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The Optimal Structure of Commodity Taxation in a Monopoly with Tax Avoidance or Evasion

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The Optimal Structure of Commodity Taxation in a Monopoly with Tax Avoidance or Evasion*

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Abstract:

If tax obligations are met, the balanced-budget substitution of an ad valorem tax on output for a specific tax not only raises a monopolist's production, but also represents a Pareto improvement. However, if tax avoidance or evasion is feasible and the marginal costs of such actions decline with the legal tax burden, a monopolist will respond to a balanced-budget substitution of an ad valorem tax for a specific tax by reducing output, while profits remain constant. Therefore, in the presence of tax avoidance or evasion activities a move towards specific taxation can represent a Pareto improvement.

Keywords: ad valorem tax, monopoly, output, tax avoidance, tax evasion, specific tax

JEL-classification: H 21, H 25, H 26

1. Introduction

There is a long-standing debate on the relative merits of ad valorem and specific (unit) taxation. Based on a setting with constant marginal costs, Wicksell (1896) showed that a monopolist's incentives to curtail output are less pronounced in the presence of an ad valorem tax than for a specific tax of equal yield. The reason is that the ad valorem tax mitigates the fall in the after-tax price resulting from an output expansion. Suits and Musgrave (1953) generalised this finding, assuming a general cost function. Building on this foundation, inter alia, Skeath and Trandel (1994) established that the ad valorem tax Pareto-dominates a specific tax of equal yield since both profits and consumer surplus rise, a result already hinted at in the work by Wicksell (1896). These analyses with simple monopoly settings have been extended in various ways, often confirming the superiority of ad valorem taxation.[1] However, the superiority of ad valorem taxation may no longer result in general equilibrium settings (Grazzini 2006, Blackorby and Murty 2007), under Bertrand competition with product differentiation (Anderson et al. 2001), in the presence of externalities (Dickie and Trandel 1996, Pirttilä 2002, Dröge and Schröder 2008), in two-sided markets (Kind et al. 2009), in multi-product oligopoly settings (Hamilton 2009), and even in competitive markets either with endogenous quality choices or output price uncertainty (Liu 2003, Goerke 2011). Furthermore, a specific tax is superior to an ad valorem tax in a monopsony (Hamilton 1999). While in all of these contributions, tax obligations are presumed to be fulfilled, there are few exceptions. Delipalla (2009a) investigates the relationship between the structure of tobacco taxation and smuggling in an oligopoly setting without, however, drawing welfare implications. In addition, Delipalla (2009b) considers a Cournot oligopoly in which formal and informal firms coexist. Formal sector firms pay ad valorem and unit taxes, while informality is characterised by the absence of tax payments but additional unit costs of production. Delipalla (2009b) shows that the optimal unit tax rate is zero, indicating that informality in her set-up does not invalidate the superiority of ad valorem taxation.

The optimal structure of commodity taxation in the presence of market imperfections and tax avoidance activities is of substantial policy relevance as indicated by, for example, the pertinent chapter in the Mirrlees Review (cf. Crawford et al. 2008). This is because the consumption of goods for which sizeable specific taxes exist in OECD countries – such as alcoholic beverages, mineral oil products and tobacco (OECD 2008) – generates a considerable portion of overall tax revenues while the respective commodities tend to be

[1] See, for example, Kay and Keen (1983), Delipalla and Keen (1992, 2006), Cheung (1998), Denicolò and Matteuzzi (2000), and Schröder (2004).

supplied by few firms. In addition, tax evasion and, in particular, tax avoidance activities by firms cause substantial revenue losses (Slemrod 2004, 2007, Keen and Smith 2006, Gatti and Honorati 2008). In a recent study published by the European Commission (2009), the gap between the theoretical VAT liability and actual receipts in 2006 was estimated at about 13% of VAT revenues in the European Union. Furthermore, the unweighted VAT revenue ratio for all OECD member states is about 60%, where this ratio is defined as the amount of actual VAT revenues as a fraction of the revenue that would be collected if the standard VAT rate was applied to final consumption (OECD 2008). This figure indicates that about 40% of potential tax revenues are not in fact obtained as a result of reduced tax rates and exemptions, tax avoidance and evasion activities. The European Union data moreover indicate that a substantial part of this shortfall results from attempts to reduce the tax burden either legally or illegally.

