tax evasion and it is the poor who end up paying the taxes too. Slemrod (2001) also uses the certainty-equivalent model and take labour supply into account in the avoidance model. In this model, the response to taxation can be divided into two groups: real substitution response, in which the tax-induced change in relative prices causes individuals to seek a different consumption bundle; (ii) and avoidance response, in which taxpayers take a variety of tax avoidance activities to directly reduce tax liability without consuming a different basket of good. By allowing individuals to make the labour-leisure choice and change their avoidance effort in response to tax reforms (changes), it draws the conclusion that the opportunities for tax avoidance mitigate the real substitution response to taxation. Neck et al. (2012) discuss the effects of (legal) tax avoidance and (illegal) tax evasion on the shadow economy. They build a theoretical microeconomic model in which households can participate in the official and in the shadow economy. Using comparative statics, it shows that the more complex the tax system is, the more possibilities of legal tax avoidance exist, and hence a smaller labour supply in the shadow economy. It also shows that a reduction in the maximum admissible number of working hours in the official economy increases the labour supply in the shadow economy.

Gamannossi degl'Innocenti and Rablen (2017) notice that tax avoidance schemes are marketed and many taxpayers buy these schemes at a given price to reduce their tax liability. In the theoretical model, a narrow bracketing approach is used, which assumes taxpayers make the avoidance choice before evasion. The taxpayer's income declaration is audited with probability and if audited, both avoidance and evasion are observed and the taxpayer has to pay a fine on the evaded tax. Then the tax authority will mount a legal challenge to the avoidance scheme, which is successful with a certain probability. If the legal challenge is successful, the taxpayer is only asked to repay the tax owed (not a fine). The model gets the interior solutions for optimal avoidance and evasion and finds an analogy of 'Yitzhaki puzzle' for avoidance—an increase in the tax rate decreases the level of the avoided tax. The results also show that evasion is an increasing function of the audit probability when the latter is low enough, yet tax avoidance is always decreasing in the probability of audit. And when holding the expected return to evasion constant, it is not always the case that the total loss of reported income due to avoidance and evasion can be stemmed by increasing the fine rate and decreasing the audit probability.

The above literature models the decision-making of tax avoidance and evasion, however, they only analyse the demand of reduction in tax liabilities. Slemrod (2004) considers the ignorance of the supply side of tax non-compliance to be a significant shortcoming of traditional economic models, especially in relation to corporate tax behaviour, and points out that the market for tax abusive schemes has grown substantially in recent years.[3] In related research, Damjanovic and Ulph (2010) model

[3]The large importance of the disclosure of the tax avoidance schemes has been recognised by HMRC and postulated in Part 7 of the Finance Act 2004. Similarly, the Internal Revenue Service proclaimed that one of its priorities in 2009 was to combat abusive tax avoidance schemes and the individuals who promote them (IRS, 2009).

both demand and supply sides of the tax avoidance market under risk-neutral assumption and get the equilibrium price and hence, the level of non-compliance. The primary focus of his contribution is that the flatter the tax schedule, the lower is the equilibrium price of tax minimisation schemes and hence, the greater is the level of non-compliance. The results indicate that there will be greater tax compliance in economies with a higher level of inequality in pre-tax income. And given the tax code and pre-tax income distribution, the government can design the monitoring and penalty functions to influence tax evasion and hence, the proportion of non-compliant taxpayers. There are, however, important differences with our model. Firstly, his model assumes that the taxpayer will be audited with some probability and if audited, the avoidance scheme will be deemed to constitute tax evasion in which case the taxpayer will have to repay the tax plus a penalty. However, we treat avoidance scheme as legal and so if tax authority mounts a legal challenge and succeed, the taxpayer who is risk-averse only needs to repay the tax. Secondly, in his assumption, the price of the tax avoidance scheme is determined by marginal costs, competitiveness of the industry and the nature of the demand schedule, but in our model, price is determined by tax rate, the successful probability of legal challenge and the proportion of avoidance. Recent work by Alstadsæter et al. (2019) combines micro-data leaked from financial institutions in tax havens with random audits and population-wide administrative income and wealth records in rich countries (Norway, Sweden and Denmark). It focuses on inequality problems raised by tax evasion and estimates the size and distribution of total tax evasion. The results show that tax evasion has important implications for the measurement of inequality, and compared with tax avoidance, fighting tax evasion can be a more effective way to collect more tax revenue from the very wealthy. A theoretical model is also built to describe the supply side of tax advice market, but the cost of offering such a scheme is the penalty to firms if caught breaking the law, which is not applicable to tax avoidance schemes.

Although a couple of paper models both sides of the tax avoidance market, they do not capture the characteristics properly. An important feature of our model is that it addresses explicitly the high customer-specific set-up cost when the firm offers the tax avoidance scheme to each taxpayer. Accordingly, the marginal cost of adding one more person into the scheme is significant whereas passing one more pound through the scheme that has already been set up costs almost nothing, which is different from the supply model of Damjanovic and Ulph (2010). In addition, there is a minimum wealth threshold for taxpayers induced by the customer-specific set-up cost. The firm also has legal cost if the tax authority mounts a legal challenge to the avoidance scheme. Another important feature of our model is that the price of the tax avoidance scheme is per unit price with a minimum fee instead of per scheme price. So taxpayers will pay more fees to promoters if they avoid more tax.

Our model is simple enough to admit an analytic solution, but it is also sufficiently rich that it discusses several implications of interest to academics and practitioners in tax authorities. First, the individual's demand for avoidance is a function of wealth, and the unit price of the tax avoidance scheme is affected by the tax rate, the probability of successful legal challenge, and the proportion of avoidance. In reality, the successful probability of legal challenge is pretty high if tax authority mounts a challenge to the scheme while the probability of mounting a legal challenge is pretty low, therefore, increasing the probability of legal challenge might be an effective way to reduce avoidance. Second, tax avoidance of unconstrained taxpayers is price elastic, so firms impose no upper limits on the amount that can be avoided; and in equilibrium, both constrained and unconstrained taxpayers avoid tax on all their wealth, but constrained taxpayers bear a higher per unit price to avoid tax than unconstrained taxpayers in general. Third, the extensive margin of constrained taxpayers for avoidance is greater than the intensive margin of unconstrained taxpayers. The last, by simulation, we find the Laffer curve indicating when the tax rate is lower than the revenue-maximising tax rate, an increase in tax rate increases both aggregate avoidance and total tax revenue; when the tax rate is higher than the revenue-maximising tax rate, increasing the tax rate will not only reduce tax revenue but also increase aggregate avoidance. Such non-monotonicity between tax revenue and tax rates has been noticed by economic policymakers (Takáts & Papp, 2008; Vogel, 2012).

The paper proceeds as follows: section 2.2 gives assumptions and develops a formal model of tax avoidance from the demand side and the supply side for the "tax advice" industry. Section 2.3 analyses the model and comparative statics of taxpayers' optimal avoidance, and gets the equilibrium. Section 2.4 shows the simulation results, and section 2.5 concludes. Proofs omitted from the text are collected in the Appendix, and figures are at the very rear.

2.2 Model

In the demand side, there is a continuum of risk-averse taxpayers and their wealth probability density function and cumulative distribution function are $g(w)$ and $G(w)$. Each taxpayer i has an exogenously income (wealth) w_i and faces a tax on income given by tw_i, where $t \in (0,1)$. Taxpayers behave as if they maximize expected utility, where utility is denoted by $U(z) = \log(z)$.[4] Taxpayers' true income is not observed by the tax authority and they can choose whether to declare their

[4] Thus, the risk-averse taxpayers have a constant (unit) coefficient of relative relative risk aversion. We adopt the logarithmic form for reasons of analytic tractability, though we note that the assumption of constant relative risk aversion commands considerable empirical support (see, Chiappori and Paiella (2011)).

true income but they must declare an amount $x_i \in [0, w_i]$. Taxpayers can choose to avoid paying tax on an amount of income $A_i \in [0, w_i]$, so $x_i = w_i - A_i$. Avoidance technology is, though, costly, because devising tax avoidance schemes that reduce tax liability without ostensibly violating tax law need to take full advantage of various provisions of the income tax code, coupled with a degree of ingenuity, that few taxpayers possess.[5] To satisfying this demand, a number of firms which are called "promoters" supplying and marketing avoidance schemes appear and gradually form the competitive "tax advice" market. A common feature of this market is the "no saving, no fee" arrangement under which the avoidance fee received by a promoter is linked to the amount by which their scheme stands to reduce the user's tax liability. From a detailed investigation in the UK that, for the majority of mass-marketed schemes, the fee is related to the reduction in the annual theoretical tax liability of the user, not the *expost realisation* of the tax saved (Committee of Public Accounts, 2013). Thus, the monetary risks associated with the possible subsequent legal challenge and the termination of a tax avoidance scheme are borne by the user.

In the supply side, there are a number of firms (e.g. 50-100 active promoters in the market) and each promoter provides only one type of scheme. The five largest types of mass marketed tax avoidance schemes are Partnership Loss schemes, Employee Benefit Trust schemes, Interest Relief schemes, Employment intermediary schemes and Stamp Duty Land Tax schemes. Taking Employee Benefit Trust schemes for example to explain how tax avoidance is achieved, tax advice firms set up trusts offshore and claim that the trust could help employees avoid paying income tax and National Insurance contributions. They sell these schemes to employers and self-employed individuals (they are both employers and employees), charge some fees

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

and then make loans to employees, which are not taxable. In practice, the loans are never repaid and are used as a way of rewarding employees. The nature of the Employee Benefit Trust is a disguised remuneration tax avoidance scheme. Some taxpayers buy more than one tax avoidance scheme as it is a risky investment and they prefer to spread risks that are found by the tax authority. However, most taxpayers avoid tax with only one firm because, firstly, firms have a minimum fee requirement that most taxpayers can not spread avoidance over two or more firms. Secondly, purchasing different types of schemes will increase avoidance cost of employers (devising a new scheme is costly but adding one more people into the existing scheme cost almost nothing) and the difficulty of execution (i.e. paying employees compensation through two bank accounts is challenging and require a lot of effort for both employers and promoters). Thirdly, advisers claim Employee Benefit Trust schemes are legal when they sell the schemes to employers and self-employed individuals, and if they suggest customers for diverse schemes, promoters will lose part of fees because some taxpayers may spread avoided tax with other firms. So promoters always advice customers to purchase tax avoidance schemes with only one firm. Although there are a number of tax advice firms available to taxpayers, promoters behave like monopolists. This is because the tax avoidance scheme is super complicated, and taxpayers could not understand and tell the difference. Therefore, they just choose a firm randomly, which means the selected firms act as a monopolist.

To keep things simple, we assume that, in the market, firms make and sell a common type of tax avoidance scheme to taxpayers at per unit market price $p < t$ (otherwise taxpayers can not benefit from the scheme and so will not buy them anymore) with minimum avoidance fee $\underline{f}$. Accordingly, there are three types of taxpayers: the first type is those who are excluded from the market as they can not afford the minimum avoidance fee and could only choose to avoid nothing; the second type is those who want to avoid income tax but are constrained by the minimum avoidance fee; the third type is those who are not constrained by the minimum avoidance fee so they could buy the scheme freely at per unit market price p, in this case, the fee received by the firm is linked to the amount that can be avoided. Therefore, their avoidance fee is 0, the minimum fee and per unit market price multiply by the amount of avoided income respectively, summarised by $f_i \in \{0, \underline{f}, pA_i\}$. We call the second and third types the constrained and unconstrained taxpayers. As I mentioned in the example of Employee Benefit Trust schemes, before the tax advice firm carries out a scheme, it needs to set up a trust offshore for the taxpayer. Accordingly, the minimum avoidance fee $\underline{f}$ is arising endogenously owing to the existence of customer-specific set-up cost τ. Therefore, the marginal cost of adding one more person is significant and given by τ, but once the trust is set up, passing one more pound through the scheme that has already been set up costs almost nothing, so the minimum avoidance fee is equal to the customer-specific set-up cost, $\underline{f} = \tau$. Before setting up the trust, to provide an effective tax reduction scheme to taxpayers, the supplier must conduct complex research into local and international tax law, devise a scheme and then "test" it by seeking a legal opinion as to whether it works in law (Damjanovic & Ulph, 2010). We call the cost induced in this process as fixed cost υ.

Except for the customer-specific set-up cost and the fixed cost, the firm also has legal cost. For example, the UK government introduced a disclosure regime, the Disclosure of Tax Avoidance Schemes (DOTAS) regime in 2004.[6] DOTAS requires promoters who design and sell certain types of avoidance schemes to disclose information about the schemes to HMRC. Taxpayers who use such a scheme are also required to report the scheme reference number on their tax return. The DOTAS

[6]DOTAS excludes VAT. There is a separate disclosure regime for VAT, which was introduced in 2004.

rules have been expanded over time and if promoters and users do not report to HMRC, they will face huge penalty up to £1 million per scheme. DOTAS is intended to capture information about marketed avoidance schemes, but is not restricted to marketed schemes. The tax authority could see the schemes through DOTAS and does not need to conduct an audit. It will mount a legal challenge to some of these schemes, accordingly promoters have relevant legal cost in order to deal with enquiries from HMRC. Compared to the number of users of avoidance schemes, only a small number of cases enter litigation. That could be explained by 'lead case' by National Audit Office — one case, or a small group of cases, will be litigated as a lead case, with the judgment intended to resolve a group of similar cases. Where it considers it feasible, HMRC may ask the Tax Tribunal to apply a ruling to bind a group of follower cases to accept the judgment of a lead case, subject to any subsequent appeal to distinguish the related cases (NAO, 2012). Although only a small number of cases enter litigation, HMRC has a high success rate when it litigates avoidance cases. If users are deemed as avoidance, they need to pay the due tax. Given the above information, we assume the firm faces a probability of a legal challenge ρ_L that tax authority may mount to the avoidance scheme, and if challenged, it has a relevant legal cost c_L to deal with enquiries from the tax authority. The legal challenge is successful with probability ρ_s and so the probability that the scheme is challenged successfully is $\rho = \rho_L \rho_s$. If the legal challenge is successful, the tax authority obtains the right to reclaim the tax owned from taxpayers and shut down the scheme but cannot levy a fine on taxpayers and the firm. In this case, instead of paying tx_i in tax, the taxpayer must pay tw_i and the tax advice firm (industry) will go bankruptcy because there is only one firm making and selling a type of tax avoidance scheme in our model.

Given the above assumptions, the expected utility of taxpayer i is

$$EU(A_i) = \rho U(w_i^s) + (1-\rho) U(w_i^u) \tag{2.1}$$

where w_i^s is the i^{th} taxpayer's wealth when the tax authority mounts a legal challenge and succeeds and w_i^u is the i^{th} taxpayer's wealth when avoidance succeeds:

$$\begin{aligned} w_i^s &= w^s(w_i, f_i) = (1-t) w_i - f_i; && (2.2) \\ w_i^u &= w^u(w_i, A_i, f_i) = (1-t) w_i + tA_i - f_i. && (2.3) \end{aligned}$$

f_i is the piecewise function of avoidance fee for different taxpayers:

$$f_i = \begin{cases} pA_i & \text{if } f_i > \underline{f} \\ \tau & \text{if } f_i = \underline{f} \\ 0 & \text{otherwise} \end{cases} . \tag{2.4}$$

And the firm's expected profit function is given by

$$E(\pi) = \int f_i g(w)\, \mathrm{d}w - \tau \int \mathbf{1}_{A_i(w)>0}\, g(w)\, \mathrm{d}w - c_L \rho_L - \upsilon,$$

where $\mathbf{1}_{A_i(w)>0}$ is a dummy variable and

$$\mathbf{1}_{A_i(w)>0} = \begin{cases} 1 & \text{if } A_i(w) > 0 \\ 0 & \text{otherwise} \end{cases}$$

which indicates avoidance when it takes 1 and no avoidance when it takes 0.

2.3 Analysis

For an unconstrained taxpayer, differentiating equation (2.1) with respect to A_i we have that

$$\frac{\partial EU\left(A_i\right)}{\partial A_i} = (1-\rho)\frac{t-p}{w_i^u} - \rho\frac{p}{w_i^s}. \tag{2.5}$$

Solving for the point $\partial EU\left(A_i\right)/\partial A_i = 0$ gives the optimal avoidance A_i^*:

$$A_i^* = \frac{(1-t)(t-p-\rho t)}{p\left(t-p\right)}w_i. \tag{2.6}$$

We can see from equation (2.6), the optimal avoidance A_i^* is proportional to the wealth of the unconstrained taxpayer. So We define

$$\mathcal{A} \equiv \frac{A_i^*}{w_i} = \frac{(1-t)(t-p-\rho t)}{p(t-p)} \tag{2.7}$$

is the optimal proportion of avoidance, where $0 < \mathcal{A} \leqslant 1$ and $\mathcal{A} = 1$ is the optimal choice whenever $\frac{(1-t)(t-p-\rho t)}{p(t-p)} \geq 1$.

Rearranging equation (2.7) we obtain a quadratic in p

$$g\left(p\right) = \mathcal{A}p^2 - \left(\mathcal{A}t + 1 - t\right)p + t(1-t)(1-\rho) = 0 \tag{2.8}$$

Lemma 1. *The inverse demand function is given by*

$$p = t - \frac{\mathcal{A}t - (1-t) + \sqrt{\left[\mathcal{A}t - (1-t)\right]^2 + 4\mathcal{A}\rho(1-t)t}}{2\mathcal{A}} \tag{2.9}$$

Lemma 1 is from solving equation (2.8) for p and the proof is in the Appendix. We see that the price of avoidance schemes is affected by the tax rate, the probability of successful legal challenge, and the proportion of avoidance.

Lemma 2. *At the optimal avoidance for unconstrained taxpayers, it holds for* $\mathcal{A}$ *that*

$$\frac{\partial \mathcal{A}}{\partial p} = \frac{2\mathcal{A}p - \mathcal{A}t - (1-t)}{p(t-p)} < 0; \qquad \frac{\partial \mathcal{A}}{\partial \rho} = -\frac{t\,(1-t)}{p\,(t-p)} < 0 \tag{2.10}$$

$$\frac{\partial \mathcal{A}}{\partial t} = \frac{(1-\mathcal{A})\,p + (1-2t)\,(1-\rho)}{p(t-p)} > 0 \text{ if } t < 0.5 \tag{2.11}$$

Lemma 2 is derived via implicit differentiation of the equation (2.8), so we omit the proof. It shows that an increase in price of avoidance scheme and the probability of successful legal challenge by the tax authority to the avoidance scheme will make unconstrained taxpayers decrease the optimal proportion of avoidance. In reality, the tax rate is less than 50%. For a given price of avoidance scheme p and the probability of successful legal challenge to avoidance scheme ρ, an increase in tax rate will make unconstrained taxpayers avoid more tax as they can benefit more.

For the unconstrained taxpayer, his avoidance A_i is greater than $\frac{\tau}{p}$ and the best choice is avoiding tax on the amount A_i^*, which implies there is a critical value of wealth $\tilde{w}_1$ (we call it the upper bound of wealth for constrained taxpayers) and when $w_i > \tilde{w}_1$, $A_i = A_i^* > \frac{\tau}{p}$ holds. Follows equation (2.6) and (2.7), we get

$$w_i > \tilde{w}_1 \equiv \tilde{w}_1\,(\mathcal{A}) = \frac{t-p}{(1-t)(t-p-\rho t)}\tau = \frac{\tau}{p\mathcal{A}}. \tag{2.12}$$

Therefore, if an individual's income is greater than $\tilde{w}_1$, the optimal amount of avoidance is $A_i^* = \mathcal{A}w_i$. $\tilde{w}_1$ is increasing in the customer-specific set-up cost and decreasing in the per unit market price and the proportion of avoidance. Rearranging equation (2.12) we get

$$z = \tilde{w}_1 - \frac{\tau}{p\mathcal{A}} = 0 \tag{2.13}$$

Lemma 3. *At the optimal avoidance for unconstrained taxpayers, it holds for* $\tilde{w}_1$ *that*

$$\frac{\partial \tilde{w}_1}{\partial p} = -\frac{\tilde{w}_1}{p} < 0; \qquad \frac{\partial \tilde{w}_1}{\partial t} = -\frac{\tilde{w}_1 \mathcal{A}_t}{\mathcal{A}} < 0 \text{ if } t < 0.5 \tag{2.14}$$

$$\frac{\partial \tilde{w}_1}{\partial \rho} = -\frac{\tilde{w}_1 \mathcal{A}_\rho}{\mathcal{A}} > 0; \qquad \frac{\partial \tilde{w}_1}{\partial \tau} = \frac{\tilde{w}_1}{\tau} > 0 \tag{2.15}$$

Lemma 3 is derived via implicit differentiation of the equation (2.13), so we omit the proof. It shows that the upper bound of wealth for constrained taxpayers is decreasing in the per unit market price, the optimal proportion of avoidance and the tax rate but increasing in the probability of successful legal challenge and the customer-specific set-up cost.

For a constrained taxpayer, he/she is constrained by the minimum avoidance fee and so could only choose to avoid tax on an amount exactly equal to $\frac{\tau}{p}$ or all his/her wealth, $A_i = \left\{\frac{\tau}{p}, w_i\right\}$ [7], so that $f_i = \tau$. Other taxpayers are excluded from the market as they can not afford the minimum avoidance fee, $f_i = 0$, and could only choose to avoid nothing, $A_i = 0$. In this case, there is a cut-off point of wealth for avoidance $w_i = \tilde{w}_0$ such that a taxpayer's expected utility is indifferent between choosing either. This can be expressed as follows:

$$U\left[w^s\left(\tilde{w}_0, 0\right)\right] = \rho U\left[w^s\left(\tilde{w}_0, \tau\right)\right] + (1-\rho)\, U\left[w^u\left(\tilde{w}_0, A_i, \tau\right)\right]. \tag{2.16}$$

[7] At this time, he/she may be only constrained by the minimum fee, in this case, the constrained taxpayer will choose to avoid a fixed amount $A_i = \frac{\tau}{p}$ of his/her income at the market unit price p if avoidance is better off than no avoidance even though he/she avoids a greater proportion of avoidance compared with unconstrained taxpayers. He/she may be constrained by his/her wealth as well, in this case, the minimum avoidance fee of the constrained taxpayer converts into avoidance up until avoidance reaches the total wealth, in other words, the constrained taxpayer avoids tax on all his/her wealth $A_i = w_i$ bearing a higher price than the per unit market price as long as avoidance is better off than no avoidance. These two cases generate two cut-off points of wealth of constrained taxpayers $\tilde{w}_0 = \left\{\tilde{w}_0^{'}, \tilde{w}_0^{''}\right\}$, we discuss both cases $A_i = \frac{\tau}{p}$ and $A_i = w_i$ in Appendix.

