



Taxpayers' Behavioural Responses and Measures of Tax Compliance 'Gaps': A Critique

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WORKING PAPER 11/2013

June 2013

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**Taxpayers' Behavioural Responses and Measures of Tax Compliance 'Gaps':
A Critique and a New Measure**

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Revised version: February, 2014

Acknowledgements:

An earlier version of this article was presented at the inaugural conference of the Institute of Fiscal Studies/University of Exeter Tax Administration Research Centre, Exeter, at an IMF Fiscal Affairs Department, workshop in Washington DC (both in January 2013), and at an H.M. Revenue & Customs seminar in London, September 2013. We thank the conference, workshop and seminar participants for their detailed and helpful comments. Both authors are international fellows at the Tax Administration Research Centre and gratefully acknowledge funding assistance.

Abstract

The work of Feldstein (1995, 1999) has stimulated substantial conceptual and empirical advances in economists' approaches to analysing taxpayers' behavioural responses to changes in tax rates. Meanwhile, a largely independent literature proposing and applying alternative measures of tax compliance has also developed in recent years, which has sought to provide tax agencies with tools to identify the extent of tax non-compliance as a first step to designing policies to improve compliance. In this context, measures of 'tax gaps' – the difference between actual tax collected and the potential tax collection under full compliance with the tax code – have become the primary measures of tax non-compliance via (legal) avoidance and/or (illegal) evasion. In this paper we argue that the tax gap as conventionally defined is conceptually flawed because it fails to incorporate behavioural responses by taxpayers. We show that conventional tax gap measures, which ignore the presence of behavioural responses, exaggerate the degree of non-compliance. This potentially applies both to indirect taxes (such as the 'VAT-gap') and direct (income) taxes. Further, where these conventional tax gap measures motivate reforms designed to increase the tax compliance rate, they will likely have a tax base *reducing* effect and hence generate a smaller increase in realised tax revenues than would be anticipated from the tax gap estimate.

1. Introduction

The seminal contributions of Feldstein (1995, 1999) have stimulated substantial conceptual and empirical advances in public economists' approaches to analysing taxpayers' behavioural responses to changes in tax rates (see, for example, Saez, 2001; Chetty, 2009; Saez et al. 2012; Creedy and Gemmell, 2013). A largely independent literature proposing and applying alternative measures of tax compliance has also developed in recent years. This latter literature (see, for example, IMF, 2013a; OECD, 2012, Shaw et al. 2010) has sought to provide tax agencies with tools to identify the extent of tax non-compliance as a first step to designing policies to improve compliance behaviour. In this context, measures of 'tax gaps' – generally, the difference between actual tax collected and the potential tax collection under full compliance with the tax code – have become the primary measures of tax non-compliance via (legal) avoidance and/or (illegal) evasion.

In this paper we argue that the tax gap as conventionally defined is conceptually flawed because it fails to capture those behavioural responses by taxpayers analysed in the Feldstein-related literature. We show that tax gap measures both for indirect taxes (such as the ‘VAT-gap’) and direct (income) taxes, which ignore the presence of behavioural responses, exaggerate the degree of non-compliance. Further, where these conventional tax gap measures motivate reforms designed to increase the tax compliance rate, they will likely serve to *reduce* the tax base and hence potentially have a tax revenue-*lowering* effect which will counteract the anticipated additional revenue via greater compliance effort.

The remainder of this article is organised as follows. Section 2 defines the tax gap and behavioural response measures in more detail and summarises the recent contributions of the two literatures described above. Section 3 then provides a simple model of the tax gap that integrates the insights from the ‘behavioural responses’ literature and Section 4 concludes.

2. Tax gap and taxpayer behavioural response definitions

Tax evasion is both pervasive and endemic and has been the subject of a great deal of economic modelling since the early contribution of Allingham and Sandmo (1972).¹ Despite explicit modelling of taxpayer behaviour in these models, and numerous studies’ attempts to estimate their extent, the literature on defining and estimating tax gaps has generally ignored these behavioural responses. This may in part reflect the characteristic of many of the tax evasion models which treat the total potential tax base as given and address the question of what determines the fraction of that base that is hidden from tax. Conventional tax gap measures can be thought of as capturing this sort of non-compliance.