There are many ways in which sales taxes can be evaded, such as the underreporting of sales, omitting to pay taxes on imported goods and false claims for credits in the case of VAT (see Keen and Smith 2006 for a more comprehensive list). In contrast to evasion, "(t)ax avoidance … is within the legal framework of the tax law. It consists in exploiting loopholes in the tax law in order to reduce one's tax liability; …" (Sandmo 2005, p. 645). In the case of consumption taxes, such loopholes are particularly pronounced in a world with multiple tax rates and cross-border shopping. First, in the European Union, for example, there are, besides the standard rates which range from 15% to 25%, reduced rates in almost all member states and, in 5 further countries, even super-reduced rates. Furthermore, in some countries there are exemptions from value-added taxation with or without refund of taxes paid for inputs. Since different tax rates are applied to essentially comparable goods, tax administrations have provided detailed lists (cf. European Commission 2011). However, the distinction between different goods leaves scope for mis-classifications and avoidance activities.[2] The repeated attempts of tax authorities in the European Union to render these categorisations more precise indicate the difficulties in closing loopholes. Second, if individuals can purchase goods in jurisdictions in which different commodity tax rates are applied, these differentials provide incentives for acquiring commodities in low-tax jurisdictions. Such cross-border shopping can be facilitated by producers and thereby contribute to a fall in tax revenues in high-tax areas.[3]

[2] The 2010 reduction in the VAT rate for overnight stays in hotels in Germany from 19% to 7%, while expenditure for meals continued to be taxed at the standard rate of 19%, constitutes an excellent example. This rate differential provides hotels with substantial incentives to adjust the price of meals, relative to that of accommodation, in order to reduce the tax burden.

[3] There is substantial evidence for such cross-border shopping of petrol, alcohol, and tobacco, for example, in the United States and the European Union. Leal et al. (2009) survey the literature.

The recent surge in online shopping raises the scope for such tax avoidance activities further (see Ballard and Lee 2007 for evidence regarding the United States). Given these substantial possibilities for evading or avoiding taxes on output, the question arises as to whether the substitution of an ad valorem tax for a specific tax will continue to raise output in non-competitive markets if tax avoidance or evasion takes place.

In the basic model of tax evasion or avoidance by firms, output (and input) choices depend on tax rates but are independent of avoidance activities.[4] In consequence, tax avoidance and evasion do not alter the merits of an ad valorem relative to a specific tax. However, this basic model of firm behaviour, inter alia, implies that irrespective of the output level a constant amount of taxes is avoided or evaded, i.e., that a rise in the official tax burden is mirrored by an equal-sized increase in taxes paid (cf. Yaniv 1995). Therefore, small and otherwise identical large firms are predicted to avoid or evade the same amount of tax; a claim not substantiated in empirical studies. If the avoidance technology is modified to allow for a more plausible relationship between firm size and such activities, the optimal structure of commodity taxation can be shown to depend on tax avoidance or evasion opportunities.

In order to simplify the theoretical analysis we, subsequently, do not model the evasion or avoidance activities in detail but simply assume that a partial non-payment of taxes is feasible. In addition, we take the extent of market power as given and assume a sole supplier of the homogeneous commodity. In this set-up we show that if the marginal costs of avoidance or evasion decline with the official tax burden, the balanced-budget substitution of an ad valorem for a specific tax will reduce the monopolist's output. A higher tax burden may lower these marginal costs if a greater official tax base enhances the opportunities to utilise tax loopholes or the marginal penalty in the case of evasion declines with the tax base. If this is the case, a tax reform which leaves output unaffected in the absence of avoidance or evasion activities can be shown to raise the official tax burden. As a consequence, this reform induces the monopolist to engage in greater tax avoidance or evasion. To balance the budget, tax rates have to be raised and output declines while, irrespective of the avoidance technology, the tax reform does not alter profits. Accordingly, in the presence of tax avoidance or evasion the welfare-ranking of taxes may be reversed and a substitution of a specific tax for an ad valorem tax can constitute a Pareto improvement.

In the remainder of the paper, Section 2 lays out the model, Section 3 investigates the envisaged tax reform, and Section 4 provides a brief summary of the analysis.

[4] See Yaniv (1995) for a general formulation of this result which goes back, for example, to Marrelli (1984), Wang and Conant (1988) and Yaniv (1988).