Lemma 4. *At the optimal avoidance for constrained taxpayers, it holds for $\tilde{w}_0$ that*

$$\frac{\partial \tilde{w}_0}{\partial p} \geq 0; \qquad \frac{\partial \tilde{w}_0}{\partial \rho} > 0; \qquad \frac{\partial \tilde{w}_0}{\partial \tau} > 0 \tag{2.17}$$

Lemma 3 is obtained via implicit differentiation from equation (2.16) and the proof is in Appendix. It clarifies that the cut-off point of wealth for avoidance is increasing in the per unit market price, the probability of successful legal challenge and the customer-specific set-up cost.

Proposition 1. *The individual's demand for avoidance is a function of wealth:*

$$A_i(w) = \begin{cases} \mathcal{A} w_i & \text{if } w_i > \tilde{w}_1 \\ \frac{\tau}{p} & \text{if } w_i \in \left[\frac{\tau}{p}, \tilde{w}_1\right] \\ w_i & \text{if } w_i \in \left[\tilde{w}_0, \frac{\tau}{p}\right] \\ 0 & \text{otherwise} \end{cases} \tag{2.18}$$

Combining equation (2.12) and (2.16), we get Proposition 1. As constrained taxpayers may choose to avoid tax on an amount exactly equal to $\frac{\tau}{p}$ or all his wealth, Proposition 1 has two specific piecewise functions of avoidance, we use Figure 2.1 to explain the case when constrained taxpayers choose to avoid tax on all their wealth. It shows that (i) points on the horizontal axis indicate taxpayers whose income is lower than the cut-off point of wealth –$\tilde{w}_0$– are excluded from the tax avoidance market by the minimum investment requirement; (ii) points on the solid grey line indicate wealthy unconstrained taxpayers, their income is higher than $\tilde{w}_1$, they avoid tax on the optimal proportion of avoidance $\mathcal{A}$ at the market unit price; (iii) points on the solid black 45-degree line indicate the wealth-constrained taxpayers, their income is between $\tilde{w}_0$ and $\frac{\tau}{p}$, and this line is steeper than the solid grey line which means they have to avoid tax on all income at a higher per unit market price so that

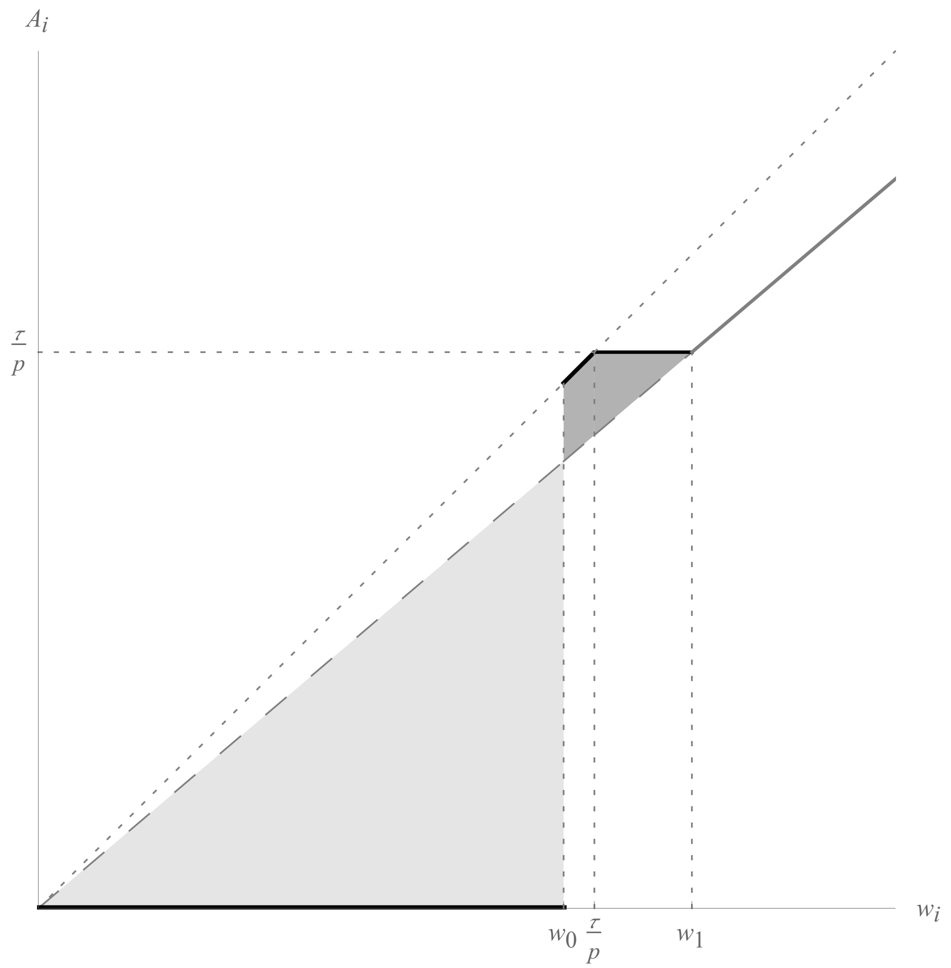


Figure 2.1: Avoidance Behaviour

the firm provides tax avoidance schemes at the minimum fee; (iv) points on the solid black horizontal line indicate the minimum-fee-constrained taxpayers, their income is between $\frac{\tau}{p}$ and $\tilde{w}_1$, they can avoid tax at the same per unit market price as wealthy unconstrained taxpayers but they have to avoid tax on a larger proportion than $\mathcal{A}$ which is equal to the fixed amount $\frac{\tau}{p}$. The existence of customer-specific set-up cost τ changes taxpayers' avoidance behaviour: it makes low-income taxpayers decrease their avoidance to zero (the light grey area) and constrained taxpayers increase their avoidance (the dark grey area).

Therefore, the aggregate avoidance A is given by

$$A = \int A_i\left(w\right) g(w)\ \mathrm{d}w. \tag{2.19}$$

Differentiating (2.19) with respect to p and ρ gives

$$\frac{\partial A}{\partial p} < 0; \qquad \frac{\partial A}{\partial \rho} < 0. \tag{2.20}$$

This implies that aggregate avoidance is decreasing in unit price of tax avoidance schemes and the probability that the scheme is challenged successfully.

We know that net revenue from constrained taxpayers is zero so we can write down the expected profit of the firm as follows:

$$\begin{aligned} E\left(\pi\right) &= \int_{\tilde{w}_1}^{\infty} f\left(w\right) g(w)\ \mathrm{d}w - \tau \int_{\tilde{w}_1}^{\infty} g(w)\ \mathrm{d}w - c_L\rho_L - \upsilon & (2.21)\\ &= p\int_{\tilde{w}_1}^{\infty} \mathcal{A}wg(w)\ \mathrm{d}w - \tau\left[1 - G\left(\tilde{w}_1\right)\right] - c_L\rho_L - \upsilon & (2.22)\\ &= pA_u - \tau\left[1 - G\left(\tilde{w}_1\right)\right] - c_L\rho_L - \upsilon & (2.23)\end{aligned}$$

$A_u = \int_{\tilde{w}_1}^{\infty} \mathcal{A}wg(w)\ \mathrm{d}w = \mathcal{A}\mu_{w>\tilde{w}_1}\left[1 - G\left(\tilde{w}_1\right)\right]$.

Proposition 2. *The demand of tax avoidance for unconstrained taxpayers is price elastic,* $\varepsilon_{A_u,p} > 1$.

Proof of Proposition 2 is in Appendix. Differentiating pointwise, the first-order condition of the firm's expected profit function is given by

$$\frac{\partial E(\pi)}{\partial A_u} = \frac{\partial p}{\partial Au} A_u + p + \tau g(\tilde{w}_1) \frac{\partial \tilde{w}_1}{\partial p} \frac{\partial p}{\partial Au} = p\left(1 - \varepsilon_{p,A_u}\right) + \tau g(\tilde{w}_1) \frac{\partial \tilde{w}_1}{\partial p} \frac{\partial p}{\partial Au} \tag{2.24}$$

From proposition 2 we know $\varepsilon_{A_u,p} > 1$, and from inequality (2.14) and (A.14) we know $\frac{\partial \tilde{w}_1}{\partial p} < 0$ and $\frac{\partial p}{\partial Au} < 0$, so $\varepsilon_{p,A_u} \in (0,1)$ and $\frac{\partial E(\pi_j)}{\partial A_u} > 0$. This indicates that the firm prefers to decrease the price slightly to get higher demand in return as the demand of tax avoidance for unconstrained taxpayers is price elastic, and for a given price, the firm would not impose an upper limit on the amount that can be avoided. Therefore, we get the following proposition.

Proposition 3. *In equilibrium, both constrained and unconstrained taxpayers avoid tax on all their wealth.*

$$A_i = \begin{cases} w_i & \text{if } w_i \geqslant \tilde{w}_0 \\ 0 & \text{otherwise} \end{cases}$$

So $\mathcal{A} = 1$ *and* $\tilde{w}_1 = \frac{\tau}{p}$ *holds, and from equation (2.7), the optimal price of tax avoidance schemes is given by*

$$p^* = t - \frac{1}{2}\left([2t-1] + \sqrt{[2t-1]^2 + 4\rho t\,[1-t]} \right). \tag{2.25}$$

Considering equation (2.10), (2.14), (2.17), and (2.20) we know that $\frac{\partial A}{\partial p} < 0$, $\frac{\partial \mathcal{A}}{\partial p} < 0$, $\frac{\partial \tilde{w}_1}{\partial p} < 0$ and $\frac{\partial \tilde{w}_0}{\partial p} \geq 0$, which means an increase in the unit price of tax avoidance schemes will increase the minimum investment requirement of constrained taxpayers, $A_i = \tilde{w}_0$, and decrease the threshold of avoidance of unconstrained taxpayers, $\frac{\tau}{p}$, and hence the critical value of wealth of unconstrained taxpayers, $\tilde{w}_1$. However, the reduction in avoidance of constrained taxpayers induced by the increase of the minimum investment requirement is greater than the increase in avoidance of unconstrained taxpayers induced by the decrease the threshold of avoidance of unconstrained taxpayers. Therefore, the aggregate avoidance A in the market decrease. So we have Proposition 4.

Proposition 4. *The extensive margin of constrained taxpayers is greater than the intensive margin of unconstrained taxpayers.*

In summary, in equilibrium, the aggregate avoidance A becomes

$$A = \int A(w)\, g(w)\ \mathrm{d}w = \int_{\tilde{w}_0}^{\infty} wg(w)\ \mathrm{d}w = \mu_{w \geqslant \tilde{w}_0} \left[1 - G\left(\tilde{w}_0\right)\right], \tag{2.26}$$

where $\mu_{w \geqslant \tilde{w}_0} = \frac{\int_{\tilde{w}_0}^{\infty} wg(w)\ \mathrm{d}w}{1 - G(\tilde{w}_0)}$.

In equilibrium, both constrained and unconstrained taxpayers avoid tax on all their wealth which means the tax authority could only collect tax from those low-income taxpayers who are excluded from the tax avoidance market by the minimum investment requirement. Therefore, the expected tax revenue of the tax authority is

$$R = \int \left[\rho t w_i + (1-\rho)\, t\left(w_i - A_i\right)\right] g(w)\ \mathrm{d}w \tag{2.27}$$

$$= \rho t \int_0^{\tilde{w}_0(t)} wg(w)\ \mathrm{d}w \tag{2.28}$$

And, the expected profit of the firm is given by

$$\begin{aligned} E(\pi) &= p^* \int_{\tilde{w}_1}^{\infty} \mathcal{A} w g(w)\ \mathrm{d}w - \tau \int_{\tilde{w}_1}^{\infty} g(w)\ \mathrm{d}w - c_L \rho_L - \upsilon \\ &= \left(p^* \mu_{w>\tilde{w}_1} - \tau\right)\left[1 - G\left(\tilde{w}_1\right)\right] - c_L \rho_L - \upsilon. \end{aligned} \tag{2.29}$$

where $\tilde{w}_1 = \frac{\tau}{p^*}$ and $\mu_{w>\tilde{w}_1} = \frac{\int_{\tilde{w}_1}^{\infty} wg(w)\ \mathrm{d}w}{1-G(\tilde{w}_1)}$.

2.4 Simulation

To make further progress, we assess the properties of optimal avoidance via a numerical optimization procedure. First, we simulate market structure of tax avoidance. By reading the National Audit Office report, we know that (1) there are currently between 50 and 100 active promoters in the market; (2) 110 cases entered litigation from April 2010 to October 2012 and 60 cases of them were judged and HMRC was successful in 51, so the successful rate of litigations, ρ_s, was between 0.46 and 0.85; (3) HMRC estimates there were 30,000 users of partnership loss schemes and employment intermediary schemes, which suggests that the probability of litigation, ρ_L, was between 0.002 and 0.0037, and $\rho = \rho_s \rho_L$ was between 0.00092 and 0.00314 (The Comptroller and Auditor General, 2012).

HMRC has won a legal case over tax avoidance scheme promoter Hyrax Resourcing Ltd, which will help the tax authority collect over £40 million in unpaid taxes. The scheme promoted by Hyrax was a disguised remuneration avoidance scheme which worked by paying scheme users in loans so they could avoid paying Income Tax and National Insurance on their earnings. Hyrax Resourcing Limited accepted applications from users, created employment contracts, signed service contracts, paid employees and transferred loan agreements to offshore trusts. Scheme users were paid just enough to comply with the National Minimum Wage. The rest of their income was made up of loans which were transferred to an offshore trust in Jersey. The amounts received under loan agreements were not declared as income on the scheme users tax return, meaning they didn't pay tax on all their earnings. Scheme users paid Hyrax 18% promoter fees to allow them to access the scheme (H.M. Revenue and Customs and The Rt Hon Mel Stride MP, 2019). Therefore, we use 18% as the equilibrium price of our baseline model. The average disposable income in the UK is £34,210 and the median is £28,418 in 2017-2018 (Office for National Statistics). We model the UK income distribution as lognormal. Using the published mean and median of the UK income distribution, we estimate that μ and σ (mean and variance parameters) are equal to 10.2548 and 0.60909 of the lognormal.

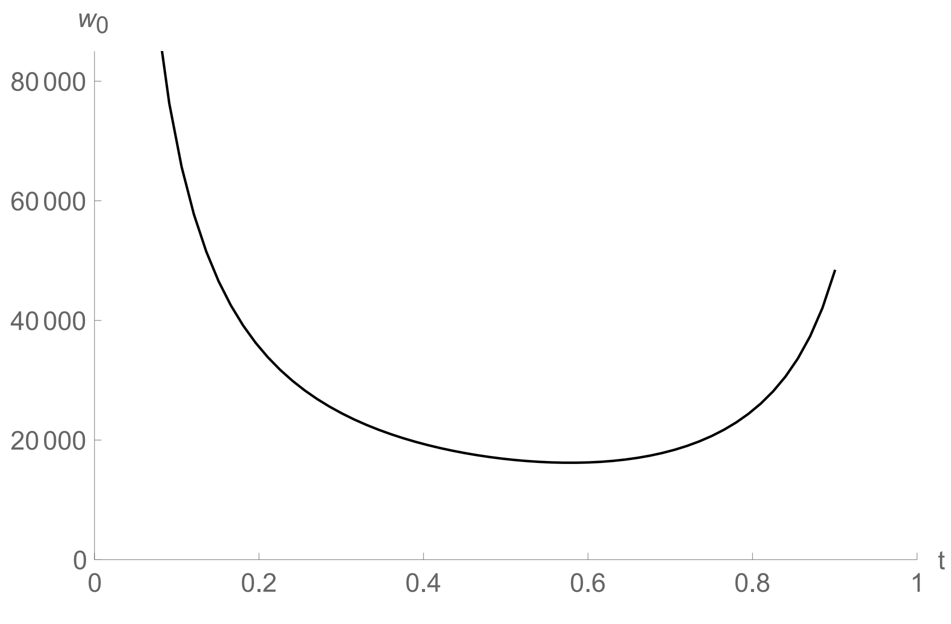


Figure 2.2: The relationship between tax rate and cut-off point of wealth for avoidance

Figure 2.2 depicts the relationship between tax rate and cut-off point of wealth for avoidance. The figure suggests, for example, that households with annual income around £30,000 and above avoid paying tax entirely by using tax avoidance schemes

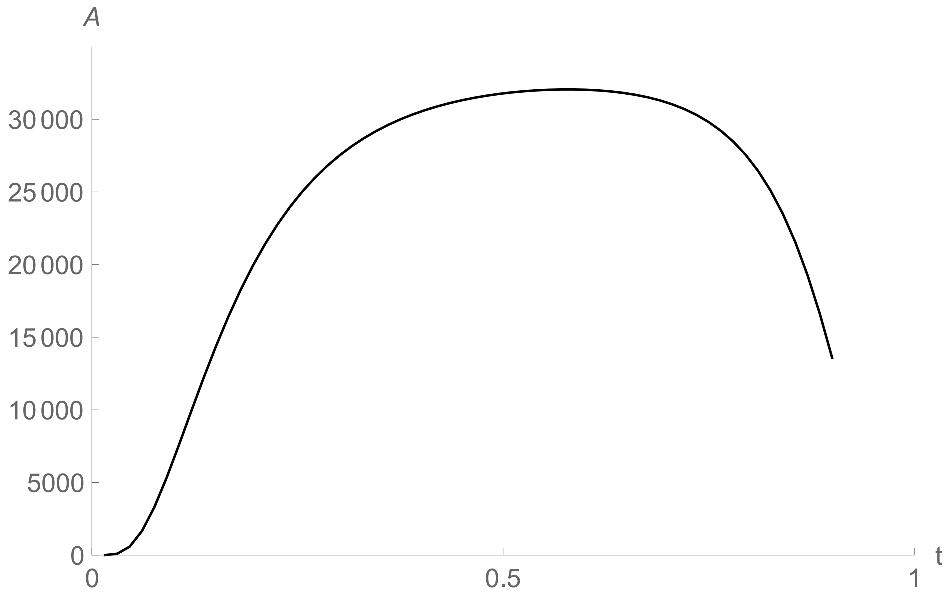


Figure 2.3: The relationship between tax rate and aggregate avoidance

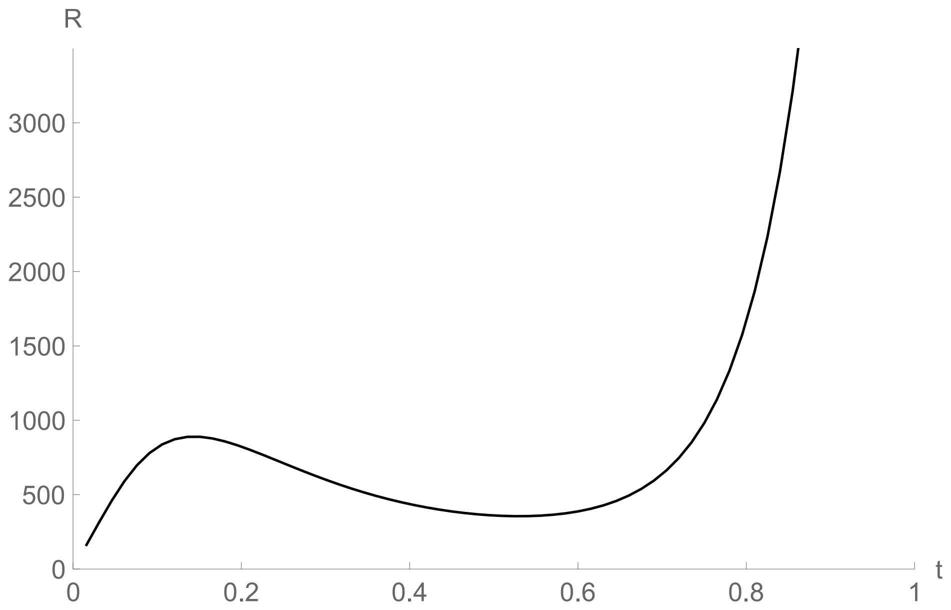


Figure 2.4: The relationship between tax rate and tax revenue

when the average tax rate is around 25%. We can see that $\tilde{w}_0$ is decreasing in tax rate when it is lower than 0.5 and at the beginning, $\tilde{w}_0$ is shrinking quickly and then slowly. Figure 2.3 depicts the relationship between tax rates and aggregate avoidance. The intensive margin is zero (unconstrained taxpayers continue to avoid tax on their all wealth), so there are three effects that determine aggregate avoidance: negative income effect, substitution effect and extensive margin effect. Negative income effect means the increase in tax rate makes taxpayers poorer. Poorer taxpayer becomes more risk averse (because log utility implies decreasing absolute risk aversion). So more risk-averse taxpayer wishes to decrease avoidance. Substitution effect means avoidance becomes more valuable as the tax rate is higher. So increase in tax rate makes the taxpayer want to avoid more. When tax rate is lower than 0.5, substitution effect dominates and aggregate avoidance is increasing; when tax rate is higher than 0.5, income effect dominates and aggregate avoidance is deceasing. Extensive margin effect is that increasing tax rate leads to $\tilde{w}_0$ fall, which means more avoiders, the constrained taxpayers enter the avoidance market and so aggregate avoidance increase. Figure 2.2 explains why aggregate avoidance start to grow fast and then slowly in Figure 2.3. Figure 2.4 depicts the relationship between tax rate and tax revenue, which is actually the Laffer curve when the tax rate is less than 0.5. There is one more effect - intensive margin effect. Even the aggregate avoidance is still the same (unconstrained taxpayers continue to avoid tax on their all wealth), increasing the tax rate makes the existing avoiders avoid more tax. Increasing the tax rate raises the tax revenue from non-avoiders, but also significantly reduces tax revenue from more constrained taxpayers (extensive margin effect) and the unconstrained avoid more tax (intensive margin effect). So there is a sharp decrease in tax revenue when substitution effect dominates, which shapes the Laffer curve. Economic policymakers document the existence of a tax avoidance Laffer curve (Takáts & Papp, 2008; Vogel, 2012). There is a trade-off between tax revenue and aggregate avoidance and how to balance them depends on the government's goal. When the tax rate is lower than the revenue-maximizing tax rate, an increase in tax rate increases both aggregate avoidance and total tax revenue. When the tax rate is higher than the revenue-maximizing tax rate, increasing the tax rate will not only reduce tax revenue but also increase aggregate avoidance.

Other numerical generated results we have analysed—which we don not report here for brevity—indicate that the qualitative nature of the results given in related comparative statics continue to hold.