2. Model

Abstracting from the details of tax evasion or avoidance opportunities, the analysis focuses on a non-price-discriminating monopolist producing a commodity at constant unit costs c, $c > 0$. The inverse demand function p(x) is linear, where p denotes the (demand) price, which declines with the output level x ($p'(x) := dp/dx < 0$, $p''(x) = 0$). The government imposes a non-negative unit tax at the rate τ, $0 \leq \tau$, and a non-negative ad valorem tax at the rate t, $0 \leq t < 1$. If the monopolist pays the amount of taxes due, official net profits will be $p(x)x - cx - T$, where $T = x(p(x)t + \tau)$ denotes the official tax burden. For later use, note that the partial derivatives of T equal $T_t = p(x)x$, $T_\tau = x$, and $T_x = \tau + t(p'(x)x + p(x)) = \tau + t\varepsilon(x)$, for $\varepsilon(x) := p'(x)x + p(x)$. In this setting, the balanced-budget increase of an ad valorem tax and the concomitant fall in the specific tax will raise output if the amount of taxes due is actually paid (Delipalla and Keen 1992, Anderson et al. 2001).

In the present analysis, however, the monopolist is assumed to engage in tax avoidance or evasion activities and to choose optimally the voluntary tax payment S, $0 < S \leq T$, and the output level x simultaneously. The costs of tax avoidance or evasion are captured by the function H(T, S). If costs H are an increasing function only of the amount T - S of taxes evaded or avoided, H will be given by H(T - S), for H', $H'' > 0$. Such a cost function has traditionally been assumed.[5] In addition, the specification H(T - S) implies that the marginal costs of avoidance or evasion $-\partial H/\partial S = -H_S$, that is of reducing S, rise with the official tax burden T, implying that $H_{ST} = -H_{SS} < 0$ for $H'' > 0$. The rationale for this assumption probably relies on the interpretation of H as representing the expected penalty in an analysis of tax evasion. From this perspective, a higher tax burden T raises the amount of taxes evaded, T – S, for a given voluntary payment S and, therefore, the penalty. As mentioned in the introduction, this functional form of H gives rise to the (somewhat) implausible prediction that the amount of taxes evaded or avoided is constant, irrespective of the tax rates or demand conditions. Note, furthermore, that the cross-derivative H_{ST} will also be negative if the expected penalty H consists of the product of a linear penalty function which rises with T – S and a detection probability which decreases linearly with the voluntary tax payment S. While a positive relationship between tax evasion and detection probability is often assumed, Allingham and Sandmo (1972) also consider the case that the detection probability rises with

[5] See, inter alia, Marrelli (1984), Virmani (1989), Cremer and Gahvari (1992, 1993), Besfamille et al. (2009), and Bayer and Cowell (2009) for analytical settings in which the difference between T and S is interpreted as tax evasion and Cross and Shaw (1982) and Erard (1993), who consider tax avoidance (by individuals).

S, ceteris paribus, arguing that such a relationship could result from the tax authorities' belief that rich individuals are more likely to evaded income taxes.

If H depicts the costs of tax avoidance and not of tax evasion it may, however, well be the case that the marginal costs of legally reducing the amount of taxes paid, i.e. of a fall in S, do not rise, but shrink with the official tax burden T, as avoidance opportunities become more ample. This could be the case because (1) a higher tax base makes avoidance less costly at the margin, (2) the number of tax loopholes and of avoidance strategies that can be utilised rises with the amount of taxes due, or because (3) administrative costs of complying with the tax system and, therefore, also of legally reducing tax payments decline with a firm's tax base.[6] In this case, $H_{ST} > 0$ is a more appropriate assumption.[7]

In sum, the features of the cost of avoidance or evasion function captured by $H_{TT} = H_{SS} = -H_{ST}$, and underlying the specification H(T - S), represent a special case. As a consequence, we presume a (more) general cost function H(T, S), satisfying $0 < H_T, H_{TT}, H_{SS} > 0 > H_S$. However, following Roine (2006) and Traxler (2009), for example, we do not impose a sign on H_{ST}.[8] Finally, we assume that $H_T t < 1$ so that a rise in the official tax burden T does not reduce profits by more than 1/t. In a setting in which H(T – S) holds, that is, in a standard tax evasion setting, $H_T < 1$ ensures that evasion actually takes place at all. To simplify the exposition, we will subsequently refer to the H(T, S) as cost of tax avoidance, although the previous discussion has made clear that it can also capture the cost of tax evasion.