2.5 Conclusion

Tax avoidance is estimated to cost the UK government £1.8 billion of income tax revenues from 2017 to 2018. Previous studies only discuss the demand side of tax avoidance but we recognise the existence of a competitive 'tax advice' industry supplying tax avoidance schemes which help taxpayers reduce their tax liability. We start from the demand of tax avoidance of taxpayers and combine the supply side of the tax avoidance market to provide an analysis which address the abuse of marketed tax avoidance schemes. It is assumed that there is a continuum of risk-averse taxpayers buying such schemes from a tax advice firm at per unit market price, subject to a minimum investment induced by the existence of the customer-specific set-up cost. The tax authority may mount a legal challenge to the scheme and, if successful, it can only reclaim the tax owed but cannot levy a fine. The firm faces a legal cost if schemes are challenged by the tax authority and has other fixed costs. Under these assumptions, we find that (1) the individual's demand for avoidance is a function of wealth: the constrained may choose to avoid tax on an amount $\frac{\tau}{p}$ or all his wealth and unconstrained taxpayers avoid tax on the optimal proportion of their income $\mathcal{A}$ at the per unit market price; (2) the unit price of tax avoidance schemes is affected by the tax rate, the probability of successful legal challenge, and the proportion of avoidance; (3) tax avoidance of unconstrained taxpayers is price elastic, so firms impose no upper limits on the amount that can be avoided; (4) so in equilibrium, both constrained and unconstrained taxpayers avoid all taxes, but constrained taxpayers bear a higher per unit price to avoid tax than unconstrained taxpayers in general; (5) the extensive margin of constrained taxpayers is greater than the intensive margin of unconstrained taxpayers; (6) by simulation, we find the Laffer curve indicating the tax authority should make appropriate tax rate if the goal is maximising tax revenue.

Our model provides a rich framework for understanding how the supply side of the tax avoidance market affects taxpayers' avoidance behaviour. However, in our model, taxpayers are only allowed to buy avoidance schemes at one firm while in reality, some taxpayers will buy different classes of avoidance schemes at different firms to spread avoided tax so that they can mitigate audit or legal challenge risks. We leave it for future research.

2.6 Appendix

Proof of Proposition 1

Rearranging equation 2.16, we obtain and define

$$F\left(\tilde{w}_0\right) = U\left[w^s\left(\tilde{w}_0, 0\right)\right] - \rho U\left[w^s\left(\tilde{w}_0, \tau\right)\right] - \left(1-\rho\right) U\left[w^u\left(\tilde{w}_0, A_i, \tau\right)\right]. \tag{A.1}$$

If $A_i = \frac{\tau}{p}$, let

$$F\left(\tilde{w}_0'\right) = U\left(w^s\left(0, \tilde{w}_0'\right)\right) - \rho U\left[w^s\left(\tau, \tilde{w}_0'\right)\right] - \left(1-\rho\right) U\left[w^u\left(\tau, \frac{\tau}{p}, \tilde{w}_0'\right)\right] \tag{A.2}$$

Then

$$F\left(\tilde{w}_0'\right) = 0$$

If $A_i = w_i$, let

$$F\left(\tilde{w}_0''\right) = U\left(w^s\left(0, \tilde{w}_0''\right)\right) - \rho U\left[w^s\left(\tau, \tilde{w}_0''\right)\right] - (1-\rho)\,U\left[w^u\left(\tau, \tilde{w}_0'', \tilde{w}_0''\right)\right] \tag{A.3}$$

Then

$$F\left(\tilde{w}_0''\right) = 0$$

So

$$\tilde{w}_0 = \begin{cases} \tilde{w}_0' & \text{if } \tau < p\tilde{w}_0' \\ \tilde{w}_0'' & \text{otherwise} \end{cases}$$

From equation (2.12) to (A.3), we get the piecewise functions of avoidance $A_i \equiv A\left(w, \tilde{w}_0\right)$.

For $\tilde{w}_0 = \tilde{w}_0^{'}$,

$$A_i \equiv A\left(w, \tilde{w}_0^{'}\right) = \begin{cases} \mathcal{A}w_i & \text{if } w_i > \tilde{w}_1 \\ \frac{\tau}{p} & \text{if } w_i \in \left[\tilde{w}_0', \tilde{w}_1\right] \\ 0 & \text{otherwise} \end{cases} \tag{A.4}$$

The A.4 lists the piecewise functions of avoidance. It shows that the taxpayer avoids tax with only a firm and so he/she invests all avoidance in that firm. When his/her wealth is more than $\tilde{w}_1$ the taxpayer will choose to avoid tax on a part $\mathcal{A}$ of his/her wealth (the optimal avoidance A_i^*) with a firm; when his/her wealth is between $\tilde{w}_0'$ and $\tilde{w}_1$ he/she could only choose to avoid tax on an amount $A_i = \frac{\tau}{p}$ with a firm; otherwise, the taxpayer will not avoid and so $A_i = 0$.

In this case, the aggregate avoidance is given by

$$A\mid_{\tilde{w}_0=\tilde{w}_0'} = \int_{\tilde{w}_0'}^{\tilde{w}_1} \frac{\tau}{p} g(w)\ \mathrm{d}w + \int_{\tilde{w}_1}^{\infty} \mathcal{A} w g(w)\ \mathrm{d}w \tag{A.5}$$

For $\tilde{w}_0 = \tilde{w}_0''$, the piecewise functions of avoidance is given by Proposition 1.

In this case, the aggregate avoidance is given by

$$A\mid_{\tilde{w}_0=\tilde{w}_0''} = \int_{\tilde{w}_0''}^{\frac{\tau}{p}} w g(w)\ \mathrm{d}w + \int_{\frac{\tau}{p}}^{\tilde{w}_1} \frac{\tau}{p} g(w)\ \mathrm{d}w + \int_{\tilde{w}_1}^{\infty} \mathcal{A} w g(w)\ \mathrm{d}w \tag{A.6}$$

Proof of Lemma 1. Since $g(0) = t(1-t)(1-\rho) > 0$ and $g(t) = -\rho t(1-t) < 0$, there are odd number of roots in the interval $(0, t)$. We know that a quadratic function have maximum two roots, therefore, there is only one root in the interval $(0, t)$. Solving equation (2.8) for p we get the inverse demand function. We begin by proving $p > 0$. From equation (2.9)

$$\begin{aligned}
p &> 0 \Leftrightarrow t > \frac{\mathcal{A}t - (1-t) + \sqrt{[\mathcal{A}t - (1-t)]^2 + 4\mathcal{A}\rho(1-t)t}}{2\mathcal{A}} && \text{(A.7)}\\
&\Leftrightarrow \mathcal{A}t + 1 - t > \sqrt{[\mathcal{A}t - (1-t)]^2 + 4\mathcal{A}\rho(1-t)t} && \text{(A.8)}\\
&\Leftrightarrow (\mathcal{A}t + 1 - t)^2 > [\mathcal{A}t - (1-t)]^2 + 4\mathcal{A}\rho(1-t)t && \text{(A.9)}\\
&\Leftrightarrow 4\mathcal{A}(1+\rho)(1-t)t > 0 && \text{(A.10)}
\end{aligned}$$

Since $4\mathcal{A}(1+\rho)(1-t)t > 0$ holds, this is consistent with the proof.

Then we prove $p < t$.

$4\mathcal{A}\rho(1-t)t > 0$, so $\sqrt{(\mathcal{A}t - (1-t))^2 + 4\mathcal{A}\rho(1-t)t} > \mathcal{A}t - (1-t)$ and the second term of equation (2.9) is greater than zero no matter what is the sign of $\mathcal{A}t - (1-t)$. Therefore, $p < t$ holds where $t \in (0, 1)$. □

Proof of Proposition 2. Differentiating equation (2.7) with respect to p gives

$$\frac{\partial \mathcal{A}}{\partial p} = \frac{2\mathcal{A}p - \mathcal{A}t - (1-t)}{p\,(t-p)} < 0$$

So the inverse price elasticity of optimal proportion of tax avoidance to wealth is given by

$$\varepsilon_{p,\mathcal{A}} = -\frac{\mathcal{A}}{p}\frac{\partial p}{\partial \mathcal{A}} = \frac{1}{2} + \frac{\mathcal{A}t - (1-t)}{2\sqrt{[\mathcal{A}t - (1-t)]^2 + 4\mathcal{A}\rho(1-t)t}} \tag{A.11}$$

From equation (A.11) we note that $-\frac{1}{2} = \frac{-\sqrt{[\mathcal{A}t-(1-t)]^2+4\mathcal{A}\rho(1-t)t}}{2\sqrt{[\mathcal{A}t-(1-t)]^2+4\mathcal{A}\rho(1-t)t}} < \frac{\mathcal{A}t-(1-t)}{2\sqrt{[\mathcal{A}t-(1-t)]^2+4\mathcal{A}\rho(1-t)t}} < \frac{\sqrt{[\mathcal{A}t-(1-t)]^2+4\mathcal{A}\rho(1-t)t}}{2\sqrt{[\mathcal{A}t-(1-t)]^2+4\mathcal{A}\rho(1-t)t}} = \frac{1}{2}$ holds irrespective of the sign of $\mathcal{A}t-(1-t)$, after plus $\frac{1}{2}$, so the inverse price elasticity of optimal proportion of tax avoidance to wealth is $\varepsilon_{p,\mathcal{A}} \in (0,1)$, which means $\varepsilon_{\mathcal{A},p} = \frac{1}{\varepsilon_{p,\mathcal{A}}} > 1$.

We define that A_u is total tax avoidance of unconstrained taxpayers

$$A_u = \int_{\tilde{w}_1}^{\infty} \mathcal{A}wg(w)\,\mathrm{d}w = \mathcal{A}\mu_{w>\tilde{w}_1}\left[1 - G\left(\tilde{w}_1\right)\right] \tag{A.12}$$

Differentiating A_u with respect to p we get

$$\frac{\partial A_u}{\partial p} = \frac{\partial \mathcal{A}}{\partial p}\int_{\tilde{w}_1}^{\infty} wg(w)\,\mathrm{d}w - \mathcal{A}\tilde{w}_1 g(\tilde{w}_1)\frac{\partial \tilde{w}_1}{\partial p} < 0 \tag{A.13}$$

So we get the price elasticity of tax avoidance of unconstrained taxpayers

$$\varepsilon_{A_u,p} = -\frac{p}{A_u}\frac{\partial A_u}{\partial p} = -\frac{p}{A_u}\left[\frac{\partial \mathcal{A}}{\partial p}\int_{\tilde{w}_1}^{\infty} wg(w)\,\mathrm{d}w - \mathcal{A}\tilde{w}_1 g(\tilde{w}_1)\frac{\partial \tilde{w}_1}{\partial p}\right] \tag{A.14}$$

From equation (2.12) we know ($\tilde{w}_1$ is a function of p)

$$\frac{\partial \tilde{w}_1}{\partial p} = \frac{\rho t \tau}{(1-t)(t-p-\rho t)^2} > 0$$

Rearranging equation (A.14), we get the price elasticity of tax avoidance of unconstrained taxpayers

$$\varepsilon_{A_u,p} = \frac{A_u \varepsilon_{\mathcal{A},p} + \tau g(\tilde{w}_1)\frac{\partial \tilde{w}_1}{\partial p}}{A_u}$$

We know $\frac{\partial \tilde{w}_1}{\partial p} > 0$ and $\varepsilon_{\mathcal{A},p} > 1$, so $\varepsilon_{A_u,p} > 1$ which means the price elasticity of tax avoidance of unconstrained taxpayers is elastic. □

Proof of Proposition 3. For constrained taxpayers, they can only choose to avoid tax on an amount $A_i = \frac{\tau}{p}$ or their total income $A_i = w_i$. So we need to check whether this two cases hold in equilibrium. By contradiction we can prove that, in equilibrium, $\tilde{w}_0 = \tilde{w}_0'$ is invalid and $\tilde{w}_0 = \tilde{w}_0''$ holds.

In equilibrium ($A_i = w_i$), setting $\tilde{w}_0 = \frac{\tau}{p}$ and from equation 2.16 we obtain

$$\begin{aligned}
U\left(w^s\left(0,\tilde{w}_0\right)\right) &= \rho U\left(w^s\left(\tau,\tilde{w}_0\right)\right) + (1-\rho)\, U\left(w^u\left(\tau, A_i, \tilde{w}_0\right)\right) \\
U\left[(1-t)\,\tilde{w}_0\right] &= \rho U\left[(1-t)\,\tilde{w}_0 - p\tilde{w}_0\right] + (1-\rho)\, U\left[(1-t)\,\tilde{w}_0 + t\tilde{w}_0 - p\tilde{w}_0\right] \quad \text{(A.15)} \\
U\left[(1-t)\,\tilde{w}_0\right] &= \rho U\left[(1-t-p)\,\tilde{w}_0\right] + (1-\rho)\, U\left[(1-p)\,\tilde{w}_0\right] \quad \text{(A.16)} \\
U\left(1-t\right) &= \rho U\left(1-t-p\right) + (1-\rho)\, U\left(1-p\right) \quad \text{(A.17)}
\end{aligned}$$

Given that $p = p^*(\rho)$ the roots of equation (A.17) are $\rho = 0$ (in which case $p^*(0) = t$) and $\rho = 1$ (in which case $p^*(1) = 0$). This is the contradiction immediately, since ρ cannot be either 0 or 1 at an interior optimum for the constrained taxpayer. In other words, $\tilde{w}_0 = \frac{\tau}{p}$ does not holds. Therefore, $\tilde{w}_0 < \frac{\tau}{p}$ holds given

$\tilde{w}_0 < \tilde{w}_1 = \frac{\tau}{p}$.

Given our assumption, taxpayers could not avoid tax more than their wealth, so the case $\tilde{w}_0 = \tilde{w}_0'$ implicitly indicates $\tilde{w}_0' > \frac{\tau}{p}$. This is the contradiction immediately, therefore, $\tilde{w}_0 = \tilde{w}_0'$ is invalid and $\tilde{w}_0 = \tilde{w}_0''$ holds in equilibrium. □

Summary of Comparative Statics. When $\tilde{w}_0 = \tilde{w}_0'$, it holds for A that

$$\frac{\partial A}{\partial p} = \frac{\partial \mathcal{A}}{\partial p}\left[1 - G(\tilde{w}_1)\right]\mu_{w \geq \tilde{w}_1} - \frac{\tau}{p} g(\tilde{w}_0')\frac{\partial \tilde{w}_0'}{\partial p} - \frac{\tau}{p^2}\left[G(\tilde{w}_1) - G(\tilde{w}_0')\right] < 0 \tag{A.18}$$

$$\frac{\partial A}{\partial \rho} = \frac{\partial \mathcal{A}}{\partial \rho}\left[1 - G(\tilde{w}_1)\right]\mu_{w \geq \tilde{w}_1} - \frac{\tau}{p} g(\tilde{w}_0')\frac{\partial \tilde{w}_0'}{\partial \rho} < 0 \tag{A.19}$$

$$\frac{\partial A}{\partial t} = \frac{\partial \mathcal{A}}{\partial t}\left[1 - G(\tilde{w}_1)\right]\mu_{w \geq \tilde{w}_1} - \frac{\tau}{p} g(\tilde{w}_0')\frac{\partial \tilde{w}_0'}{\partial t} \gtrless 0 \tag{A.20}$$

$$\frac{\partial A}{\partial \tau} = \frac{1}{p}\left[G(\tilde{w}_1) - G(\tilde{w}_0') - \tilde{w}_0' g(\tilde{w}_0')\right] \gtrless 0 \tag{A.21}$$

When $\tilde{w}_0 = \tilde{w}_0''$, it holds for A that

$$\frac{\partial A}{\partial p} = \frac{\partial \mathcal{A}}{\partial p}\left[1 - G(\tilde{w}_1)\right]\mu_{w \geq \tilde{w}_1} - \frac{\tau}{p^2}\left[G(\tilde{w}_1) - G(\frac{\tau}{p})\right] < 0 \tag{A.22}$$

$$\frac{\partial A}{\partial \rho} = \frac{\partial \mathcal{A}}{\partial \rho}\left[1 - G(\tilde{w}_1)\right]\mu_{w \geq \tilde{w}_1} - \tilde{w}_0'' g(\tilde{w}_0'')\frac{\partial \tilde{w}_0''}{\partial \rho} < 0 \tag{A.23}$$

$$\frac{\partial A}{\partial t} = \frac{\partial \mathcal{A}}{\partial t}\left[1 - G(\tilde{w}_1)\right]\mu_{w \geq \tilde{w}_1} - \tilde{w}_0'' g(\tilde{w}_0'')\frac{\partial \tilde{w}_0''}{\partial t} \gtrless 0 \tag{A.24}$$

$$\frac{\partial A}{\partial \tau} = \frac{1}{p}\left[G(\tilde{w}_1) - G(\frac{\tau}{p})\right] - \tilde{w}_0'' g(\tilde{w}_0'')\frac{\partial \tilde{w}_0''}{\partial \tau} \gtrless 0 \tag{A.25}$$

Equation (A.2) implies the second derivative of F' with respect to $\tilde{w}_0'$ which is given by

$$d' = \frac{\partial F'}{\partial \tilde{w}_0'} - \frac{\mathcal{A}\tau(t-p)\left(\tilde{w}_1 - \tilde{w}_0'\right)}{\tilde{w}_0' w^s\left(\tau, \tilde{w}_0'\right) w^u\left(\tau, \frac{\tau}{p}, \tilde{w}_0'\right)} < 0 \tag{A.26}$$

Differentiating equation (A.2) we obtain

$$\frac{\partial \tilde{w}_0'}{\partial p} = -\frac{\partial F'/\partial p}{\partial F'/\partial \tilde{w}_0'} = -\frac{(1-\rho)t\tau}{p^2 d' w^u\left(\tau, \frac{\tau}{p}, \tilde{w}_0'\right)} > 0 \tag{A.27}$$

$$\frac{\partial \tilde{w}_0'}{\partial \rho} = -\frac{\log\left[w^u\left(\tau, \frac{\tau}{p}, \tilde{w}_0'\right)\right] - \log\left[w^s\left(\tau, \tilde{w}_0'\right)\right]}{d'} > 0 \tag{A.28}$$

$$\frac{\partial \tilde{w}_0'}{\partial \tau} = \frac{\tilde{w}_0'}{\tau} > 0 \tag{A.29}$$

$$\frac{\partial \tilde{w}_0'}{\partial t} = \frac{1}{d'}\left\{\frac{(1-\rho)\left(\frac{\tau}{p} - \tilde{w}_0'\right)}{(1-t)\tilde{w}_0' - \tau + \frac{t\tau}{p}} - \frac{\rho \tilde{w}_0'}{(1-t)\tilde{w}_0' - \tau} + \frac{1}{1-t}\right\} \gtrless 0 \tag{A.30}$$

Equation (A.3) implies the second derivative of F with respect to $\tilde{w}_0$ which is given by

$$d'' = \frac{\partial F''}{\partial \tilde{w}_0''} = -\frac{\tau\left[w^s\left(\tau, \tilde{w}_0''\right) + \rho t \tilde{w}_0''\right]}{\tilde{w}_0'' w^u\left(\tau, \tilde{w}_0'', \tilde{w}_0''\right) w^s\left(\tau, \tilde{w}_0''\right)} < 0 \tag{A.31}$$

Differentiating equation (A.3) we obtain

$$\frac{\partial \tilde{w}_0''}{\partial p} = 0 \tag{A.32}$$

$$\frac{\partial \tilde{w}_0''}{\partial \rho} = -\frac{\log\left[w^u\left(\tau, \tilde{w}_0'', \tilde{w}_0''\right)\right] - \log\left[w^s\left(\tau, \tilde{w}_0''\right)\right]}{d''} > 0 \tag{A.33}$$

$$\frac{\partial \tilde{w}_0''}{\partial \tau} = -\frac{w^s\left(\tau, \tilde{w}_0''\right) + \rho t \tilde{w}_0''}{w^u\left(\tau, \tilde{w}_0'', \tilde{w}_0''\right) w^s\left(\tau, \tilde{w}_0''\right) d''} > 0 \tag{A.34}$$

$$\frac{\partial \tilde{w}_0''}{\partial t} = \frac{(1-\rho)\left(1-t\right)\tilde{w}_0'' - \tau}{d''(1-t) w^s\left(\tau, \tilde{w}_0''\right)} \gtrless 0 \tag{A.35}$$

□

Chapter 3

Diversified Tax Avoidance Schemes: A Theoretical Comparison

3.1 Introduction

This chapter will continue to study tax avoidance defined in Chapter 2. According to HMRC data, nearly half of the individuals involved in tax avoidance during the 2018-2020 tax year participated in more than one avoidance scheme (HMRC, 2022a, 2022b). Therefore, we extend the modelling framework by allowing a taxpayer to use differentiated avoidance schemes to spread against the risk that any one scheme is declared illegal. Starting with the assumption that the tax avoidance industry is a monopoly market, we analyse the taxpayer's demand for tax avoidance as well as the supply and pricing of firms. Then we assume that it is a duopoly market, so that the taxpayer can choose how much tax to avoid through each firm. Next, we re-analyse the tax avoidance demand of the taxpayer and the supply and pricing of firms in the duopoly market. By comparing the two models, we gain economic insights in seeking to understand tax avoidance behaviour.

This chapter is based on chapter 2 to derive a theoretical model that can explain how the taxpayer's behaviour changes when multiple differentiated tax avoidance schemes are available. Consequently, there is considerable overlap in the literature between these two chapters. To avoid repetition, the literature presented in Chapter 2 is omitted here.

Perhaps because the tax avoidance industry has not existed for a long time, literature on tax avoidance has historically focused more on the demand side rather than the supply side (Slemrod & Yitzhaki, 2002; Slemrod, 2004). The only study we aware of to focus on the supply-side considerations of marketed tax avoidance schemes is that of Damjanovic and Ulph (2010). However, these authors assume that the "tax advice" industry provides a single tax scheme rather than differentiated products. Furthermore, they take a simple approach to the demand side, which is markedly different from the one that is proposed in this chapter. In order to capture whether a taxpayer chooses to avoid tax and, if so, how much tax is avoided in a monopoly market and how the proportion of tax avoidance is allocated through each firm in a duopoly market, we treat these behaviours as the portfolio selection and use the "mean-variance" approach proposed by Markowitz (1952) to analyse them. Specifically, we calculate the expected returns and variances of each tax avoidance scheme and then use mathematical optimization techniques (the Lagrangian equations) to find the optimal portfolio weights that lie on the efficient frontier. Substituting these optimal weights on per-unit prices into the profit functions of firms and solving the profit-maximising functions for per-unit prices, we could get firms' pricing strategies. Therefore, the price of avoidance is endogenous in this chapter, which is different from the implicit assumption that tax avoidance technology is supplied perfectly elastically at an exogenously determined level of price in Gamannossi degl'Innocenti and Rablen (2017).

Our model comes up with two important findings. First, within a certain range of possibilities of legal challenges by the tax authority, tax avoidance increases with the level of legal enforcement in the duopoly market, marked contrast to the prediction of the Gamannossi degl'Innocenti and Rablen (2017) model, which predicts that when the tax authority increase anti-avoidance activities, all avoiders will reduce their avoidance. Second, the per-unit price of avoidance in a duopoly market is higher than in a monopoly market as the taxpayer can spread the risk of being caught by the tax authority in the duopoly market. These observations imply that legal enforcement is less effective than expected and it is necessary to employ innovative ways outside legal enforcement to raise the cost of doing business for promoters.

The Chapter proceeds as follows: Section 3.2 gives assumptions and develops models of tax avoidance from the demand and supply sides, in monopoly and duopoly markets. Section 3.3 compares the monopoly and duopoly models from the level of legal enforcement and the per-unit price of avoided tax. Section 3.4 concludes. Proofs are collected in the Appendix at the very rear.

3.2 Model

3.2.1 Monopoly Model

We assume that there is a continuum of risk-averse taxpayers, each with an exogenous income (wealth) $W \in \mathbb{R}_{++}$ and an exogenous tax liability on income given by tW, where $t \in (0, 1)$ is the marginal tax rates. A taxpayer's true income is not observed by the tax authority. Thus the taxpayer may choose to avoid paying tax on an amount of income $A \in [0, W]$. We define the proportion of avoidance as $\omega = \frac{A}{W} \in [0, 1]$, then the proportion of non-avoidance is $1 - \omega$. If the 'tax advice' industry is a monopoly market, taxpayers can only avoid tax through one firm (a type of tax avoidance scheme). By purchasing avoided tax at a price per unit, $p \in (0, 1)$, each taxpayer could avoid a percentage of avoided tax to tax liabilities, $\phi \in [0, 1]$. For example, a taxpayer plans to avoid paying tax on an amount of income of A with the monopolist, i.e. to avoid paying tax of tA. Only by purchasing the scheme, the taxpayer could avoid tax of ϕtA and accordingly needs to pay the fee of $p\phi tA$ to the firm. Tax avoidance schemes may be challenged by the tax authority. If a challenge is upheld by the tax authorities with with probability ρ, it applies to all schemes. Then taxpayers must repay tax owed to the tax authority, but no fine as fines cannot be levied retrospectively.

Given the above, the return on wealth not invested in avoiding tax on income of

A for a taxpayer is

$$R_0 = \frac{(1-t)(W-A)-(W-A)}{W-A} = -t. \tag{3.1}$$

If he/she chooses to avoid tax on income of A, with probability ρ, the taxpayer gets $(1-t)A$; with probability $(1-\rho)$, the taxpayer gets $[1-t(1-\phi)]A$. Thus, the expected return of investing in tax avoidance schemes is

$$\begin{aligned} \overline{R}_a &= \frac{\rho(1-t)A+(1-\rho)[1-t(1-\phi)]A-pt\phi A-A}{A} \\ &= -t[1-\phi(1-p-\rho)]. \end{aligned}$$

Define

$$\mu = \overline{R}_a - R_0 = (1-p-\rho)\phi t > 0 \tag{3.2}$$

as the risk premium of tax avoidance schemes, where $0 < p < 1-\rho$ allow the taxpayer receive a positive risk premium from schemes.

If the scheme is successfully challenged by the tax authority, the taxpayer receives a lower return

$$R_l = \frac{(1-t)A-pt\phi A-A}{A} = -t(1+p\phi);$$

if not, the taxpayer receives a higher return

$$R_h = \frac{[1-t(1-\phi)]A-pt\phi A-A}{A} = -t(1+p\phi-\phi).$$

Therefore, the expected utility of a taxpayer is

$$EU(\omega) = \rho U[(1-\omega)R_0+\omega R_l]+(1-\rho)U[(1-\omega)R_0+\omega R_h].$$

The taxpayer behaves as if he/she maximizes expected utility, where utility is denoted by the quadratic function, $U(z) = \alpha z - \frac{\beta}{2}(z - \overline{z})^2$. Thus, the expected utility becomes

$$EU(\omega) = \alpha(R_0 + \mu\omega) - \frac{\beta}{2}\omega^2\sigma^2, \tag{3.3}$$

where $\sigma = t\phi\sqrt{(1-\rho)\rho} > 0$.

Differentiating the expected utility $EU(\omega)$ gives

$$\frac{\partial EU(\omega)}{\partial \omega} = \alpha\mu - \beta\omega\sigma^2,$$

and solving for the $\frac{\partial EU(\omega)}{\partial \omega} = 0$ gives

$$\omega_M = \frac{\alpha}{\beta}\frac{\mu}{\sigma^2}. \tag{3.4}$$

Differentiating equation 3.4 with respect to p gives

$$\frac{\partial \omega_M}{\partial p} = -\frac{\alpha}{\beta}\frac{\phi t}{\sigma^2}.$$

The first derivative of the expected utility function is monotonically decreasing at $\omega \in [0,1]$,so when $\frac{\partial EU}{\partial \omega}|_{\omega=0} = \alpha\mu \leqslant 0$ which is equivalent to $p \geqslant \overline{p} = 1-\rho$, $\omega = 0$ maximises $EU(\omega)$; when $\frac{\partial EU}{\partial \omega}|_{\omega=1} = \alpha\mu - \beta\sigma_a^2 \geqslant 0$ which is equivalent to $p \leqslant \underline{p}_M = 1 - \rho - \frac{\beta\sigma^2}{\alpha\phi t}$, $EU(\omega)$ is maximised at $\omega = 1$; when $\frac{\partial EU}{\partial \omega}|_{\omega=0} > 0$ and $\frac{\partial EU}{\partial \omega}|_{\omega=1} < 0$ which is equivalent to $\underline{p}_M < p < \overline{p}$, $\omega = \omega_M$ makes $EU(\omega)$ maximised. These are summarized as a piecewise function as follows

$$\omega[p] = \begin{cases} 0 & \overline{p} \leqslant p < 1; \\ \omega_M & \underline{p}_M < p < \overline{p}; \\ 1 & 0 < p \leqslant \underline{p}_M, \end{cases}$$

where $\underline{p}_M > 0$ implies $\frac{\alpha}{\beta} > \rho t\phi \Leftrightarrow \rho < \frac{\alpha}{\beta t\phi}$.

The promoter, namely the monopolistic firm, gets revenue by selling avoided tax at a price per unit, p, and has a variable cost for every unit of income avoided, c_0. Also, seeking 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. Remunerating the human capital of the attorneys, accountants, bankers, etc., who perform this activity comes at a (symmetric) cost $\upsilon > 0$. The relevant legal cost to deal with enquiries from the tax authority enters into the symmetric cost υ as it is borne by promoters (firms) and does not change with the amount of tax avoided. Therefore, the profit function of the firm is given by

$$E(\pi) = (pt\phi - c_0)\,\omega[p]\,W - \upsilon.$$

where $p \geqslant \frac{c_0}{t\phi}$.

Differentiating $E(\pi)$ with respect to p gives

$$\frac{\partial E(\pi)}{\partial p} = t\phi\omega W + (pt\phi - c_0)\,W\frac{\partial \omega}{\partial p}, \tag{3.5}$$

where

$$\frac{\partial \omega}{\partial p} = \begin{cases} 0 & \overline{p} \leqslant p < 1; \\ \frac{\partial \omega_M}{\partial p} & \underline{p}_M < p < \overline{p}; \\ 0 & 0 < p \leqslant \underline{p}_M. \end{cases}$$

When $\overline{p} \leqslant p < 1$, the price is too high so that the risk premium becomes negative, therefore, the taxpayer chooses to avoid nothing, i.e. $\omega = 0$. In this case, any decrease in prices will not affect the proportion of avoidance, i.e. $\frac{\partial \omega}{\partial p} = 0$. In order not to make a loss, the firm will choose to sell avoided tax at the variable cost, i.e. $p = \overline{p} = \frac{c_0}{t\phi}$.

When $\underline{p}_M < p < \overline{p}$, the taxpayer receive a positive risk premium from schemes such that $\omega = \omega_M$. In this case, equation 3.5 becomes

$$\frac{\partial E(\pi)}{\partial p}|_{\omega=\omega_M} = \frac{\alpha}{\beta}\frac{t\phi}{\sigma^2}W\left[(1-\rho-2p)\,\phi t + c_0\right],$$

solving $\frac{\partial E(\pi)}{\partial p} = 0$ for p gives

$$p_1 = p^*|_{\omega=\omega_M} = \frac{t\phi\,(1-\rho)+c_0}{2t\phi}. \tag{3.6}$$

Replacing p_1 in the equation 3.4 we get the equilibrium proportion of avoidance

$$\omega_M^* = \frac{\alpha}{\beta}\frac{(1-\rho)t\phi - c_0}{2(1-\rho)\rho t^2\phi^2}.$$

Let ρ_0 be the unique ρ for which $p_1(\rho_0) = \underline{p}_M$, i.e.,

$$\rho_0 \equiv p_1^{-1}\left(\underline{p}_M\right) = \widetilde{\rho}_0;\text{[1]}$$

let ρ_1 be the unique ρ for which $p_1(\rho_1) = \overline{p}$, i.e.,

$$\rho_1 \equiv p_1^{-1}(\overline{p}) = 1 - \frac{c_0}{t\phi}.$$

$\frac{\partial E(\pi)}{\partial p}|_{\omega=\omega_M}$ is monotonically decreasing at $p \in \left(\underline{p}_M, \overline{p}\right)$, $\frac{\partial E(\pi)}{\partial p}|_{p=\underline{p}_M} > 0$ and $\frac{\partial E(\pi)}{\partial p}|_{p=\overline{p}} < 0$, which are equivalent to $\rho_0 < \rho < \rho_1$, ensure that $p_1 > \frac{c_0}{t\phi}$ holds and $p = p_1$ maximises $E(\pi)$ at $p \in \left(\underline{p}_M, \overline{p}\right)$.

When $0 < p \leqslant \underline{p}_M$, the price of avoided tax is low enough so that the taxpayer chooses to avoid tax on all his/her income, i.e. $\omega = 1$. In this case, any decrease in prices will not affect the proportion of avoidance, i.e. $\frac{\partial \omega}{\partial p} = 0$, then we have $\frac{\partial E(\pi)}{\partial p} = t\phi W > 0$. The first derivative of the profit function is positive at $p \in \left[0, \underline{p}_M\right]$, so

[1] See appendix for proof.

$p = \underline{p}_M$ maximises $E(\pi)$ where $\underline{p}_M \geqslant \frac{c_0}{t\phi}$ implies $\rho \leqslant \widehat{\rho} = \widehat{\rho}_1$.[2] Summarised above, the price of avoided tax is a piecewise function of the probability of a successful challenge by the tax authority, as shown below

$$p = \begin{cases} \underline{p}_M & 0 \leqslant \rho \leqslant \rho_0; \\ p_1 & \rho_0 < \rho < \rho_1; \\ \frac{c_0}{t\phi} & \rho_1 \leqslant \rho \leqslant 1. \end{cases}$$

The price of avoided tax and the proportion of avoidance in the monopoly model as a function of the probability of a successful challenge by the tax authority, are depicted in Figure 3.1: the price of avoided tax (the yellow line) is decreasing with the probability of a successful legal challenge for any $\rho \in [0, \rho_1)$. When $0 \leqslant \rho \leqslant \rho_0$, although the price of tax avoidance is high, the probability of a successful legal challenge is low enough that the taxpayer will avoid tax on all income (the blue line); when $\rho_0 < \rho < \rho_1$, the price of tax avoidance is lower than before, but, considering the increased probability of detection, the taxpayer will choose to avoid only a proportion of the tax. When $\rho_1 \leqslant \rho \leqslant 1$, the probability of legal enforcement is too high, which results in the upper limit of the price (the red line) that the customer can afford being lower than the cost price ($\frac{c_0}{t\phi}$); to avoid making a loss, consequently, the firm will not provide tax avoidance schemes. As such, the taxpayer cannot avoid tax, at least not from tax avoidance schemes, i.e. $\omega = 0$.

3.2.2 Duopoly Model

We next extend the monopoly model to a duopoly model. We assume that there are two promoters (firms) in the market offering avoidance schemes and each firm i devises a differentiated scheme to help the taxpayer avoid tax on part of income. Thus, the taxpayer could spread avoidance with two firms, $A = \sum_{i=1}^{2} a_i$. ($i = 0$

[2] The proofs for $\widehat{\rho} = \widehat{\rho}_1$ and $\rho_0 < \widehat{\rho}$ are in the Appendix.

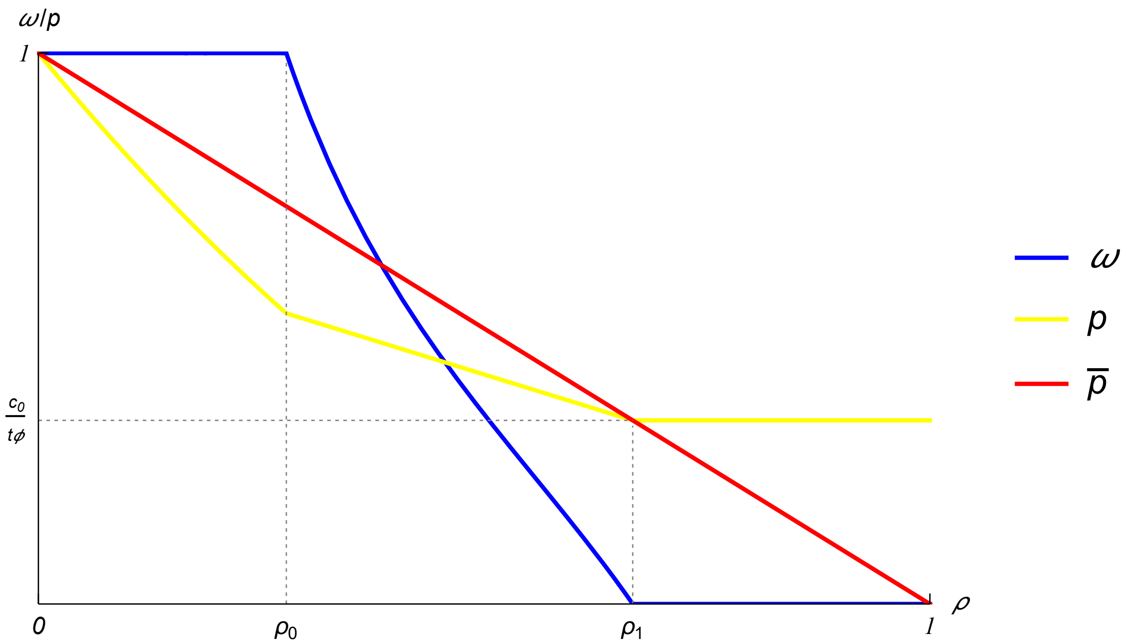


Figure 3.1: The price of avoided tax and the proportion of income avoided in the monopoly model as a function of the probability of a successful challenge by the tax authority.

indicates no tax avoidance and $i \in \mathbb{N}^+$ indicates tax avoidance.) We define the proportion of non-avoidance to wealth is $\omega_0 = \frac{a_0}{W}$ and the proportion of avoidance with firm i is $\omega_{i|i\neq 0} = \frac{a_i}{W}$, so $\sum_{i=0}^{N} \omega_i = 1$. By purchasing avoided tax at a price per unit, $p_i \in (0, 1)$, the taxpayer could avoid a percentage of tax avoided to tax liabilities from a firm, $\phi_i \in (0, 1)$. Tax avoidance schemes may be challenged by the tax authority. However, even if a challenge is upheld by the tax authorities, it does not apply to all schemes, as the scheme offered by each promoter is not identical. Assume the expected proportion of firms challenged is $m \in [0, 1]$, and the probability that exactly k firms are challenged, given m, is $\varsigma_k \in [0, 1]$. Then the probability that exactly two firms are challenged is

$$\begin{aligned} \varsigma_2 &= \max(2m - 1, 0) \\ &= (2m - 1)\, \mathbf{1}_{m>1/2}. \end{aligned}$$

The probability that only one firms is challenged is

$$\begin{aligned}\varsigma_1 &= \min(2m,1) - \varsigma_2 \\ &= 1 + \min(2m-1,0) - \varsigma_2 \\ &= 1 + (2m-1)\left(1 - \mathbf{1}_{m>1/2}\right) - \varsigma_2 \\ &= 2(m - \varsigma_2),\end{aligned}$$

and the probability of no firm being challenged is

$$\begin{aligned}\varsigma_0 &= 1 - \varsigma_1 - \varsigma_2 \\ &= 1 - 2m + \varsigma_2.\end{aligned}$$

Figure 3.2 shows the relationship between the probability that k firms are challenged and the expected proportion of firms challenged. The probability of exactly two firms being challenged (the red line) is zero until the expected proportion of law enforcement reaches half; afterwards, the probability of two firms being challenged increases with the expected level of enforcement, reaching one at $m = 1$. The probability of no firm being challenged (the yellow line) is opposite to the case where exactly two firms are challenged. The probability of only one firm being challenged rises with the expected level of enforcement, reaching a peak of 1 at $m = 0.5$, then declines and becomes zero at $m = 1$. The probabilities of exactly k firms being challenged add up to one. For example, given half of the expected proportion of firms challenged, the probabilities of exactly two, one and no firms challenged are zero, one and zero respectively, which sum to one.

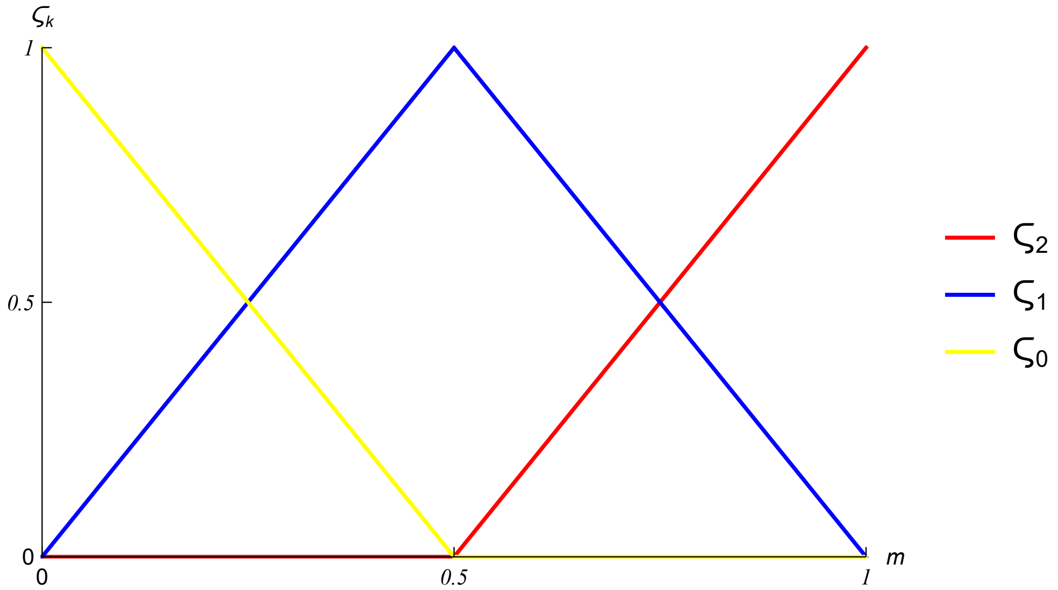


Figure 3.2: The probability that k firms are challenged

So the probability that firm i is challenged is

$$\begin{aligned}\rho_i &= \theta_i \varsigma_1 + \varsigma_2 = 2\theta_i m + (1-2\theta_i)\,\varsigma_2 \qquad (3.7)\\ &= 2\theta_i m + (1-2\theta_i)\,(2m-1)\,\mathbf{1}_{m>1/2}\end{aligned}$$

where $\theta_i \in [0,1]$ is the probability, conditional on exactly one firm being challenged, that the one challenge falls on firm i, and $\theta_1 + \theta_2 = 1$.

Hence,

$$\rho_1 + \rho_2 = \varsigma_1 + 2\varsigma_2 = 2m.$$

According to equation 3.1, the return of not avoiding a_0 is equal to

$$R_0 = \frac{(1-t)\,a_0 - a_0}{a_0} = -t.$$

If the taxpayer chooses to avoid tax on income of $a_{i|i\neq 0}$ with firm i, with probability ρ_i, the taxpayer gets $(1-t)\,a_i$; with probability $(1-\rho_i)$, the taxpayer gets

$[1 - t(1 - \phi_i)]\, a_i$. Thus, the expected return of investing in schemes i is

$$\begin{aligned} \overline{R}_i &= \frac{\rho_i (1-t)\, a_i + (1-\rho_i)\left[1 - t(1-\phi_i)\right] a_i - p_i t \phi_i a_i - a_i}{a_i} \\ &= -t\left[1 - \phi_i (1 - p_i - \rho_i)\right] < 0 \end{aligned} \tag{3.8}$$

Define

$$\mu_i = \overline{R}_i - R_0 = (1 - p_i - \rho_i)\, \phi_i t > 0 \tag{3.9}$$

as the risk premium of scheme i, where $0 < p_i < 1 - \rho_i$ allow the taxpayer receive a positive risk premium from schemes. The expected portfolio return is a weighted average of the returns invested in each scheme, given as

$$\begin{aligned} \overline{R}_p &= \sum_{i=0}^{2} \omega_i \overline{R}_i \\ &= (1 - \omega_1 - \omega_2)\, R_0 + \omega_1 \overline{R}_1 + \omega_2 \overline{R}_2 \\ &= R_0 + \omega_1 \left(\overline{R}_1 - R_0\right) + \omega_2 \left(\overline{R}_2 - R_0\right) \\ &= R_0 + \mu_p \end{aligned}$$

where $\mu_p = \sum_{i=1}^{2} \omega_i \mu_i$ is the portfolio risk premium.If schemes i is successfully challenged by the tax authority, the taxpayer receives a lower return

$$R_{il} = \frac{(1-t)\, a_i - p_i t \phi_i a_i - a_i}{a_i} = -t\,(1 + p_i \phi_i)\,;$$

if not, the taxpayer receives a higher return

$$R_{ih} = \frac{\left[1 - t(1-\phi_i)\right] a_i - p_i t \phi_i a_i - a_i}{a_i} = -t\,(1 + p_i \phi_i - \phi_i)\,.$$

Given the above, the expected utility of a taxpayer is

$$\begin{aligned} EU(\omega_i) &= \varsigma_0 U[\omega_0 R_0 + \omega_1 R_{1h} + \omega_2 R_{2h}] + \theta_1 \varsigma_1 U[\omega_0 R_0 + \omega_1 R_{1l} + \omega_2 R_{2h}] \\ &\quad + \theta_2 \varsigma_1 U[\omega_0 R_0 + \omega_1 R_{1h} + \omega_2 R_{2l}] + \varsigma_2 U[\omega_0 R_0 + \omega_1 R_{1l} + \omega_2 R_{2l}]. \end{aligned}$$

The taxpayer behaves as in the monopoly model, maximising expected utility, where utility is represented by the quadratic function, $U(z) = \alpha z - \frac{\beta}{2}(z - \overline{z})^2$. Therefore, the expected utility becomes

$$EU(\omega_i) = \alpha \overline{R}_p - \frac{\beta}{2}\sigma_p^2 = \alpha \sum_{i=0}^{2} \omega_i \overline{R}_i - \frac{\beta}{2}\left(\sum_{i=1}^{2} \omega_i^2 \sigma_i^2 + 2\omega_1\omega_2\rho_{12}\sigma_1\sigma_2\right), \qquad (3.10)$$

where

$$\begin{aligned} \sigma_i &= t\phi_i\sqrt{(1-\rho_i)\rho_i} > 0; \\ \rho_{12} &= -\frac{\rho_1\rho_2 - \varsigma_2}{\sqrt{(1-\rho_1)\rho_1}\sqrt{(1-\rho_2)\rho_2}} < 0. \end{aligned}$$

σ_p is the standard deviation of the portfolio consisting of two tax avoidance schemes, and σ_1 and σ_2 are the standard deviations for scheme 1 and 2, respectively. ρ_{12} is the correlation coefficient between the two schemes, and the negative relationship explains that the taxpayer weighs the two schemes and more tax avoidance with one scheme lead to less investment in the other. The absolute value of ρ_{12} reflects the degree of heterogeneity that captured by the correlation between different schemes successfully challenged in the court by the tax authority. $\rho_{12} \in [-1, 0]$ and the proof is in the Appendix.