Given the above assumptions, we can express the net profits π of a tax-avoiding monopolist as:

$$\pi(x, S) = p(x)x - cx - S - H(T(x(\tau, t), \tau, t), S) \tag{1}$$

[6] There is substantial evidence that administrative costs of taxation represent a smaller fraction of the tax base for larger firms than for smaller ones, as the comprehensive survey by Vaillancourt et al. (2008) demonstrates.

[7] See Slemrod (2001) and Grubert and Slemrod (1998) for similar settings within models of personal or corporate income tax avoidance. Slemrod (2001), for example, assumes that the cost function H depends on the tax base and the amount of income avoided. If the tax base and the official tax burden are related positively, his assumption implies that H = H(T, T – S) holds. He furthermore considers $-H_{TS} = \partial^2 H/(\partial T \partial(T - S)) \leq 0$ to be "the most likely case", although the sign of the cross-derivative "is ultimately an empirical question" (Slemrod 2001, p. 121). The respective evidence on tax compliance and firm size is scarce and mixed and can only be indicative of the sign of H_{TS} because, for example, firm size is a very rough measure of tax liability T. Rice (1992), for example, reports a positive effect of a firm size variable on non-compliance, while Hanlon et al. (2007) find a U-shaped relationship. Giles (2000), Gatti and Honorati (2008), Cai and Liu (2009), Dabla-Norris et al. (2008), and Tedds (2010) observe larger firms to be more compliant.

[8] An example of a function H satisfying all the above requirements is $H = (T - S)^{\alpha} + \beta/(ST)$, where $\alpha \geq 1$ and $\beta \geq 0$ hold. For $\alpha = 1$ and $\beta > 0$, we have $H_{ST} > 0$ and in the case of $\alpha > 1$ and $\beta = 0$, $H_{ST} < 0$ results. In both settings $H_T > 0$ can be guaranteed by appropriate choice of the parameters α and β.

Maximisation with respect to output x and actual tax payments S yields:

$$\pi_x = (p'(x)x + p(x)) - c - H_T T_x = \varepsilon(x) - c - H_T(\tau + t\varepsilon(x)) = \varepsilon(x)(1 - H_T t) - c - H_T \tau = 0 \quad (2a)$$

$$\pi_S = -1 - H_S = 0 \quad (2b)$$

The last equality in the first-order condition (2a) indicates that $\varepsilon(x) > 0$ and, hence, $\varepsilon(x) > c > 0$ hold, since $H_T t < 1$. It therefore implies that a rise in output will always increase revenues net of ad valorem tax payments or, alternatively, that the monopolist will never expand output to such an extent that marginal revenues fall below unit costs. Note, finally, for later use that $\varepsilon(x) > c$ implies that $T_x > 0$ and vice versa. The derivatives of equations (2a) and (2b) are:

$$\pi_{xx} = 2p'(x)(1 - H_T t) - H_{TT}(T_x)^2 < 0 \quad (3a)$$

$$\pi_{SS} = -H_{SS} < 0 \quad (3b)$$

$$\pi_{Sx} = \pi_{xS} = -H_{ST} T_x \quad (3c)$$

The sufficient second-order condition $D > 0$ for a maximum of (1) will hold if $H_{TT}H_{SS} - (H_{ST})^2 > 0$, which we assume to be the case.

$$D = (T_x)^2[H_{TT}H_{SS} - (H_{ST})^2] - 2p'(x)(1 - H_T t)H_{SS} \quad (4)$$

Since the term in square brackets in (4) will be zero for $H = H(T - S)$, a necessary condition for the output choice to maximise profits is the restriction $H_T t < 1$ imposed above.

3. Output Effects of Commodity Tax Reform

Assume that the government lowers the specific tax τ and raises the ad valorem tax rate t, holding constant the monopolist's actual tax payments S and, hence, public revenues. To analyse the output effects of this tax reform, we need to know the impact of a marginal rise in the tax rates on the first-order conditions in (2):

$$\pi_{x\tau} = -H_T - H_{TT} T_x x < 0 \quad (5a)$$

$$\pi_{xt} = -H_T \varepsilon(x) - H_{TT} T_x p(x) x < 0 \quad (5b)$$

$$\pi_{S\tau} = -H_{ST} x = \frac{\pi_{St}}{p(x)} \quad (5c)$$

Using equations (3), (4), and (5), we can calculate the changes in output x as:

$$\frac{dx}{d\tau} = -T_x x \frac{H_{TT}H_{SS} - (H_{ST})^2}{D} - \frac{H_T H_{SS}}{D} < 0 \tag{6a}$$

$$\frac{dx}{dt} = -p(x) T_x x \frac{H_{TT}H_{SS} - (H_{ST})^2}{D} - \varepsilon(x) \frac{H_T H_{SS}}{D} < 0 \tag{6b}$$