The taxpayer may choose to avoid a proportion of the tax or to avoid all tax with two firms. In the former case, i.e. $\omega_0 > 0$, the Lagrangian problem for the taxpayer is

$$L_1 = EU(\omega_i) - \lambda_1(\omega_0 + \omega_1 + \omega_2 - 1)\,; \tag{3.11}$$

in the latter case, i.e. $\omega_0 = 0$, the Lagrangian problem for the taxpayer becomes

$$L_2 = EU(\omega_i) - \lambda_2(\omega_1 + \omega_2 - 1)\,. \tag{3.12}$$

We first consider the former case. Differentiating equation 3.11 with ω_i and λ_1 gives

$$\begin{aligned}
\frac{\partial L_1}{\partial \omega_0} &= \alpha R_0 - \lambda; \\
\frac{\partial L_1}{\partial \omega_1} &= \alpha \overline{R}_1 - \beta\left(\omega_1\sigma_1^2 + \omega_2\rho_{12}\sigma_1\sigma_2\right) - \lambda; \\
\frac{\partial L_1}{\partial \omega_2} &= \alpha \overline{R}_2 - \beta\left(\omega_2\sigma_2^2 + \omega_1\rho_{12}\sigma_1\sigma_2\right) - \lambda; \\
\frac{\partial L_1}{\partial \lambda_1} &= \omega_0 + \omega_1 + \omega_2 - 1,
\end{aligned}$$

and solving for the $\frac{\partial L_1}{\partial z} = 0$ we obtain

$$\begin{aligned}
\omega_0 &= 1 - \frac{\alpha}{\beta}\frac{\mu_1\sigma_2^2 + \mu_2\sigma_1^2 - (\mu_1 + \mu_2)\rho_{12}\sigma_1\sigma_2}{\sigma_1^2\sigma_2^2(1 - \rho_{12}^2)}; \\
\omega_1 &= \frac{\alpha}{\beta}\frac{\mu_1\sigma_2 - \mu_2\rho_{12}\sigma_1}{\sigma_1^2\sigma_2(1 - \rho_{12}^2)} \geqslant 0; \\
\omega_2 &= \frac{\alpha}{\beta}\frac{\mu_2\sigma_1 - \mu_1\rho_{12}\sigma_2}{\sigma_1\sigma_2^2(1 - \rho_{12}^2)} \geqslant 0; \\
\lambda_1 &= \alpha R_0.
\end{aligned}$$

Accordingly, their derivatives with respect to p_i is given by

$$\frac{\partial \omega_i}{\partial p_i} = \frac{\partial \omega_i}{\partial \mu_i}\frac{\partial \mu_i}{\partial p_i} = -\frac{\alpha}{\beta}\frac{t\phi_i}{\sigma_i^2(1 - \rho_{12}^2)}. \tag{3.13}$$

If tax avoidance schemes are symmetric, i.e. $p_i = p, \rho_i = \rho = m$[3] and $\phi_i = \phi$, then the risk premium and standard deviation of each scheme are the same such that $\mu_1 = \mu_2 = \mu$ and $\sigma_1 = \sigma_2 = \sigma$, so the taxpayer will invest evenly in two schemes such that

$$\omega_1 = \omega_2 = \omega_O = \frac{\alpha}{\beta}\frac{\mu}{\sigma^2\,(1+\rho_{12})}, \tag{3.14}$$

where $1 - \rho - \frac{\beta}{\alpha}\frac{\sigma^2(1+\rho_{12})}{2\phi t} = \underline{p}_O < p < \overline{p} = 1-\rho$. The right-side inequality, $p < \overline{p}$, is the condition that the avoidance gamble be better than non-avoidance. The left-side inequality, $\underline{p}_O < p$, makes it unworthwhile for the taxpayer to avoid tax on all income. After symmetry, equation 3.13 becomes

$$\frac{\partial \omega_O}{\partial p} = -\frac{\alpha}{\beta}\frac{t\phi}{\sigma^2\,(1-\rho_{12}^2)}. \tag{3.15}$$

We now turn to the latter case that the taxpayer chooses to avoid tax on all income with two firms. Differentiating equation 3.12 with ω_i and λ_2 gives

$$\begin{aligned}
\frac{\partial L_2}{\partial \omega_1} &= \alpha\overline{R}_1 - \beta\sigma_1(\omega_1\sigma_1^2 + \omega_2\rho_{12}\sigma_1\sigma_2) - \lambda_2;\\
\frac{\partial L_2}{\partial \omega_2} &= \alpha\overline{R}_2 - \beta\sigma_2(\omega_1\rho_{12}\sigma_1\sigma_2 + \sigma_2^2\omega_2) - \lambda_2;\\
\frac{\partial L_2}{\partial \lambda_2} &= \omega_1 + \omega_2 - 1,
\end{aligned}$$

and solving for the $\frac{\partial L_2}{\partial z} = 0$ we obtain

$$\begin{aligned}
\omega_1 &= \frac{\alpha(\mu_1-\mu_2) + \beta\sigma_2(\sigma_2 - \rho_{12}\sigma_1)}{\beta\,(\sigma_1^2+\sigma_2^2-2\rho_{12}\sigma_1\sigma_2)};\\
\omega_2 &= \frac{\alpha(\mu_2-\mu_1) + \beta\sigma_1(\sigma_1 - \rho_{12}\sigma_2)}{\beta\,(\sigma_1^2+\sigma_2^2-2\rho_{12}\sigma_1\sigma_2)};\\
\lambda_2 &= \frac{\alpha\overline{R}_2\sigma_1^2 + \alpha\overline{R}_1\sigma_2^2 - \alpha\rho_{12}\sigma_1\sigma_2(\overline{R}_1+\overline{R}_2) - \beta\,(1-\rho_{12}^2)\,\sigma_1^2\sigma_2^2}{\sigma_1^2+\sigma_2^2-2\rho_{12}\sigma_1\sigma_2}.
\end{aligned}$$

[3]The proofs for $\rho = m$ is in the Appendix.

Accordingly, their derivatives with respect to p_i is given by

$$\frac{\partial \omega_i}{\partial p_i} = \frac{\partial \omega_i}{\partial \mu_i}\frac{\partial \mu_i}{\partial p_i} = -\frac{\alpha t \phi_i}{\beta\left(\sigma_1^2 + \sigma_2^2 - 2\rho_{12}\sigma_1\sigma_2\right)} < 0. \tag{3.16}$$

After symmetry, the taxpayer avoids all taxes evenly through two schemes such that $\omega_1 = \omega_2 = \frac{1}{2}$ and $p \leqslant \underline{p}_O$, and equation 3.16 becomes

$$\frac{\partial \omega}{\partial p}|_{\omega_0=0} = -\frac{\alpha}{\beta}\frac{t\phi}{2\sigma^2\left(1-\rho_{12}\right)} < 0. \tag{3.17}$$

Summarizing, the taxpayer's optimal demand for avoidance is

$$\omega\left(p\right) = \begin{cases} 0 & \overline{p} \leqslant p < 1; \\ \omega_O & \underline{p}_O < p < \overline{p}; \\ \frac{1}{2} & 0 < p \leqslant \underline{p}_O. \end{cases} \tag{3.18}$$

Having first examined the demand side of the market for avoidance, we move on to consider the market's supply side. As in the monopoly model, firms in the duopoly model bear the marginal cost of income avoided $c_0 > 0$, and a fixed entry cost $\upsilon > 0$. However, firms sell avoided tax at different prices per-unit p_i as they offer differentiated schemes. Therefore, the profit function of firm i is given by

$$E\left(\pi_i\right) = \left(p_i t \phi_i - c_0\right)\omega_i\left[p_i\right]W - \upsilon,$$

where $p_i \geqslant \frac{c_0}{t\phi_i}$. After symmetry, the first derivative of the profit function with respect to price is given by

$$\frac{\partial E\left(\pi\right)}{\partial p} = t\phi\omega\left(p\right)W + \left(pt\phi - c_0\right)\frac{\partial \omega}{\partial p}W. \tag{3.19}$$

When $0 < p \leqslant \underline{p}_O$, the taxpayer avoids all taxes evenly through two schemes such that $\omega_1 = \omega_2 = \frac{1}{2}$, and any decrease in price has no effects on avoidance, i.e. $\frac{\partial \omega}{\partial p} = 0$. Therefore, equation 3.19 becomes

$$\frac{\partial E(\pi)}{\partial p}|_{\omega=\frac{1}{2}} = \frac{1}{2} t\phi W > 0, \tag{3.20}$$

which indicates that $p = \underline{p}_O$ maximises $E(\pi)$. When $\overline{p} \leqslant p < 1$, the risk premium turns negative since the exogenous price is too high; thus, non-avoidance is better than gambling on avoidance for the taxpayer, i.e. $\omega = 0$. The profit constraint is binding so the exogenous price of avoided tax is exactly the cost price that firms provide tax avoidance schemes, i.e. $p = \overline{p} = \frac{c_0}{t\phi}$.

When $\underline{p}_O < p < \overline{p}$, the taxpayer chooses to avoid tax on a proportion of income, i.e. $\omega = \omega_O$, equation 3.19 becomes

$$\frac{\partial E(\pi)}{\partial p}|_{\omega=\omega_O} = t\phi W \left[\omega_O - (pt\phi - c_0)\frac{\alpha}{\beta}\frac{1}{\sigma^2(1-\rho_{12}^2)}\right], \tag{3.21}$$

and solving $\frac{\partial E(\pi)}{\partial p}|_{\omega=\omega_O} = 0$ for equilibrium price gives

$$p_2 = p^*|_{\omega=\omega_O} = \frac{\phi t(1-\rho)(1-\rho_{12}) + c_0}{\phi t(2-\rho_{12})}. \tag{3.22}$$

where

$$\rho < 1 - \frac{c_0}{t\phi}; \qquad 0 < \frac{\alpha}{\beta} < \frac{(2-\rho_{12})(1+\rho_{12})\sigma^2}{2\left[(1-\rho)t\phi - c_0\right]}.$$

When $\frac{\alpha}{\beta}$ is low enough, p_2 and $\underline{p}_O$ intersect at three points, two of which lie in the interval $(0, \frac{1}{2})$ and one in the interval $(\frac{1}{2}, 1)$; when $\frac{\alpha}{\beta}$ is high, p_2 and $\underline{p}_O$ have only one intersection point which is located in the interval $(\frac{1}{2}, 1)$.

Proposition 5. *Consider a pricing strategy that maximises profits when a firm offers tax avoidance schemes. Let*

- $\rho^* \in \left(0, \frac{1}{2}\right)$ *be the unique* ρ *for which* $\omega_O(\rho^*) = \min(\omega_O)$*, i.e.,*

$$\rho^* \equiv \omega_O^{-1}(\min \omega_O);$$

- $\{\rho_2, \rho_3\} \in (0, \frac{1}{2}]$ *be the real roots for which* $p_2(\rho_2) = \underline{p}_O$ *or* $p_2(\rho_3) = \underline{p}_O$*, i.e.,*

$$\{\rho_2, \rho_3\} \equiv p_2^{-1}\left(\underline{p}_O\right);$$

- $\rho_4 \in \left(\frac{1}{2}, 1\right)$ *be the unique* ρ *for which* $p_2(\rho_4) = \underline{p}_O$*, i.e.,*

$$\rho_4 \equiv p_2^{-1}\left(\underline{p}_O\right);$$

- $\rho_5 \in \left(\frac{1}{2}, 1\right)$ *be the unique* ρ *for which* $p_2(\rho_5) = \overline{p}$*, i.e.,*

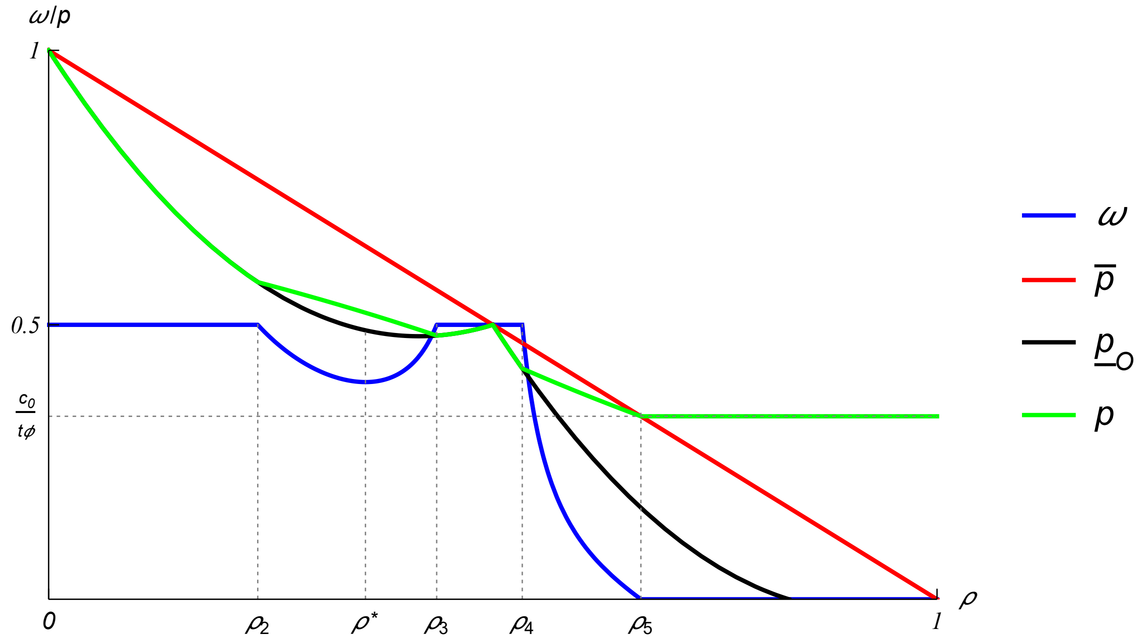
$$\rho_5 \equiv p_2^{-1}(\overline{p}) = 1 - \frac{c_0}{t\phi}.$$

Therefore, the equilibrium price function is

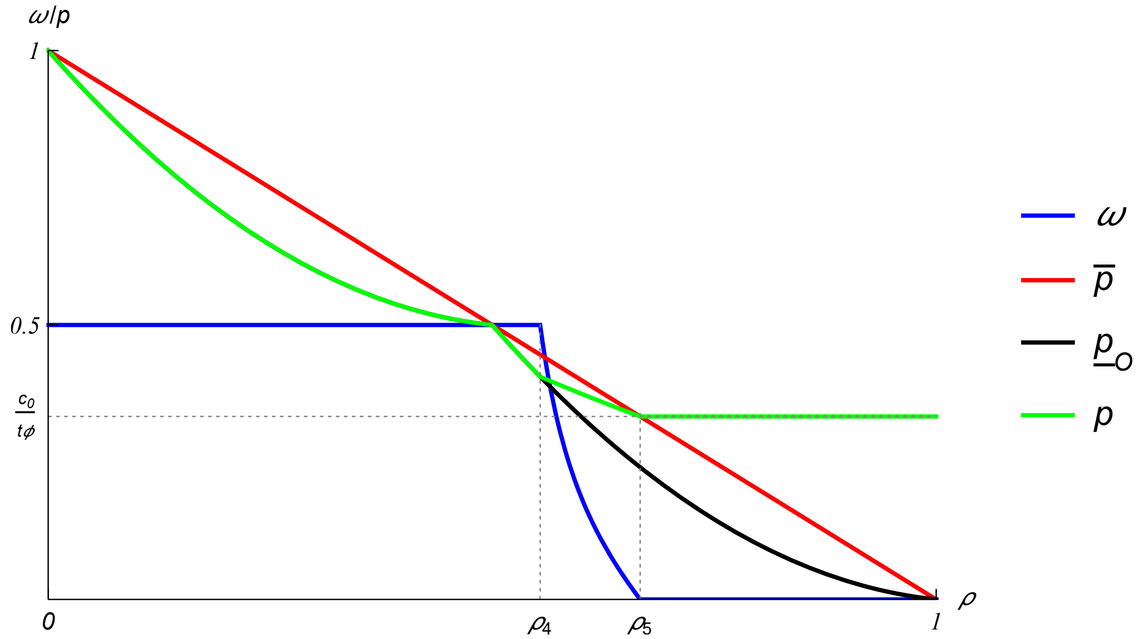
$$p_a^* = \begin{cases} \underline{p}_O & 0 \leqslant \rho < \rho_2; \\ p_2 & \rho_2 \leqslant \rho \leqslant \rho_3; \\ \underline{p}_O & \rho_3 \leqslant \rho \leqslant \rho_4; \\ p_2 & \rho_4 \leqslant \rho \leqslant \rho_5; \\ \frac{c_0}{t\phi} & \rho_5 < \rho \leqslant 1, \end{cases}$$

or

$$p_b^* = \begin{cases} \underline{p}_O & 0 \leqslant \rho < \rho_4; \\ p_2 & \rho_4 \leqslant \rho \leqslant \rho_5; \\ \frac{c_0}{t\phi} & \rho_5 < \rho \leqslant 1. \end{cases}$$



(a)



(b)

Figure 3.3: Optimal avoidance demand and firms' profit-maximizing price when $\frac{\alpha}{\beta}$ is (a) low enough; and (b) high.

Proposition 5 describes the pricing characteristics of firms. A firm's choice of profit-maximizing price depends heavily on $\frac{\alpha}{\beta}$. These piecewise functions are depicted in Figure 3.3: panel (a) illustrates the case where $\frac{\alpha}{\beta}$ is sufficiently low, i.e. $p = p_a^*$; and panel (b) illustrates the case where $\frac{\alpha}{\beta}$ is high, i.e. $p = p_b^*$. As shown in panel (a), When the probability of a successful challenge by the tax authority is lower than ρ_2, the endogenous per-unit price of avoidance is quite high, the taxpayer still tends to avoid all taxes. This is because, for the taxpayer, the benefits of paying high prices for tax avoidance are far greater than the losses caused by being caught for tax avoidance under a low level of legal enforcement, so it is valuable. As the probability of legal challenge increases until it reaches ρ^*, the taxpayer gradually reduces the tax avoidance ratio; thereafter, as the level of legal challenge increases slowly, he/she progressively raises the amount of tax avoidance due to the significant reduction in per-unit price, until avoids all. With the risk of being caught for tax avoidance rising from ρ_4 to ρ_5, the avoidance proportion for the taxpayer drops rapidly even as firms cut their prices; when the risk is higher than ρ_5, firms sell at cost prices and can no longer make profits, so the taxpayer avoids nothing. Panel (b) only captures the reduction in tax avoidance prices and the taxpayer's demand due to the high-level risk of getting caught ($\rho > 0.5$).

3.3 Analysis

3.3.1 Effectiveness of Anti-Avoidance Activity

Proposition 6. *On the interval* (ρ^*, ρ_3)*, tax avoidance increases with the probability of legal enforcement.*

Figure 3.1 presents that avoidance proportion decreases with the probability of legal challenge by the tax authority, which is exactly what the tax authority expects.

However, Proposition 6 and Figure 3.3a suggest that tax avoidance increases with the probability of legal enforcement over the interval (ρ^*, ρ_3). This is because taxpayers can spread the risk of capture through two firms and the endogenous adjustment of per-unit prices makes avoidance more attractive in the duopoly market than in the monopoly market, which results in anti-avoidance activities being less effective than expected. Hence, beyond legal enforcement, new approaches to anti-avoidance may be needed, such as a broader regulatory approach to raising promoter's costs of doing business.

3.3.2 Price of Avoidance

Proposition 7. *The equilibrium per-unit price in a duopoly market is higher than that in a monopoly market.*

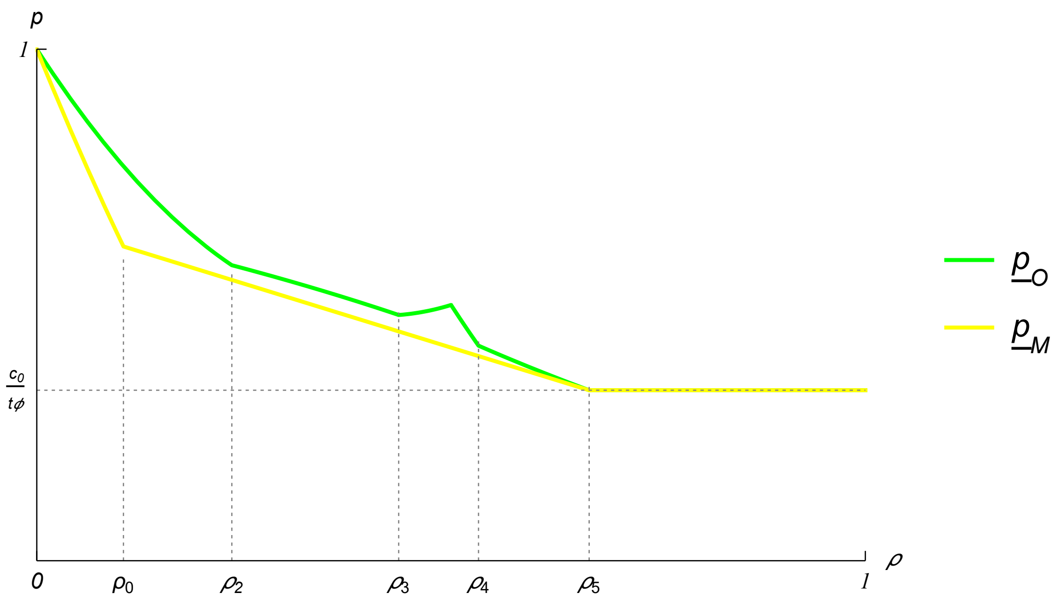


Figure 3.4: The equilibrium per-unit price in a duopoly market and in a monopoly market.

See the Appendix for proof of Proposition 7. The equilibrium per-unit price in a duopoly market (the green curves) and in a monopoly market (the yellow lines) are depicted in Figure 3.4: clearly, firms offer tax avoidance schemes at the cost price ($p = \frac{c_0}{t\phi}$) when the profit constraint is binding; once the per-unit price of avoided tax is higher than the cost price, the price in the duopoly market is higher than that in the monopoly market, regardless of whether the taxpayer chooses to avoid a proportion of the tax or to avoid all tax. This is consistent with economic intuition: in the duopoly market, the taxpayer can spread the risk of being caught by the tax authority, which cannot be achieved in the monopoly market. Therefore, the taxpayer is willing to pay for this even if the per-unit price of avoided tax is higher in the duopoly market. Moreover, the endogenous adjustment of per-unit prices makes the price in the duopoly market not much higher than in the monopoly market, which is much more attractive to taxpayers.

3.4 Conclusion

According to HMRC data, nearly half of the individuals involved in tax avoidance during the 2018-2020 tax year participated in more than one avoidance scheme (HMRC, 2022a, 2022b). Therefore, based on Chapter 2, we expand the modelling framework allowing the taxpayer to use differentiated avoidance schemes as a form of diversification against the risk that any one scheme is declared illegal. This chapter analyses the tax avoidance demands of the taxpayer and the supply and pricing of firms, in monopoly and duopoly markets.

With the endogenous adjustment of per-unit prices allowed in both market structures, from the profit-maximising pricing strategy of firms in the duopoly market, it is found that for a certain range of possibilities of legal challenges by the tax authority, tax avoidance increases with the level of legal enforcement. However, legal enforcement can easily suppress tax avoidance behaviour in the monopoly market.

By comparison, it is straightforward that the duopoly market structure diversifies the risk of being caught for the taxpayer, and increases the complexity of capturing tax avoidance behaviour and reduces the effectiveness of anti-avoidance activities by the tax authority. Another finding to be highlighted is that the endogenous per-unit price of avoided tax in a duopoly market is higher than that in a monopoly market. The economic intuition is that normally the price of a product in a monopoly market is higher than in a duopoly market. Although this finding seems counter-intuitive, it is reasonable as the taxpayer can spread the risk of being caught through two firms, and is therefore willing to pay a premium for security. These findings have important policy implications that increasing the level of legal enforcement alone may not be enough to prevent promoters from exploiting legal loopholes and marketing tax avoidance schemes for profit. A broader regulatory approach may be needed to increase the cost of doing business for promoters, which may require expertise beyond that found currently in tax authorities.

3.5 Appendix

Proof of $\widehat{\rho} = \widehat{\rho}_1$.

$$1 - \rho - \frac{\beta\sigma^2}{\alpha\phi t} = \frac{c_0}{t\phi} \tag{B.1}$$

Solving the above equation gives two roots

$$\widehat{\rho}_1 = \frac{\alpha + \beta t\phi - \sqrt{(\alpha - \beta t\phi)^2 + 4\alpha\beta c_0}}{2\beta t\phi} \tag{B.2}$$

$$\widehat{\rho}_2 = \frac{\alpha + \beta t\phi + \sqrt{(\alpha - \beta t\phi)^2 + 4\alpha\beta c_0}}{2\beta t\phi} \tag{B.3}$$

We start with the proof that $\widehat{\rho}_2 > 1$. $\frac{\alpha}{\beta} > \rho t\phi$ holds for any $\rho \in [0, 1]$, which means

$\alpha > \beta t\phi$.

$$\widehat{\rho}_2 = \frac{(\alpha-\beta t\phi)+2\beta t\phi+\sqrt{(\alpha-\beta t\phi)^2+4\alpha\beta c_0}}{2\beta t\phi} \tag{B.4}$$
$$= 1+\frac{(\alpha-\beta t\phi)+\sqrt{(\alpha-\beta t\phi)^2+4\alpha\beta c_0}}{2\beta t\phi} \tag{B.5}$$

Then we prove $\widehat{\rho}_1 < 1$

$$\widehat{\rho}_1 = \frac{(\alpha-\beta t\phi)+2\beta t\phi-\sqrt{(\alpha-\beta t\phi)^2+4\alpha\beta c_0}}{2\beta t\phi}$$
$$= 1-\frac{\sqrt{(\alpha-\beta t\phi)^2+4\alpha\beta c_0}-(\alpha-\beta t\phi)}{2\beta t\phi}$$

Lastly we prove $\widehat{\rho}_1 > 0$

$$\begin{aligned}\widehat{\rho}_1 &> 0 \Leftrightarrow \alpha+\beta t\phi > \sqrt{(\alpha-\beta t\phi)^2+4\alpha\beta c_0}\\ &\Leftrightarrow (\alpha+\beta t\phi)^2 > (\alpha-\beta t\phi)^2+4\alpha\beta c_0\\ &\Leftrightarrow 4\alpha\beta t\phi > 4\alpha\beta c_0 \Leftrightarrow t\phi > c_0\end{aligned}$$

From the profit function, $pt\phi \geqslant c_0$ holds for any $p \in (0,1)$, so $t\phi > c_0$ always holds, accordingly, $\widehat{\rho}_1 > 0$. As $\rho \in [0,1]$, $\widehat{\rho} = \widehat{\rho}_1$.

Proof of $\rho_0 \equiv p_1^{-1}\left(\underline{p}_M\right) = \widetilde{\rho}_0$.

$p_1(\rho_0) = \underline{p}_M$ is equivalent to

$$\frac{t\phi(1-\rho)+c_0}{2t\phi} = 1-\rho-\frac{\beta\sigma^2}{\alpha\phi t},$$

Solve the above equation and give two roots

$$\begin{aligned}\widetilde{\rho}_0 &= \frac{\alpha + 2\beta t\phi - \sqrt{(\alpha - 2\beta t\phi)^2 + 8\alpha\beta c_0}}{4\beta t\phi};\\ \widetilde{\widetilde{\rho}}_0 &= \frac{\alpha + 2\beta t\phi + \sqrt{(\alpha - 2\beta t\phi)^2 + 8\alpha\beta c_0}}{4\beta t\phi}.\end{aligned}$$

We start with the proof that $\widetilde{\widetilde{\rho}}_0 > 1$

$$\begin{aligned}\widetilde{\widetilde{\rho}}_0 &= \frac{(\alpha - 2\beta t\phi) + 4\beta t\phi + \sqrt{(\alpha - 2\beta t\phi)^2 + 8\alpha\beta c_0}}{4\beta t\phi}\\ &= 1 + \frac{(\alpha - 2\beta t\phi) + \sqrt{(\alpha - 2\beta t\phi)^2 + 8\alpha\beta c_0}}{4\beta t\phi}.\end{aligned}$$

Then we prove $\widetilde{\rho}_0 < 1$

$$\begin{aligned}\widetilde{\rho}_0 &= \frac{(\alpha - 2\beta t\phi) + 4\beta t\phi - \sqrt{(\alpha - 2\beta t\phi)^2 + 8\alpha\beta c_0}}{4\beta t\phi}\\ &= 1 - \frac{\sqrt{(\alpha - 2\beta t\phi)^2 + 8\alpha\beta c_0} - (\alpha - 2\beta t\phi)}{4\beta t\phi}.\end{aligned}$$

Lastly we prove $\widetilde{\rho}_0 > 0$

$$\begin{aligned}\widetilde{\rho}_0 &> 0 \Leftrightarrow \alpha + 2\beta t\phi > \sqrt{(\alpha - 2\beta t\phi)^2 + 8\alpha\beta c_0}\\ &\Leftrightarrow (\alpha + 2\beta t\phi)^2 > (\alpha - 2\beta t\phi)^2 + 8\alpha\beta c_0\\ &\Leftrightarrow 8\alpha\beta t\phi > 8\alpha\beta c_0 \Leftrightarrow t\phi > c_0.\end{aligned}$$

From the profit function, $pt\phi \geqslant c_0$ holds for any $p \in (0, 1)$, so $t\phi > c_0$ always holds, accordingly, $\widetilde{\rho}_0 > 0$. As $\rho \in [0, 1]$, $\rho_0 = \widetilde{\rho}_0$.

Proof of $\widehat{\rho} > \rho_0$

$$\begin{aligned}
\widehat{\rho} &> \rho_0 \Leftrightarrow \frac{\alpha+\beta t\phi-\sqrt{(\alpha-\beta t\phi)^2+4\alpha\beta c_0}}{2\beta t\phi} > \frac{\alpha+2\beta t\phi-\sqrt{(\alpha-2\beta t\phi)^2+8\alpha\beta c_0}}{4\beta t\phi} \\
&\Leftrightarrow 2\alpha+2\beta t\phi-2\sqrt{(\alpha-\beta t\phi)^2+4\alpha\beta c_0} > \alpha+2\beta t\phi-\sqrt{(\alpha-2\beta t\phi)^2+8\alpha\beta c_0} \\
&\Leftrightarrow \alpha-2\sqrt{(\alpha-\beta t\phi)^2+4\alpha\beta c_0} > -2\sqrt{(\alpha-\beta t\phi)^2+4\alpha\beta c_0} > -\sqrt{(\alpha-2\beta t\phi)^2+8\alpha\beta c_0} \\
&\Leftrightarrow 4\left(\alpha-\beta t\phi\right)^2+8\alpha\beta c_0 > \left(\alpha-2\beta t\phi\right)^2 \\
&\Leftrightarrow 3\alpha^2+4\alpha\beta\left(2c_0-t\phi\right) > 0
\end{aligned}$$

Proof of $\rho_{12} \in [-1, 0]$.

$\theta_i \in [0,1]$ and $\theta_1+\theta_2=1$. If $0.5 < m \leqslant 1$, $\varsigma_2 = 2m-1$,

$$\rho_1\rho_2-\varsigma_2 = 4\theta_1\theta_2(1-m)^2 \geqslant 0;$$

if $0 \leqslant m \leqslant 0.5$, $\varsigma_2 = 0$,

$$\rho_1\rho_2-\varsigma_2 = 4\theta_1\theta_2 m^2 \geqslant 0.$$

So $\rho_1\rho_2 \geqslant \varsigma_2$ holds for $m \in [0,1]$, $\rho_{12} \leqslant 0$.

If $0.5 < m \leqslant 1$,

$$\begin{aligned}
&\rho_1\rho_2-\varsigma_2-\sqrt{(1-\rho_1)\rho_1}\sqrt{(1-\rho_2)\rho_2} \\
=\ &4(1-\theta_1)\theta_1(1-m)^2-2\sqrt{(1-\theta_1)(1-m)\left[2m-1+2\theta_1\left(1-m\right)\right]}\sqrt{\theta_1(1-m)\left[1-2\theta_1(1-m\right.}
\end{aligned}$$

if $0 \leqslant m \leqslant 0.5$,

$$\begin{aligned}
&\rho_1\rho_2-\varsigma_2-\sqrt{(1-\rho_1)\rho_1}\sqrt{(1-\rho_2)\rho_2} \\
=\ &4(1-\theta_1)\theta_1 m^2-2\sqrt{m(1-\theta_1)\left[1-2(1-\theta_1)m\right]}\sqrt{\theta_1 m(1-2\theta_1 m)} \leqslant 0.
\end{aligned}$$

So $\rho_{12} \geqslant -\frac{\sqrt{(1-\rho_1)\rho_1}\sqrt{(1-\rho_2)\rho_2}}{\sqrt{(1-\rho_1)\rho_1}\sqrt{(1-\rho_2)\rho_2}} = -1$ holds for $m \in [0,1]$. Then we draw the conclusion $\rho_{12} \in [-1, 0]$.

Proof of $\rho = m$.

Since $\theta_1 + \theta_2 = 1$,

$$\begin{aligned} \rho_1 + \rho_2 &= (\theta_1 + \theta_2)\,\varsigma_1 + 2\varsigma_2 \\ &= 2\,(m - \varsigma_2) + 2\varsigma_2 = 2m. \end{aligned}$$

After symmetry, $\rho_1 = \rho_2 = \rho$, so $\rho = m$.

Proof of conditions for p_2

$$\begin{aligned} \frac{\partial E(\pi)}{\partial p}\Big|_{p=\underline{p}_O} &= \frac{\beta\sigma^2\,(2 + \rho_{12}\,(1-\rho_{12})) + 2\alpha(c - (1-\rho)t\phi)}{2\beta\,(1-\rho_{12}^2)\,\sigma^2} t\phi W > 0 \\ \Longleftrightarrow\ & \frac{\alpha}{\beta} < \frac{\sigma^2(2-\rho_{12})(1+\rho_{12})}{2\,[(1-\rho)t\phi - c]} \\ \frac{\partial E(\pi)}{\partial p}\Big|_{p=\overline{p}} &= \frac{\alpha}{\beta}\frac{[c - (1-\rho)t\phi]}{\sigma^2\,(1-\rho_{12}^2)} t\phi W < 0 \Longleftrightarrow \rho < 1 - \frac{c}{t\phi} \Longleftrightarrow c < (1-\rho)t\phi \end{aligned}$$

Proof of Proposition 7

$$\begin{aligned} \underline{p}_O - \underline{p}_M &= \frac{\beta\rho t\phi}{2\alpha} > 0; \\ p_2 - p_1 &= \frac{[(1-\rho)t\phi - c]\rho}{2(2-\rho)t\phi} > 0. \end{aligned}$$

Chapter 4

Corporate Tax Avoidance and Firm Value - Evidence from Chinese Listed Firms

4.1 Introduction

Corporate tax avoidance has attracted substantial attention both in practice and academic research. It is estimated that countries worldwide lose USD 100-240 billion each year due to corporate tax avoidance, which is approximately 4-10 percent of global corporate income tax revenue; and developing countries are more severely affected as they are generally more dependent on corporate income tax than developed economies (OECD, 2021).

The theory of corporate tax avoidance starts to develop since Slemrod (2004) firstly examines the magnitude and characteristics of corporate tax noncompliance. Many researchers investigate the determinants of corporate tax avoidance in depth. For example, multinational corporations benefit from the economies of scale in tax avoidance (Rego, 2003), increases in equity-based compensation reduce the extent of tax avoidance (Desai & Dharmapala, 2006), family firms avoid fewer taxes compared with their non-family counterparts (Chen et al., 2010), and so on. Tax avoidance may lead to a variety of consequences. For instance, tax avoidance can be used as a non-debt substitution, influencing capital structure (Graham & Tucker, 2006), corporate tax avoidance increases the probability of stock price crash risk (Kim et al., 2011), tax avoidance activities have a negative effect on corporate value (Kirkpatrick & Radicic, 2020), and so on.

Meanwhile, considerable research has evaluated the impact of tax avoidance on managers, shareholders, creditors, and governments. The nature of taxation leads to a transfer of wealth from households or companies to the government. Thus, tax avoidance allows corporate profits to be transferred from the state back to shareholders, reducing corporate cash outflows and increasing firm value, which is the traditional perspective of tax avoidance. However, the effect of tax avoidance is significantly influenced by agency problems stemming from the separation between ownership and control,and the agency perspective of tax avoidance arises. This perspective argues that direct and indirect costs to the firm of engaging in tax avoidance activities partially or entirely offset or even outweigh its benefits and therefore have an ambiguous impact on firm value. For example, managers may take the opportunity to retain part or all earnings generated by tax avoidance and benefit themselves if they are not properly motivated (Jensen & Meckling, 1976; Desai & Dharmapala, 2006). Accordingly, the relationship between tax avoidance and firm value becomes complex. Numerous studies have found that the impact of tax avoidance on firm value is influenced by different transmission mechanisms. These transmission mechanisms range from macro-level factors such as tax reform, tax regulation and economic policy to micro-level factors such as organisational structure, connected transactions and corporate transparency (Chen et al., 2010, 2014; Wang, 2010). Most researchers believe that tax avoidance is positively correlated with firm value and strong corporate governance increases the correlation because higher-quality governance mitigates the agency costs associated with tax avoidance and thus benefits to firms generated by tax avoidance outweigh its costs (Desai & Dharmapala, 2009; Wilson, 2009). However, a few studies find a negative relationship between tax avoidance and firm value as corporate governance mechanisms do not appear to reduce the agency costs associated with tax avoidance (Abdul Wahab & Holland, 2012).

Much of the previous research examines US and UK data to explain the effect of tax avoidance on firm value in their tax environments (Wang, 2010; Inger, 2014; Hasan et al., 2021). In the Chinese tax environment, a few studies explore the relationship between tax avoidance and firm value with agency problems from different perspectives such as information transparency and pyramidal layers in business groups (Chen et al., 2014; Zhang et al., 2016). However, research on the relationship between tax avoidance and firm value with corporate governance is relatively young and has not been thoroughly investigated in China.

The paper proceeds as follows. Section 4.2 discusses the relevant literature and develops the main hypotheses to be tested; Section 4.3 describes the data, defines the variables, and outlines the empirical research design. Section 4.4 reports the empirical results and investigates their robustness. Section 4.5 concludes.

4.2 Literature review and hypotheses development

4.2.1 Theory and empirical evidence

Tax avoidance is broadly defined as the reduction of a firm's explicit taxes (Dyreng et al., 2008). This definition captures all transactions that have any effect on the firm's explicit tax liability and does not distinguish between real activities that are tax-favored, avoidance activities specifically designed to reduce taxes or even evasion activities to obtain tax exemptions in violation of tax laws (Hanlon & Heitzman, 2010).[1]

Corporate tax avoidance theory has two main perspectives. The traditional perspective ignores the influence of separation of ownership and control and merely treats tax avoidance as a tax-saving device that directly increases the cash flow of the company, which transfers wealth from the government to the shareholders and therefore increases the value of the company. Graham and Tucker (2006) form a sample of firms involved in 44 corporate tax shelter cases from 1975 to 2000. They conclude that tax shelters as non-debt substitutes for the use of interest tax

[1] We use the term 'avoidance' rather than tax sheltering, tax evasion, or tax aggressiveness because we do not intend to imply any wrongdoing on the part of the firm, but rather that the firm is able to avoid paying tax on its income through all means.

deductions have an effect on capital structure. Evidence shows that the tax savings induced by shelters are substantially higher than interest tax deductions for firms that do not identify as using tax shelters, and debt-to-asset ratios of tax sheltering firms are more than 5% lower than that of non-shelter firms. Jacob and Schütt (2020) build a theoretical framework of firm valuation with cash flow forecast uncertainty induced by tax avoidance activities and find that uncertainty-adjusted tax avoidance is strongly positively related to firm valuation by using a sample of 3,071 firms from Compustat and CRSP over 1986 - 2015. These two papers represent the traditional view that corporate tax shelters are simply tax-saving devices without the impact of separation of ownership and control.

Based on the theoretical foundation laid by Slemrod (2004) and Chen and Chu (2005), an alternative theoretical perspective considers agency problems resulting from the separation of ownership and control in the theory of corporate tax avoidance. After Slemrod (2004) points out the agency issues, Chen and Chu (2005) develop a principal-agent model incorporating corporate tax avoidance which proves tax evasion increases the profit retained by the firm but at the sacrifice of internal control efficiency. Crocker and Slemrod (2005) examine the incentive effects of compensation contracts on the executive who makes decisions to evade or avoid taxable income, and model results suggest that penalties for the tax manager (the agent) are more effective in reducing tax evasion than those for shareholders (the principal). Corporate governance is taken into account in tax avoidance theories with agency problems. Modelling the effect of incentive compensation and governance structures on tax avoidance at the firm level leads to a negative association between equity-based compensation and tax avoidance, but only among firms with weaker shareholder rights and lower institutional ownership (Desai & Dharmapala, 2006; Desai et al., 2007).

According to empirical research, tax avoidance activities have an ambiguous impact on firm value because the direct and indirect costs to the firm partially or entirely offset or even outweigh the benefits. Desai and Dharmapala (2009) construct a sample consisting of 4,492 observations at the firm-year level on 862 firms from 1993 to 2001. Their regression results reveal that book-tax differences (their proxy for tax avoidance) have no relationship with firm value measured by Tobin's q, which does not support the traditional view. Rather, the patterns in the data are more consistent with the agency perspective on corporate tax avoidance, that higher-quality firm governance leads to a stronger positive effect of tax avoidance on firm value, which emphasizes the mediating role of governance. Wilson (2009) analyses a sample of 215 observations on 59 firms over fiscal years from 1975 to 2002, and draw a consistent conclusion with Desai and Dharmapala (2009) that active tax shelter firms with strong corporate governance generate significant positive returns, which indicates tax sheltering is a tool for wealth creation in well-governed firms. Wang (2010) uses a self-constructed corporate opacity index as a proxy of agency costs associated with tax avoidance and finds that transparent firms, which potentially have less severe agency problems, avoid more tax relative to their opaque counterparts and thus enhance firm value. Hasan et al. (2021) use a large sample of U.S. firms during 1986–2016 and find robust evidence that firms with higher organizational capital, implying higher organizational efficiency, avoid more corporate tax, and the effect of OC on tax avoidance will be value-enhancing to firms. Inger (2014) reveals that tax avoidance due to stock option deductions is positively related to firm value. A subsequent series of studies analyse how specific types of tax avoidance activity affect variations in value (De Simone & Stomberg, 2012; Goh et al., 2016; Jacob & Schütt, 2020).