The decrease in the specific tax rate τ which becomes feasible due to a marginal rise in the ad valorem tax rate t is determined by $dS = S_\tau d\tau + S_t dt = 0$, where S_t and S_τ are given by:

$$S_\tau = \frac{H_{ST}}{D}\left[2p'(x)x(1 - H_T t) + H_T T_x\right] = \frac{S_t}{p(x)} - \frac{H_{ST}}{D} H_T T_x \frac{p'(x)x}{p(x)} \tag{7a}$$

$$S_t = \frac{H_{ST}}{D}\left[2p'(x)xp(x)(1 - H_T t) + H_T T_x \varepsilon(x)\right] \tag{7b}$$

A priori, the budgetary effect of a rise in either of the tax rates is uncertain. In the present framework this ambiguity is particularly pronounced, because there is no tax-base effect resulting from a rate change, in contrast to a setting in which taxes due are always paid. Instead, the firm adjusts its actual tax payments S in accordance with the first-order conditions (2a) and (2b). Let us suppose then, hypothetically, that actual payments S declined with tax rates. In this case, the optimal policy would be to lower tax rates and thereby expand actual revenues S and output x (cf. equation (5)), thus achieving a Pareto improvement. Once a situation had been reached in which additional reductions in tax rates would not raise tax revenues any further, the issue of the optimal structure of commodity taxation would become relevant, that is, the problem we focus on here. In consequence, we assume that S_t, $S_\tau > 0$. Substituting for H_T in accordance with (2a), which is feasible for $T_x > 0$, we can rewrite equations (7a) and (7b) as:

$$S_\tau = \frac{H_{ST}}{D}\left[2p'(x)x + 2p'(x)x\frac{c - \varepsilon(x)}{T_x} t + \varepsilon(x) - c\right] \tag{8a}$$

$$S_t = \frac{H_{ST}}{D}\left[2p'(x)xp(x) + 2p'(x)xp(x)t\frac{c - \varepsilon(x)}{T_x} + (\varepsilon(x) - c)\varepsilon(x)\right] \tag{8b}$$

Since $\varepsilon(x) - c > 0$, the second and third terms in square brackets in equations (8a) and (8b) are positive, whereas the respective first terms are negative. Therefore, the sign restrictions on S_t and S_τ do not generate insights with respect to the derivative H_{ST}. The output effect of the balanced-budget tax reform (see Appendix for a derivation) is:

$$\frac{dx}{dt}\bigg|_{dS=0} = H_{ST}\underbrace{\frac{p'(x)x^2(\varepsilon(x)-c)}{DS_\tau T_x}}_{(-)} \tag{9}$$

Accordingly, for $H_{ST} < 0$ (> 0), output will rise (fall) with a balanced-budget substitution of an ad valorem tax for a specific tax. Employing $T_t = p(x)x$, $T_\tau = x$, and $\varepsilon(x) = p(x) + p'(x)x$, as well as equations (8) and (9), we can show that the proposed tax reform neither has an impact on the official tax burden T, nor on net profits π:

$$\frac{dT}{dt}\bigg|_{dS=0} = T_t + T_\tau \frac{d\tau}{dt}\bigg|_{dS=0} + T_x \frac{dx}{dt}\bigg|_{dS=0} = T_t - T_\tau \frac{S_t}{S_\tau} + T_x \frac{dx}{dt}\bigg|_{dS=0}$$

$$= \left[\frac{H_{ST}}{S_\tau D} x(\varepsilon(x)-c)(p(x)-\varepsilon(x))\right] + T_x \frac{dx}{dt}\bigg|_{dS=0} = 0 \tag{10}$$

$$\frac{d\pi}{dt}\bigg|_{dS=0} = \underbrace{\pi_x}_{=0} \frac{dx}{dt}\bigg|_{dS=0} + \underbrace{\pi_S}_{=0} \underbrace{\frac{dS}{dt}\bigg|_{dS=0}}_{=0} + \pi_T \underbrace{\frac{dT}{dt}\bigg|_{dS=0}}_{=0} = 0 \tag{11}$$