The majority of the existing research investigates US data from Compustat and is therefore restricted to explaining the US tax environment. Two of the very few exceptions explore the relationship between tax avoidance and firm value in the UK tax environment, which is consistent with the agency perspective of tax avoidance. Abdul Wahab and Holland (2012) use a sample of 444 observations on 196 firms listed on the London Stock Exchange for three years from 2005 to 2007. Kirkpatrick and Radicic (2020) use a sample of 350 observations on 70 firms from FTSE 100 companies over five years from 2006 to 2010. They both report a negative relationship between the level of tax avoidance and firm value (measured by market value of equity and market value of equity per share, respectively). However, contrary to Desai and Dharmapala (2009) and Wilson (2009), corporate governance mechanisms (measured by institutional ownership) do not appear to mitigate the agency costs associated with tax planning in the UK tax environment (Abdul Wahab & Holland, 2012).

In the Chinese tax environment, research on the relationship between tax avoidance and firm value with agency problems is still young and underexplored. Chen et al. (2014) investigate a large sample of Chinese listed-firms data from 2001 to 2009 and treat information transparency as a proxy of agency cost.[2] The results suggest that information transparency interacts with corporate tax avoidance, mitigating the negative association between tax avoidance and firm value. A decentralised pyramidal structure is very prevalent in China's state-owned enterprises (SOEs), which is seen as an agency issue.[3] Zhang et al. (2016) manually collect pyramidal

[2]The Shenzhen Stock Exchange evaluates information disclosure features on an annual basis in terms of compliance, accuracy, timeliness, and completeness, and rated each firm on four levels: excellent, good, acceptable, and unacceptable.

[3]Since the 1990s, the Chinese government has implemented a decentralized organization of SOEs in which state assets are stripped away from government agencies, spun off from parent SOEs, and injected into newly established subsidiaries (Fan et al., 2013). As a consequence, pyramid-like business groups are formed in which firms' decision-making rights are decentralized and productive assets are better allocated, but most of the subsidiaries remain majority-owned by governments (Aghion & Tirole, 1997).

layers data from the Chinese Securities Market and Accounting Research (CSMAR) over 2004–2011. The findings suggest that pyramids built by local governments can reduce the tax burden on SOEs and taxation is one of the channels through which state-controlled pyramids increase firm value. Shifting income among regions matters as well.[4] Shevlin et al. (2012) examine a sample of 320 firm-year observations for Chinese listed firms from 1999 to 2004 and discovered that the average firm has a 23 percentage point difference between the highest and lowest statutory tax rate applied to any subsidiary within the group. Shifting income into low-tax jurisdictions generates significant tax benefits and thus increases firms' cash flow.

In summary, research findings on the relationship between tax avoidance and firm value in different tax environments are inconsistent. The fact that the government takes a fraction of profits from firms increases the incentive of shareholders and managers to avoid taxes if the expected incremental benefit exceeds the cost incurred. While the separation of ownership and control generates information asymmetry and gives managers opportunities to divert corporate resources for their own interests, thus might result in a negative association between tax avoidance and firm value. However, corporate governance and external monitoring can reduce these possibilities. The overall effect depends on whether agency problems dominate these forces. Therefore, the nature of the association between tax avoidance and firm value is an empirical question.

4.2.2 Hypotheses development

Existing research on the relationship between tax avoidance and corporate value has two main views. The traditional view of tax avoidance considers tax avoidance

[4]The Chinese central and local governments offer significantly reduced tax rates for businesses operating in targeted regions in order to promote economic development. As a result, the tax rates that apply to subsidiary firms within the consolidated group vary significantly for Chinese domestic firms.

as simply a tax-saving tool that directly increases the cash flow of the firm, which transfers wealth from the government to the shareholders and therefore increases the value of the firm (Graham & Tucker, 2006; Jacob & Schütt, 2020). The agency view of tax avoidance incorporates principal-agent theory into the analytical framework, arguing that the complexity and concealment of tax avoidance can lead to information asymmetry and moral hazard by management, creating serious agency conflicts (Desai & Dharmapala, 2006). In this case, the association between tax avoidance and firm value is positive or negative depending on whether the benefits generated by tax avoidance outweigh its costs. Some scholars believe that tax avoidance increases the profit retained by the firm but at the expense of internal control efficiency (Chen & Chu, 2005). And specific types of tax avoidance (e.g., tax avoidance due to stock option deductions) will be value-enhancing to firms while tax avoidance generated by accelerated tax depreciation deductions will not be related to firm value (Inger, 2014). Some scholars focusing on the UK tax environment argue that there is a negative relationship between the level of tax avoidance and firm value because of the agency problems (Abdul Wahab & Holland, 2012; Kirkpatrick & Radicic, 2020). From the above, we can see that the effect of tax avoidance on firm value is ambiguous, and the nature of the correlation is an empirical question. This argument leads to the following two competing hypotheses:

H1a: Corporate tax avoidance is positively related to firm value on average.

H1b: Corporate tax avoidance is negatively related to firm value on average.

The impact of tax avoidance on firm value is influenced by different transmission mechanisms (Shevlin et al., 2012; Hasan et al., 2021), and as agency perspective points out, agency issues are an important factor. A common proxy for agency costs is the quality of corporate governance, and it is expected to relieve the agency problems (Shleifer & Vishny, 1997; Chen et al., 2012). The better the corporate governance, the more costly and less opportunity there is for managers to increase diversion or to benefit themselves; as a result, firms could retain more earnings when they transfer value from the state to shareholders through avoiding taxes. Although a few studies find that corporate governance mechanisms do not appear to mitigate the agency costs associated with tax avoidance (Abdul Wahab & Holland, 2012), most evidence shows that tax avoidance with strong corporate governance generates significantly higher firm value, which emphasizes the mediating role of governance (Desai & Dharmapala, 2009; Wilson, 2009). Some researchers in China believe that decreasing agency costs tends to mitigate the negative relationship between tax avoidance and firm value by using information transparency as a proxy for agency costs (Chen et al., 2014). But some other Chinese scholars argue that decreasing agency costs leads to a larger positive effect of tax avoidance on firm value by using pyramidal layers in business groups as a proxy for agency costs (Zhang et al., 2016). Accordingly, we state the second hypothesis as follows:

H2: The relationship between tax avoidance and firm value is conditional on corporate governance.

4.3 Sample, variables and research design

4.3.1 Sample

The data used is drawn from A-share firms listed on the Shanghai Stock Exchange (SHSE) or the Shenzhen Stock Exchange (SZSE). The research period starts from 2008 because China passed the new Corporate Income Tax Law in 2007, which came into effect on January 1, 2008.[5] The tax reform had a significant impact on

[5]China adopted a dual income tax system for domestic and foreign-invested enterprises since the Tax Reform 1994. The Tax Reform 2008 unified the statutory tax rates into 25% and provided

the taxation behaviour of enterprises.[6] To ensure that the results are not driven by this tax reform we use data from 2008 to 2020. The initial sample has 39,793 observations at the firm-year level, and we select the sample by using the following criteria. Firstly, we drop firms in the financial sector ($n = 770$) because their financial indicators are very different from other industries (Wen et al., 2020; Chen et al., 2022). Secondly, we remove firm-year observations with missing or negative values of pre-tax income ($n = 4,029$) due to the difficulty in interpreting the effective tax rate (Rego, 2003; Hoopes et al., 2012; Bradshaw et al., 2019). Thirdly, we delete observations that have abnormal effective tax rates (effective tax rate is negative or greater than one) ($n = 3,539$) to be line with prior literature (Wen et al., 2020; Chen et al., 2022). We lastly eliminate $n = 13,067$ observations with insufficient data to compute firm value (Tobin's q), tax avoidance measurements, firm governance and other control variables. We obtain a final sample consisting of 18,388 observations (2,492 unique firms). We summarize the sample selection procedure in Table 4.1. To avoid the influence of outliers, we winsorize each continuous variable at the top and bottom 1% of their distributions. The data used in this Chapter are mainly sourced from the China Stock Market and Accounting Research (CSMAR) database, while firm governance data comes from the Wind Economic Database.[7]

4.3.2 Variables measures

The dependent variable is firm value and it can be measured from two perspectives: the accounting profitability perspective and the stock market perspective. From the view of accounting profitability, the standard measure is Tobin's q, which equals

a single system of tax deductions, incentives and other compliance rules for both domestic and foreign-invested enterprises.

[6]See, for example, An (2012) and Lin et al. (2012, 2014).

[7]Most tax avoidance measures are obtained from financial statement data because tax returns are not publicly available and access is granted to only a few.

Table 4.1: Sample selection

Selection Criteria	Number of observations
Observations of Chinese firms from 2008 to 2020	39793
Less:	
Observations from the financial industry	770
Observations with negative values of pre-tax income	4029
Observations with effective tax rate below 0 or above 1	3539
Observations with missing Tobin's q	2107
Observations with missing data on tax avoidance	5964
Observations with missing data on firm governance	468
Observations with missing values of control variables	4528
Final sample	18388

the market value of a company divided by its assets' replacement cost (book value of assets).[8] It captures growth opportunities and long-term financial performance (Aivazian et al., 2005). In contrast, return on assets (ROA) and return on equity (ROE) (calculated by net income divided by book value of total assets and net assets, respectively) only reflect the profitability and efficiency generated by the capital of shareholders and creditors (Kabajeh et al., 2012). From the perspective of the stock market, several researchers employ share price or market value of equity (MVE) as a proxy for firm value (Kim et al., 2011; Abdul Wahab & Holland, 2012). Based on the Chinese tax environment, we follow the definition of Chen et al. (2011) in the analysis below, whereby Tobin's q is measured as the sum of market value of tradable shares, book value of non-tradable shares and liabilities, divided by book value of total assets.[9]

The measure of firm governance used in testing hypotheses is the fraction of the firm's shares owned by institutional investors, consistent with Desai and Dharmapala (2009). This proxy is based on the fundamental assumption that institutional investors have more incentives and capabilities to monitor management performance.

[8]See Lang and Stulz (1994) and Bolton et al. (2011) for two excellent applications of Tobin's q.

[9]China has no preferred stock. Given the illiquidity of non-traded shares, we use the book value to compute Tobin's q. Such shares are typically traded at a price close to the book value of equity in over-the-counter markets.

Therefore, the higher the fraction, the greater the level of scrutiny to which managerial actions are subjected, and the less important are agency problems between managers and shareholders. Many studies support this assumption. For example, Cornett et al. (2007) show that a positive relationship exists between a firm's operating cash flow returns and both the percent of institutional stock ownership and the number of institutional investors. Chung and Zhang (2011) also find that the proportion of the firm's shares owned by institutional investors increases with its governance quality. Institutional shareholders as powerful external monitoring mechanisms can mitigate agency problems, and thus decrease the effect of tax avoidance on stock price (Kim et al., 2011).

Book Tax Difference (BTD) and *Effective Tax Rate* (ETR) and their variations have been used widely as measures of tax avoidance (Chen et al., 2010). BTD is estimated by simply subtracting inferred taxable income from the firm's reported pre-tax income, where the inferred taxable income is the difference between the income tax expense and deferred tax expense, divided by the applicable statutory tax rate (Desai & Dharmapala, 2009). To account for differences in firm scale and because the dependent variable is deflated by total assets, BTD is also scaled by total assets. $DDBTD$ is a variation of BTD, to account for the component of the book-tax difference arising from earnings management (measured by total accruals $TA_{i,t}$ divided by total assets in year t). Building on the work of Desai and Dharmapala (2006, 2009), we calculate $DDBTD$ by estimating the following model by OLS:

$$BTD_{i,t} = \beta_1 TA_{i,t} + \mu_i + \varepsilon_{i,t}$$

where μ_i is the average value of the residual for firm i over the sample period $2008 - 2020$; and $\varepsilon_{i,t}$ is the deviation in year t from firm i's average residual μ_i. The residual book-tax difference ($DDBTD$) from this regression (the component of $BTD_{i,t}$ that cannot be explained by variations in total accruals, and hence by earnings management) can be interpreted as a more precise measure of unexplained tax avoidance activity.

ETR is usually calculated by dividing income tax expense by pre-tax income, and lower ETR means more tax avoidance. Because of various tax preferential policies, applicable statutory tax rates ($STRs$) for Chinese listed firms actually vary significantly (Wu et al., 2007; Shevlin et al., 2012).[10] To solve this problem, we follow Hanlon and Heitzman (2010), Chan et al. (2016) and Wen et al. (2020), and use the difference between applicable $STRs$ and $ETRs$ to reflect tax aggressiveness. We calculate ETR in two ways: $ETR1$ uses the standard definition and is equal to income tax expense divided by pre-tax income (Chen et al., 2010; Hanlon & Heitzman, 2010; McGuire et al., 2012; Wen et al., 2020); we also take the effect of deferred tax expense into account and calculate $ETR2$ as the difference between the income tax expense and deferred tax expense, divided by the difference between pre-tax income and inferred income before deferred tax. Therefore, the third proxy for tax avoidance, $TAXAVOID1$, is defined as firm's STR minus $ETR1$. The fourth proxy, $TAXAVOID2$, is firm's STR minus $ETR2$. The fifth and sixth measures of tax avoidance are $METR1$ and $METR2$, defined as $ETR1$ divided by STR and $ETR2$ divided by STR (Wen et al., 2020). According to definitions, higher values of BTD, $DDBTD$, $TAXAVOID1$ and $TAXAVOID2$ suggest more aggressive tax avoidance; a higher $METR1$ or $METR2$ indicates a lower level of tax avoidance. Detailed definitions of tax avoidance measures and other variables are presented in Table 4.5.

Panel A of Table 4.2 reports the descriptive statistics of all variables used in

[10] For example, the applicable STRs for high-tech companies is 15%, and tax exemptions are usually granted to businesses engaged in agriculture, forestry, animal husbandry, and fishery.

the following econometric analysis. The mean values of Tobin's q and Gov from 2008 to 2020 are 1.947 and 0.414, respectively, while the mean values of Tobin's q and institutional ownership proportion of U.S. firms from 1993 to 2001 are 2.354 and 0.585 respectively (Desai & Dharmapala, 2009). This indicates that China's financial market is not as developed as the United States. And the maximum and minimum values of Tobin's q are 0.782 and 13.601 while the 75% value of Tobin's q is 2.194, which indicates that Chinese companies are unevenly developed and that 75% of them are worth less. The mean (median) values of BTD and $DDBTD$ are 0.005 (0.001) and 0.004 (0.002) respectively, which suggests that firms, in general, participate in tax avoidance activities, because their pre-tax income exceeds their taxable income. The mean (median) values of $TAXAVOID1$ and $TAXAVOID2$ (0.01 (0.015) and 0.015 (0.016) respectively) are positive, and the mean (median) values of $METR1$ and $METR2$ (0.975 (0.921) and 0.974 (0.915) respectively) are less than 1, which also means that firms generally avoid tax. However, these values are not high, suggesting that tax avoidance activities are not serious in China. The minimum, mean and maximum of STR are 0.03, 0.213 and 0.25, respectively, indicating little variation in the sample. The mean (standard deviation) value of $Growth$ is 0.489 (1.634), which implies wide variation in growth and uneven development among listed companies in China. The mean (median) value of Age is 2.329 (2.525), suggesting that China's listed companies have not been listed for long in general. The descriptive statistics of control variables (e.g., $Size$, $Beta$, Lev, $Growth$, Age and $Intang$) suggest that the sample firms are financially healthy.

Panel B of Table 4.2 reports pairwise correlation metrics. We find that all tax avoidance measurements (BTD, $DDBTD$, $TAXAVOID1$, $TAXAVOID2$, $METR1$, and $METR2$) and firm governance (Gov) are positively correlated with firm value (Tobin's q), suggesting that tax avoidance and firm governance have positive impacts on firm value. The minimum, mean and maximum of STR are 0.03, 0.213 and 0.25, respectively, indicating little variation in the sample. Hence, there is a high correlation between the two measures of tax avoidance ($TAXAVOID1/2$ and $METR1/2$), suggesting that these measures tend to capture consistent information. Tax avoidance and firm governance do not appear to be correlated as the correlation values of each tax avoidance measure and firm governance are not significant. Most control variables are correlated with Tobin's q and statistically significant at the 1% level; therefore, they can potentially explain changes in the outcome variable. Panel B also shows that most correlations between the control variables are below 0.2, which indicates that multicollinearity is not a serious issue in the study.

Table 4.2: Summary statistics

Panel A: Descriptive analysis

	N	mean	sd	min	p25	p50	p75	max
Tobins'q	18388	1.947	1.297	0.782	1.192	1.532	2.194	13.601
BTD	18388	0.005	0.028	-0.107	-0.010	0.001	0.016	0.155
DDBTD	18388	0.004	0.027	-0.078	-0.010	0.002	0.017	0.122
STR	18388	0.213	0.049	0.030	0.150	0.250	0.250	0.250
TAXAVOID1	18388	0.010	0.122	-0.544	-0.027	0.015	0.081	0.250
TAXAVOID2	18388	0.015	0.135	-0.835	-0.022	0.016	0.080	0.707
METR1	18388	0.975	0.572	0.000	0.638	0.921	1.137	3.984
METR2	18388	0.954	0.649	-2.158	0.648	0.915	1.108	6.315
Gov	18388	0.414	0.237	0.000	0.226	0.427	0.600	0.915
Size	18388	22.357	1.345	19.254	21.412	22.179	23.132	26.872
Beta	18388	1.127	0.265	0.292	0.966	1.131	1.287	2.461
Lev	18388	0.456	0.200	0.044	0.301	0.455	0.609	1.001
Growth Rate	18388	0.489	1.634	-0.921	-0.033	0.128	0.409	18.958
SOE	18388	0.450	0.497	0.000	0.000	0.000	1.000	1.000
Listage	18388	2.329	0.710	0.430	1.861	2.525	2.893	3.366
Intang	18388	0.048	0.056	0.000	0.016	0.034	0.059	0.410

Panel B: Correlation metrics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Tobins'q	1.00															
BTD	0.17***	1.00														
DDBTD	0.14***	0.83***	1.00													
STR	-0.01	0.24***	0.21***	1.00												
TAXAVOID1	0.11***	0.55***	0.49***	0.17***	1.00											
TAXAVOID2	0.10***	0.48***	0.42***	0.15***	0.70***	1.00										
METR1	-0.11***	-0.55***	-0.49***	-0.18***	-0.98***	-0.67***	1.00									
METR2	-0.10***	-0.47***	-0.41***	-0.15***	-0.67***	-0.98***	0.68***	1.00								
Gov	0.07***	-0.01	0.01	0.10***	-0.01	-0.01	0.01	0.01	1.00							
Size	-0.38***	-0.10***	-0.09***	0.11***	-0.08***	-0.07***	0.08***	0.07***	0.43***	1.00						
Beta	-0.08***	-0.07***	-0.07***	-0.14***	-0.04***	-0.03***	0.03***	0.02***	-0.15***	-0.05***	1.00					
Lev	-0.26***	-0.18***	-0.16***	0.20***	-0.16***	-0.12***	0.15***	0.12***	0.18***	0.46***	-0.02*	1.00				
Growth Rate	0.02**	-0.01	-0.01	0.09***	-0.02**	-0.00	0.01	-0.00	-0.00	0.00	-0.01	0.12***	1.00			
SOE	-0.11***	-0.04***	-0.04***	0.18***	-0.04***	-0.02**	0.05***	0.02***	0.29***	0.27***	-0.01	0.25***	0.02*	1.00		
Listage	0.00	-0.04***	-0.04***	0.25***	-0.09***	-0.07***	0.09***	0.07***	0.32***	0.35***	-0.07***	0.33***	0.09***	0.38***	1.00	
Intang	0.03***	-0.03***	-0.02**	0.03***	-0.02**	-0.02**	0.03***	0.03***	0.02*	-0.02*	-0.03***	-0.04***	-0.07***	0.04***	0.03***	1.00

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.3.3 Regression model

Since the sample is a short panel consisting of 2,492 unique firms over the period from 2008 to 2020 and all variables are continuous, we employ the fixed effects (FE) model to control for unobserved heterogeneity across firms (Desai & Dharmapala, 2009). We also apply the random effects (RE) model in the robustness tests section to exploit also variation across firms and not only within firms. The first hypothesis investigates the question of whether tax avoidance is likely to increase or decrease firm value. This is examined by equation (4.1). The second hypothesis tests whether the effect of tax avoidance on firm value is dependent on corporate governance. This is tested by extending equation (4.1) as follows:

$$q_{i,t} = \beta_0 + \beta_1 BTD_{i,t} + \mathbf{X}_{i,t}\gamma + \mu_i + \varepsilon_t + v_{i,t}, \quad (4.1)$$

$$q_{it} = \beta_0 + \beta_1 BTD_{it} + \beta_2 Gov_{it} + \beta_3 Gov_{it} * BTD_{it} + \mathbf{X}_{it}\gamma + \mu_i + \varepsilon_t + v_{it}. \quad (4.2)$$

where

- i stands for each firm in the sample;
- t denotes each year in the sample, ranging from 2008 to 2020;
- q_{it} is firm i's value in year t;
- BTD_{it} is the level of tax avoidance for firm i in year t;
- Gov_{it} is the governance quality for firm i in year t;
- $\mathbf{X}_{i,t}$ is a set of control variables for firm i in year t;
- μ_i is the unobserved time-invariant firm effect;
- ε_t is time dummy variables controlling for year effect;

- $v_{i,t}$ is the error term for firm i in year t.

This chapter selects control variables that are commonly used in corporate valuation studies, for example, Bai et al. (2004), Lin and Su (2008) and Desai and Dharmapala (2009). Although the relevant variables are scaled by total assets, larger firms benefit from economies of scale in tax avoidance, which may result in lower firm value. To examine the effect of tax avoidance level on corporate value for the same absolute firm size, we use the logarithm of total assets ($Size$) to control the size effect. Changes in firms' leverage (Lev) are included because firms with a higher level of leverage already benefit from the tax benefits of debt financing, which can reduce the value of engaging in tax avoidance (Fama & French, 1998; Graham & Tucker, 2006). We control for the growth rate of income ($Growth$), as growth firms are more valuable, they may invest more in tax-favoured assets to increase cash flow and have more chance to avoid taxes (e.g., Chen et al. (2010) and Salvi et al. (2020)). A measure of volatility ($Beta$) is also added to account for changes in a firm's stock price's risk over time. Many companies in China raise money on the stock market, for which they divide their most profitable assets and businesses into a joint-stock company for the IPO. To further control for the impact of the corporate financing cycle on firm value, we include the number of years after going public (Age) (Lin & Su, 2008). Additionally, whether a firm is state-owned (SOE) and the intensity of intangible assets ($Intang$) are included as the level of tax avoidance rates are significantly lower for state-owned enterprises compared to non-state-owned enterprises, and firm's intangible assets are predictably increasing with future cash flow and firm value (Arrighetti et al., 2014; Bradshaw et al., 2019).

A positive β_1 in equations (4.1) supports **H1a** that tax avoidance tends to increase firm value on average, whereas a negative β_1 supports **H1b** that tax avoidance tends to decrease firm value on average; and a statistically significant β_3 in equations (4.2) supports **H2** that the effect of tax avoidance on firm value depends on the quality of corporate governance. The results using FE model estimation on equations (4.1) and (4.2) are reported in Table 4.3.

4.4 Empirical Results

4.4.1 Main results

Columns (1) and (2) of Table 4.3 present the empirical results of the relationship between tax avoidance and firm value using equation (4.1). Before and after including the control variables, the estimated coefficients of BTD are positive and statistically significant at the 1% level; this supports **H1a** that corporate tax avoidance is positively related to firm value on average. Moreover, the R^2 increases from 0.196 in column (1) to 0.283 in column (2), suggesting that the inclusion of the control variables in equation (4.1) fits the sample better.

Columns (3) to (9) of Table 4.3 present the results of the relationship between tax avoidance and firm value conditional on corporate governance using equation (4.2). After interacting with corporate governance, the estimates on BTD are still positive but become statistically insignificant, while the estimated coefficients of the interaction term (Gov^*BTD) are all positive and statistically significant at the 1% level, which supports the second hypothesis **H2** that the positive correlation between tax avoidance and firm value depends on corporate governance quality. The results are robust to adding control variables one by one. In column (2), the estimate on BTD is 3.847, primarily indicating that the value of the firm increases by 3.847 units for every unit increase in tax avoidance without consideration of corporate governance; the estimated coefficient for the interaction term of BTD and Gov in column (9) is positive, which further indicates that higher-quality corporate governance enhances the increase in firm value created by tax avoidance. Therefore, the conclusion can be drawn that tax avoidance multiplies corporate value in general but depends on corporate governance quality.

My findings are more consistent with the agency perspective of tax avoidance (Desai & Dharmapala, 2009). The sophistication and cover-up of tax avoidance will give rise to management moral hazard and information asymmetry, which can result in severe agency problems. However, corporate governance can relieve the agency problems (Chen et al., 2012). Better corporate governance makes tax avoidance more expensive and reduces managers' opportunities to divert resources or benefit themselves; as a result, firms may be able to keep more of their profits when managers shift value from the government to shareholders through avoiding taxes. In this chapter, the benefits generated by tax avoidance outweigh agency costs because of the quality of corporate governance, and thus increase firm value. In contrast, Chen et al. (2014) find a negative relationship between tax avoidance and firm value, but it is mitigated by information transparency. The main reason for the difference between Chen et al. (2014)'s and our conclusions is that Chen et al. (2014) use the data of Chinese A-share listed firms over the period 2001-2009 while we use the data from 2008 to 2020. Before the Tax Reform 2008 unifying the statutory tax rates into 25% and providing a single system of tax deductions, incentives and other compliance rules for both domestic and foreign-invested enterprises, avoiding tax could lead to huge profits and managers could use various tax codes and rules to avoid tax and benefit themselves, which resulted in tax avoidance reducing firm value. However, after the Tax Reform 2008, many loopholes in tax law were shut down and corporate governance increased, consequently, the benefits generated by tax avoidance outweigh agency costs and increase firm value. The results of the control variables are generally in line with prior research.

Table 4.3: Basic results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
BTD	4.245***	3.847***	1.657*	1.041	1.057	1.065	1.068	1.354	1.363
	(0.512)	(0.478)	(0.980)	(0.896)	(0.896)	(0.881)	(0.880)	(0.871)	(0.869)
Gov			1.337***	1.494***	1.501***	1.491***	1.489***	1.385***	1.385***
			(0.064)	(0.062)	(0.062)	(0.062)	(0.062)	(0.061)	(0.061)
$Gov^{*}BTD$			5.424***	5.237***	5.223***	5.727***	5.734***	5.081***	5.072***
			(1.978)	(1.879)	(1.881)	(1.838)	(1.836)	(1.833)	(1.831)
Size		-0.597***		-0.597***	-0.598***	-0.634***	-0.633***	-0.641***	-0.641***
		(0.038)		(0.034)	(0.034)	(0.037)	(0.037)	(0.036)	(0.036)
Beta		-0.071*			0.045	0.054	0.054	0.038	0.038
		(0.039)			(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
Leverage		0.200				0.536***	0.541***	0.241*	0.240*
		(0.134)				(0.131)	(0.131)	(0.131)	(0.131)
Growth Rate		-0.013**					-0.008	-0.010*	-0.010*
		(0.006)					(0.006)	(0.006)	(0.006)
Listing age		0.783***						0.644***	0.643***
		(0.046)						(0.045)	(0.045)
Intangible assets		0.167							0.126
		(0.379)							(0.372)
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.196	0.283	0.242	0.310	0.310	0.313	0.313	0.330	0.330
Observations	18388	18388	18388	18388	18388	18388	18388	18388	18388

Note: All specifications include year effects, firm fixed effects, and the controls listed. Robust standard errors adjusted for heteroscedasticity are presented in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. All continuous variables are winsorized at the 1st and 99th percentiles.

4.4.2 Heterogeneity analysis

We investigate the heterogeneity of the results with respect to ownership structure, listing age, and firm size. Specifically, we divide the full sample into two sub-groups according to ownership structure (state-owned enterprises (SOEs) and non-SOEs), and the top 25 percentile of listing age and firm size, respectively. We then re-estimate the model (4.2) within sub-groups. Columns (1) and (2) of Table 4.4 present the results of SOEs and non-SOEs. The estimates of BTD and $Gov^{*}BTD$ for non-SOEs (1.638 and 7.090 respectively) are positive and statistically significant at the 10% level, suggesting that for non-SOEs, tax avoidance could considerably increase firm value and higher-quality corporate governance multiplies corporate value generated by tax avoidance.

In contrast, the estimated coefficients of BTD and $Gov^{*}BTD$ for SOEs (0.689 and 3.266 respectively) in columns (1) and (2) are positive but statistically insignificant, which indicates that the argument for corporate tax avoidance as a value transfer from the state to shareholders is not supported. The distinction between SOEs and non-SOEs is probably because of different motivations for tax planning from the divergence of enterprise positions and duties. Prior research suggests two explanations for why SOEs rarely engage in tax avoidance activities. First, the government encourages SOEs to pay more taxes as the government's priority is not to maximize the value of SOEs but to maximize social welfare and higher taxes are presumably essential for the government to achieve certain social objects (Zhang et al., 2012).[11] Some researchers reach a consistent conclusion that SOEs in China

[11]SOEs and Non-SOEs have different operational aims. For example, affected by COVID-19, many private companies reduced their expenses to sustain their operations; even the highest-paid Chinese internet private companies, such as Tencent and Alibaba, have laid off at least 10% of their employees and not taken on new employees during the recruitment season. However, in order to reduce unemployment and safeguard social stability, few SOEs lay off staff, opting instead for pay cuts.

avoid taxes substantially less than non-SOEs (Bradshaw et al., 2019). Second, top executives in Chinese SOEs are assigned by the government, and the majority hold bureaucratic titles (Li, 1998). Evidence shows that higher corporate income taxes contribute to the achievement of promotions to higher-level managerial or bureaucratic positions by SOEs managers(Bradshaw et al., 2019). To summarise briefly, the heterogeneity analysis shows that non-state-owned enterprises and younger firms are the primary drivers of the conditionality on corporate governance quality. In addition, the impact of tax avoidance on firm value via corporate governance is greater for large firms than for small firms.

Columns (3) and (4) of Table 4.4 present the results of older firms and young firms. The estimated coefficient of $Gov^{*}BTD$ on young firms (7.247) in column (4) is positive and statistically significant at the 1% level, strongly advising that for young firm tax avoidance increasing firm value is conditional on corporate governance quality. However, the estimates of BTD and $Gov^{*}BTD$ on older firms in column (3) are both statistically insignificant, which indicates that corporate tax avoidance probably does not increase firm value even with higher-quality corporate governance for older firms.

Columns (5) and (6) of Table 4.4 present the results of big firm and small firms. The estimated coefficients of $Gov^{*}BTD$ are positive and statistically significant at the 1% level for both large and small firms, but the estimate for big firms (coefficient = 6.204) is greater than that for small firms (coefficient = 5.449), which reflects the economies of scale in the value of tax avoidance to firms.

4.4.3 Robustness tests

To further ensure the robustness of the results, we use five alternative measures of tax avoidance ($DDBTD$, $TAXAVOID1$, $TAXAVOID2$, $METR1$, and $METR2$)

Table 4.4: Heterogeneity analysis

	Ownership		Listing age		Firm size	
	(1) SOEs	(2) non-SOEs	(3) older	(4) young	(5) big size	(6) small size
BTD	0.689	1.638*	2.914	0.492	-2.258**	2.021*
	(1.734)	(0.995)	(2.232)	(0.867)	(1.102)	(1.058)
Gov	1.257***	1.517***	1.569***	1.466***	0.645***	1.507***
	(0.090)	(0.082)	(0.157)	(0.067)	(0.054)	(0.078)
*Gov*BTD*	3.266	7.090***	0.985	7.247***	6.204***	5.449**
	(3.324)	(2.252)	(4.504)	(1.912)	(2.163)	(2.314)
Size Size	-0.573***	-0.709***	-0.927***	-0.491***		
	(0.051)	(0.050)	(0.078)	(0.035)		
Beta)	0.199***	-0.051	-0.032	0.073*	0.197***	-0.071
	(0.056)	(0.048)	(0.089)	(0.040)	(0.042)	(0.050)
Leverage	0.198	0.301*	0.637**	0.379***	-0.231*	-0.389**
	(0.220)	(0.163)	(0.283)	(0.134)	(0.135)	(0.174)
Growth Rate	-0.008	-0.012	-0.004	-0.015*	-0.011***	-0.018**
	(0.006)	(0.009)	(0.008)	(0.008)	(0.004)	(0.009)
Listing age	0.333***	0.671***			0.179	0.612***
	(0.105)	(0.059)			(0.125)	(0.055)
Intangible assets	-0.196	0.395	0.911	0.124	-0.267	0.449
	(0.482)	(0.546)	(0.954)	(0.415)	(0.466)	(0.548)
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.285	0.373	0.352	0.313	0.223	0.308
Observations	8271.000	10117.000	4610.000	13778.000	4602.000	13786.000

Note: All specifications include year effects, firm fixed effects, and the controls listed. Robust standard errors adjusted for heteroscedasticity are presented in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. All continuous variables are winsorized at the 1st and 99th percentiles.

as a robustness check and report the results in Table 4.6. All alternative measures of tax avoidance have been discussed in subsection 4.3.2. By construction, higher values of $DDBTD$, $TAXAVOID1$ and $TAXAVOID2$, represent more aggressive tax avoidance. As shown in columns (1) to (3), the estimated coefficients of tax avoidance measures ($DDBTD$, $TAXAVOID1$, and $TAXAVOID2$) are statistically insignificant, while the estimates of the interaction terms of tax avoidance and corporate governance ($DDBTD^*Gov$, $TAXAVOID1^*Gov$, and $TAXAVOID2^*Gov$) are positive and statistically significant at the 5% level, which is in line with the earlier findings that the positive effect of tax avoidance on firm value is conditional on corporate governance and higher-quality firm governance increases the positive effect of tax avoidance on firm value.

As shown in columns (4) and (5), the estimates of tax avoidance measures ($METR1$ and $METR2$) are statistically insignificant, while the estimated coefficients of the interaction term of tax avoidance and corporate governance ($METR1^*Gov$ and $METR2^*Gov$) are negative and statistically significant at the 1% level. As a higher $METR1$ or $METR2$ implies a lower level of tax avoidance, we accordingly draw a consistent conclusion with that using the other three tax avoidance measures in Table 4.6. Therefore, the results are robust to use alternative measures of tax avoidance. Additionally, Table 4.2 shows little variation in STR and a high correlation between the two measures of tax avoidance ($TAXAVOID1/2$ and $METR1/2$); hence, identical R-squared in the associated regressions.

Compared with the fixed effects model, random effects estimation allows to exploit also variation across firms and not only within firms. To investigate the robustness of the results to alternative estimation techniques, we employ a random effects model with industry and year effects. The regression results are reported in Table 4.7. Columns (1) - (5) report regression results using $DDBTD$, $TAXAVOID1$,

$TAXAVOID2$, $METR1$, or $METR2$ as alternative measures of tax avoidance, respectively. All estimated coefficients on tax avoidance measures are not statistically significant while the estimates of $DDBTD^{*}Gov$, $TAXAVOID1^{*}Gov$, and $TAXAVOID2^{*}Gov$ are positive and statistically significant at the 5% level, the estimates of $METR1^{*}Gov$ and $METR2^{*}Gov$ are negative and statistically significant at the 1% level. The results of Table 4.7 are totally consistent with that of Table 4.6, which suggests that the use of an alternative estimation technique strongly supports the hypothesis that the positive relationship between tax avoidance and firm value depends on corporate governance.

4.5 Conclusion

This paper analyzes the effect of tax avoidance on firm value by using a large sample of Chinese A-share listed firms over the period from 2008 to 2020. It is found that there is a significantly positive relation between tax avoidance and firm value, and that the effect is conditional on corporate governance quality, with higher-quality corporate governance enhancing the increase in corporate value created by tax avoidance. The results are robust to the use of alternative tax avoidance measures and alternative estimation techniques. Heterogeneity analysis reveals that the conditionality on corporate governance quality is mostly driven by non-state-owned enterprises and younger firms. Moreover, the effect of tax avoidance on firm value by corporate governance is stronger for big companies than for small companies.

This chapter extends the prior literature by providing evidence from a developing market and by adding new evidence to corporate tax avoidance literature from the agency perspective. In addition to information transparency and the pyramidal hierarchy that can lead to agency problems, corporate governance is an important transmission mechanism that affects the relationship between tax avoidance and corporate value. Management efforts are intricately entangled with tax avoidance, which is more than simply a transfer of wealth from the government to shareholders. There are also a few proxies for corporate governance, such as measures of internal corporate governance and external regulation. However, the impact of these proxies on the relationship between tax avoidance and corporate value is unclear, which can be left for future research.

4.6 Appendix

Table 4.5: Variable definitions

Variable	Definition
Tobin's q	the sum of market value of tradable shares, book value of non-tradable shares and liabilities, divided by book value of total assets
BTD	Book-tax difference. (Firm i' s pre-tax income in year t − taxable income)/ total assets at the end of year t. Taxable income = (the income tax expense − deferred tax expense)/ the applicable statutory tax rate.
DDBTD	Book-tax difference calculated following (Desai & Dharmapala, 2006, 2009). The residual part of regressing BTD on total accruals (TA). TA = (net income - cash flows from operations) total assets at the end of year t.
ETR1	The effective tax rate 1 is firm i's income tax expense divided by pre-tax income.
ETR2	The effective tax rate 2 = (the income tax expense − deferred tax expense)/ (pre-tax income - deferred tax expense/statutory income tax rate)
TAXAVOID1	Firm i's applicable statutory tax rate in year t minus ETR1.
TAXAVOID2	Firm i's applicable statutory tax rate in year t minus ETR2.
METR1	Firm i's ETR1 in year t divided by applicable statutory tax rate.
METR2	Firm i's ETR2 in year t divided by applicable statutory tax rate.
Gov	Corporate governance quality, measured by the fraction of the firm's shares held by institutional investors.
Size	Firm size, equals the natural logarithm of total assets plus one
Leverage	Firm leverage, equals the ratio of total liabilities to total assets.
Growth rate	Growth rate of income from main business from year = income from main business at the end of year t - income from main business at the beginning of year t)/income from main business at the beginning of year t.
SOE	firm's ownership, state-owned or non-state-owned enterprises.
Beta	A measure of risk associated with a firm's stock price from CSMAR database.
Listingage	The number of years after going public, equals the natural logarithm of the number of years from the IPO date plus one.
Intang	Intangible assets, equals firm i's net value of intangible assets in year t divided by total assets.

Table 4.6: Tax avoidance and firm value: robustness checks

Dependent variable: Tobin's q. Method: Fixed Effect Model. Estimation period: 2008-2020					
	(1)	(2)	(3)	(4)	(5)
DDBTD	1.033				
	(0.958)				
TAXAVOID1		-0.106			
		(0.146)			
TAXAVOID2			-0.100		
			(0.127)		
METR1				0.028	
				(0.030)	
METR2					0.025
					(0.026)
Gov	1.396***	1.402***	1.416***	1.746***	1.618***
	(0.062)	(0.061)	(0.062)	(0.095)	(0.083)
*Gov**DDBTD*	4.990**				
	(2.022)				
*Gov**TAX1*		1.543***			
		(0.318)			
*Gov**TAX2*			0.935***		
			(0.257)		
*Gov**METR1*				-0.335***	
				(0.066)	
*Gov**METR2*					-0.196***
					(0.052)
Size	-0.642***	-0.648***	-0.647***	-0.648***	-0.648***
	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
Beta	0.034	0.025	0.025	0.025	0.025
	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
Leverage	0.204	0.192	0.168	0.189	0.164
	(0.133)	(0.132)	(0.133)	(0.132)	(0.133)
Growth Rate	-0.010*	-0.010*	-0.010*	-0.010*	-0.010*
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Listing age	0.647***	0.639***	0.641***	0.639***	0.641***
	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)
Intangible assets	0.087	0.062	0.056	0.073	0.056
	(0.373)	(0.377)	(0.377)	(0.376)	(0.377)
Year FEs	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes
R-squared	0.327	0.326	0.324	0.326	0.324
Observations	18388	18388	18388	18388	18388

Note: All specifications include year effects, firm fixed effects, and the controls listed. Robust standard errors adjusted for heteroscedasticity are presented in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. All continuous variables are winsorized at the 1st and 99th percentiles.

Table 4.7: Tax avoidance and firm value: robustness checks

Dependent variable: Tobin's q. Method: Random Effect Model. Estimation period: 2008-2020					
	(1)	(2)	(3)	(4)	(5)
DDBTD	0.975				
	(0.886)				
TAXAVOID1		-0.084			
		(0.141)			
TAXAVOID2			-0.066		
			(0.125)		
METR1				0.025	
				(0.029)	
METR2					0.020
					(0.025)
Gov	1.389***	1.395***	1.408***	1.750***	1.617***
	(0.057)	(0.056)	(0.057)	(0.088)	(0.078)
Gov^*DDBTDD	5.052**				
	(1.966)				
Gov^*TAX1		1.571***			
		(0.304)			
Gov^*TAX2			0.945***		
			(0.251)		
Gov^*METR1				-0.347***	
				(0.063)	
Gov^*METR2					-0.202***
					(0.050)
Size	-0.596***	-0.599***	-0.598***	-0.599***	-0.598***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
Beta	-0.037	-0.047	-0.047	-0.047	-0.048
	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)
Leverage	0.088	0.078	0.052	0.075	0.049
	(0.109)	(0.108)	(0.109)	(0.108)	(0.109)
Growth Rate	-0.003	-0.004	-0.003	-0.004	-0.003
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Listing age	0.346***	0.348***	0.346***	0.348***	0.347***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Intangible assets	0.311	0.293	0.291	0.307	0.294
	(0.297)	(0.298)	(0.298)	(0.298)	(0.299)
Year effects	Yes	Yes	Yes	Yes	Yes
industry effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.323	0.323	0.320	0.323	0.320
Observations	18388	18388	18388	18388	18388

Note: All specifications include year effects, industry effects, and the controls listed. Robust standard errors clustered at the firm level are presented in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. All continuous variables are winsorized at the 1st and 99th percentiles.

Chapter 5

Conclusion

5.1 Summary of Findings

The thesis explores tax avoidance from theoretical and empirical angles. Chapter 2 and Chapter 3 present theoretical models that analyse marketed tax avoidance schemes. The main difference between the assumptions in these two chapters is that firms in Chapter 2 provide a common type of scheme while firms in Chapter 3 offer the taxpayer differentiated avoidance schemes as a form of diversification against the risk that any one scheme is declared illegal. These two chapters consider both the demand and supply sides and make the price of avoidance endogenous.

The feature of two-part pricing in Chapter 2 leads to an endogenous threshold income above which taxpayers avoid maximally, and below which they are excluded from the market for avoidance by the minimum fee. Tax avoidance of unconstrained taxpayers is price elastic, so firms impose no upper limits on the amount that can be avoided; therefore, in equilibrium, both constrained and unconstrained taxpayers avoid all taxes, but constrained taxpayers bear a higher per unit price than unconstrained taxpayers in general. The simulations reveal that avoidance may drive a Laffer relationship between tax rates and tax revenue.

Chapter 3 calculates the expected returns, variances and optimal weights of each tax avoidance scheme from the portfolio selection perspective, in the monopoly and duopoly markets, respectively. With the endogenous adjustment of per-unit prices allowed in both market structures, it is found that tax avoidance increases with the level of legal enforcement in the duopoly market within a specific range of possibilities of legal challenges by the tax authority. Another finding to be highlighted is that the endogenous per-unit price of avoided tax in a duopoly market is higher than in a monopoly market. These findings mean that both duopoly market structure and endogenous adjustments in the per-unit price reduce the effectiveness of anti-avoidance activities by the tax authority. Therefore, increasing the level of legal enforcement may not be sufficient to stop promoters from taking advantage of legal loopholes and selling tax avoidance schemes for profit. A broader regulatory approach may be needed to increase the cost of doing business for promoters, which may require expertise beyond that found currently in tax authorities.

Chapter 4 empirically studies the effect of tax avoidance on firm value by using a large sample of Chinese A-share listed firms over the period from 2008 to 2020. It was found that there is a significantly positive relation between tax avoidance and firm value and that the effect is conditional on corporate governance quality. The results are robust to the use of alternative tax avoidance measures and alternative estimation techniques. Heterogeneity analysis reveals that the conditionality on corporate governance quality is mostly driven by non-state-owned enterprises and younger firms. Moreover, the effect of tax avoidance on firm value by corporate governance is stronger for big companies than for small companies.

5.2 Implications, Limitation and Future Research

Combating tax avoidance has long been a priority for tax authorities. However, increasing the level of legal enforcement is less effective than expected. Therefore, tax authorities should work with partner bodies to stop the promotion of schemes at an earlier stage. For example, tackling misleading tax avoidance advertisements on websites.

Chapter 2 and Chapter 3 have examined the avoidance demand of the taxpayer and the supply and pricing strategies of firms in the monopoly and duopoly markets, and when one and two types of avoidance schemes are available to taxpayers. However, it is unclear how a taxpayer makes avoidance decisions when a few firms offer more differentiated schemes, which could be left for future research. For Chapter 4, it is worth exploring how different types of corporate governance, i.e. internal corporate governance and external regulation, affect the relationship between tax avoidance and firm value in the future.

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