Net profits π remain constant because output x and tax payments S are chosen optimally, while the official tax burden T and, hence, the costs of avoidance are unaffected, for a given payment S.[9] The change in the official tax burden T consists of a direct effect in square brackets in equation (10) resulting from the variations in the tax rates, which is positive for $H_{ST} > 0$ (since $p(x) > \varepsilon(x) > c$) and will be negative if $H_{ST} < 0$. In consequence, the firm adjusts output x, inducing a change in T as the last term in equation (10) clarifies. This adjustment owing to the output change exactly compensates the direct tax effect, irrespective of the tax avoidance technology, that is, of the sign of H_{ST}. This is the case because the incentives to avoid tax payments, as given by equation (2b), must be unaffected by the tax reform. This restriction, dictated by the requirement of constant tax revenues S, necessitates an unchanged difference between the official tax burden T and the amount of taxes paid S.[10]

We summarise the findings captured by equations (9) to (11) in

[9] This prediction differs from the result for a setting without tax avoidance, namely that profits will rise with the balanced-budget introduction of an ad valorem tax (Skeath and Trandel 1994).

[10] Any variation in determinants of the firm's output decision which alters the official tax burden will cause an adjustment in the amount of tax avoidance, given H_{SS}, $H_{ST} > 0$. This is in contrast to an avoidance technology H(T - S) for which the first-order condition (2b) dictates a constant value of T - S, irrespective of the output level. Note that for the general function H(T, S), T - S is constant in the case of the balanced-budget tax reform only because S cannot be varied by assumption.

Proposition 1

Given a tax-avoiding or tax-evading monopolist, the balanced-budget substitution of an ad valorem tax on output for a specific tax alters neither the official tax burden T nor net profits π. The tax reform will reduce output x if the marginal gain H_S from a higher tax payment rises with the official tax burden T, implying that $H_{ST} > 0$. For $H_{ST} < 0$, the reverse prediction holds.

The intuition for this finding can best be obtained by starting with the standard case of there being no tax avoidance or evasion. If the ad valorem tax rate is raised while the specific tax rate is reduced in a manner which ensures that tax payments remain unaffected at the initial output level, the monopolist will have an incentive to expand its output. This effect occurs because the increase in the ad valorem tax diminishes marginal revenues by less than they are raised due to the fall in the specific tax. Given higher marginal revenues and unchanged unit costs, the monopolist produces a greater quantity. This quantity expansion generates a budget surplus so that tax rates can be reduced, strengthening the positive output effect.

Suppose next that, say, tax evasion is feasible and its costs are given by H(T - S), where H', H'' > 0 hold. This implies that $H_{ST} < 0$ and, in addition, that the output decision can be separated from the tax evasion decision. The output level is independent of evasion activities (as can be seen from inspection of equation (2a) for $H_T = - H_S = 1$). In this case, the tax reform that leaves tax payments T constant in the absence of evasion raises the monopolist's output (Suits and Musgrave 1953, Skeath and Trandel 1994). However, this change has no impact on the gain from tax evasion which is determined by the constant difference between the official tax burden T and the amount S of taxes paid. Accordingly, the tax reform does not alter actual tax revenues and, therefore, the positive output effect of the shift towards ad valorem taxation is unaffected (cf. equation (9)).

Assume, finally, that the monopolist's output decision cannot be separated from the tax underpayments ($H_T \neq - H_S$), to which we refer as avoidance, for simplicity. If, furthermore, $0 > H_{ST} > -H_{SS}$ applies, the increase in profits resulting from the tax reform in the absence of tax avoidance activities is mitigated. The costs of avoiding an additional unit of tax payments decline, relative to those occurring in the case of a cost function H(T - S). As a consequence, the monopolist increases the amount of taxes avoided, given the tax rate variations occurring in the absence of avoidance activities. As long as this effect on avoidance is not too strong, i.e. $H_{ST} < 0$ holds, the marginal revenue impact will dominate the tax avoidance effect.

However, for $H_{ST} > 0$, the marginal costs of avoidance fall with a higher official tax burden. To maximise net profits, the monopolist will substitute avoidance for output and, hence, reduce the latter.

In conclusion, tax avoidance or evasion activities may strengthen the positive impact on output resulting from a marginal substitution of an ad valorem tax for a specific tax (if $H_{ST} < -H_{SS} < 0$), may mitigate it (if $0 > H_{ST} > -H_{SS}$), or may even reverse it (for $H_{ST} > 0$). However, this effect of tax avoidance or evasion is conditional on the tax reform already having an output effect in the absence of a difference between T and S. Such an output effect does not arise in a deterministic competitive setting (Suits and Musgrave 1953, Keen 1998) which could be modelled by setting $p'(x) = 0$ in the first-order condition (2a). Inspection of equation (9) then shows that avoidance activities do not alter the finding that the commodity tax structure is irrelevant in a competitive market.

Corollary 1

The balanced-budget substitution of an ad valorem tax for a specific tax will not alter output in a competitive market, irrespective of the amount of tax avoidance or evasion activities.

The intuition for Corollary 1 is basically the same as for a world without tax avoidance or evasion: a change in the structure of the commodity tax, holding constant the required tax payment, does not affect a competitive firm's incentives to alter output. Given an unchanged output level and a constant tax burden, also the amount of taxes actually paid remains optimal.

4. Summary

If the costs of not paying the full amount of taxes are a function only of the amount of taxes avoided or evaded, a firm's output decision can be separated from its avoidance choice. In such a setting, a monopolist's response to the balanced-budget shift from specific to ad valorem taxation is unaffected by avoidance or evasion activities. However, if the amount of taxes not paid has an effect on output, tax avoidance or evasion opportunities may strengthen, mitigate or reverse the output and welfare consequences of the proposed tax reform. In particular, if the marginal costs of tax avoidance fall with the official tax base, for example, it becomes easier to find tax loopholes the larger the official tax base is because, the balanced-budget shift towards ad valorem taxation will reduce the monopolist's output. Profits, however, are unaffected by the tax reform, given an adjustment in tax payments. In such a situation, a shift *away* from ad valorem taxation represents a Pareto improvement.

Furthermore, the interaction between the tax reform and avoidance activities requires the shift towards specific taxation to already have an effect on output in the absence of tax avoidance activities and, consequently, does not occur in a competitive setting. Since, however, the tax reform's impact on output also arises in an oligopoly without tax avoidance or evasion (Keen 1998), it is likely to occur in an oligopolistic world with avoidance or evasion activities as well.

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Appendix - Derivation of Equation (9)

The balanced-budget output change is determined by:

$$\left.\frac{dx}{dt}\right|_{dS=0} = \frac{dx}{dt} + \frac{dx}{d\tau}\left.\frac{d\tau}{dt}\right|_{dS=0} = \frac{1}{S_\tau}\left[\frac{dx}{dt}S_\tau - \frac{dx}{d\tau}S_t\right] \tag{A.1}$$

Substituting $p(x)dx/d\tau - p'(x)xH_T H_{SS}/D$ for dx/dt in accordance with the equations in (6) and for S_τ in line with (7a), we obtain:

$$\left.\frac{dx}{dt}\right|_{dS=0} = \frac{1}{S_\tau}\left[\left(\frac{dx}{d\tau}p(x) - \frac{p'(x)xH_T H_{SS}}{D}\right)\left(\frac{S_t}{p(x)} - \frac{p'(x)xH_T H_{ST}T_x}{Dp(x)}\right) - \frac{dx}{d\tau}S_t\right] \tag{A.2}$$

Simplifying and relacing S_t and $dx/d\tau$ in accordance with equations (6a) and (7b), yields:

$$\left.\frac{dx}{dt}\right|_{dS=0} = \left[p(x)(T_x)^2 x\left(H_{TT}H_{SS} - (H_{ST})^2\right) + p(x)H_T H_{SS}T_x\right]\frac{p'(x)xH_T H_{ST}}{S_\tau D^2 p(x)}$$

$$-\frac{p'(x)xH_T H_{ST}}{S_\tau D^2 p(x)}\left[H_{SS}\left[2p'(x)xp(x)(1-H_T t) + H_T T_x \varepsilon(x)\right] - p'(x)xH_T H_{SS}T_x\right] \tag{A.3}$$

Using $\varepsilon(x) = p(x) + p'(x)x$, it can be noted that all terms that include $H_T H_{SS} T_x$ cancel out in (A.3). Employing the definition of D (cf. equation (4)) and substituting $(\varepsilon(x) - c)/T_x$ for H_t, we arrive at:

$$\left.\frac{dx}{dt}\right|_{dS=0} = H_{ST}\frac{p'(x)x^2(\varepsilon(x) - c)}{DS_\tau T_x} \tag{9}$$