Recent modelling of taxpayer responses to tax rate changes, following Feldstein (1995, 1999), has however focused on shifts in the total tax base for a particular tax. This literature has mainly considered income taxes and derived expressions, and estimates, for the responsiveness of taxable income (and, by extension, tax revenue) to marginal tax rate changes. The usual measure of this responsiveness is the ‘elasticity of taxable income’ (ETI) – the proportionate change in taxable income in response to a given proportionate change in the ‘net-of-tax’ rate (one minus the tax rate).

¹ See, for example, Feinstein (1991, 1999) and the reviews by Andreoni et al. (1998) and Sandmo (2005).

By using the *net-of-tax* rate, rather than the tax rate, the ETI is expected to be positive in the presence of behavioural responses.

The ETI has been shown to provide a simple yet powerful tool in the analysis of the revenue and welfare (deadweight cost) effects of tax rate changes. Saez *et al.* (2012), for example, highlight the difference between the ‘mechanical’ and ‘behavioural’ revenue responses to a tax rate change. The mechanical effect describes the revenue change consequent on a tax rate change in the absence of an associated behavioural change. Observed revenue changes reflect the combination of both responses, with the behavioural effect summarised by the ETI and the elasticity of revenue with respect to taxable income changes. This latter elasticity is a function of the tax structure; see Creedy and Gemmell (2013).

The relevance of the ETI literature for tax compliance measurement is that, the *effective* marginal tax rate (EMTR) that an individual faces can be thought of as a combination of the statutory marginal tax rate, t , and the extent of compliance. In the next section we specify the proportion of the (total or any additional) tax base that is declared, or otherwise observed, for tax purposes as θ . Hence, we can think of the effective marginal tax rate as θt . That is, if a non-compliant taxpayer experiences an increase in their tax base (say, taxable income) then they will pay a fraction θt on that additional income, rather than the fully compliant fraction t . The ETI literature generally argues that it is changes in this EMTR, not just the statutory rate, which acts as an incentive for behavioural responses. As a result, a change in either the statutory rate, t , or the ‘compliance rate’, θ , could be expected to generate a behavioural response.²

This need not imply that the responses to changes in each of these EMTR components, θ and t , are the same. For example, Chetty *et al.* (2009) and others have argued recently that some tax rates may be more salient, or ‘visible’, to taxpayers than others, with the result that taxpayers respond to *perceived* tax rates rather than *actual* rates.³ As a result the extent of any behavioural responses could differ in association with different tax types or, in our case, responses could differ to changes in θ or t

² There are, of course, other determinants of effective rates, such as deductions against tax, or social welfare payments, which are withdrawn at a ‘taper’ rate.

³ They analyse the specific case of US state-level excises and sales taxes which are added to the price of goods at retail outlets, but where some taxes are stated explicitly on the shelf or price label while others are simply added at check-out; see Chetty *et al.*, 2009, for details.

depending on how aware each taxpayer is regarding the impact that each tax/compliance ‘rate’ has on his/her effective marginal rate.

The literature on tax gap measurement has also expanded in recent years. In particular, increasing awareness of erosion of key tax bases in advanced economies (in response to such changes as globalization, factor mobility and increasing public indebtedness following the global financial crisis) has stimulated an increased focus within tax agencies on measuring the extent of avoidance or evasion. International organisations such as the OECD and IMF are also increasingly examining and proposing methods to estimate ‘tax gaps’ – broadly the difference between revenue actually raised and potential revenue that would be raised if non-compliance was reduced or eliminated e.g., HMRC (2011, 2012, 2013) OECD (2012), IMF (2013a). Separately, Gemmell and Hasseldine (2012) review the various tax gap definitions and their use in practice, measurement methods and prior estimates and IMF (2013b) provides a detailed review specifically for the U.K.

These ‘tax gap’ measures are also increasingly popular as a means of assessing the degree of success with which a particular tax or tax system is implemented, and have been proposed as possible performance indicators for tax collection agencies. Given observed tax revenues, the key component of tax gap measures is the unobservable ‘theoretical’ or hypothetical tax base and revenue that would be expected without evasion or avoidance.⁴

There are several possible definitions of the tax gap. Most have been developed within tax agencies to capture the aggregate tax revenue lost through non-compliance (for a specific tax or tax system). In the U.S. the ‘official’ IRS definition is simply: “*The difference between the tax that taxpayers should pay and what they actually pay on a timely basis*”.⁵ Plumley (2005) notes that this defined gap is split into three components: non-filing (failure to file a return), under-reporting (of income, and also overstating of deductions), and under-payment (failure to fully pay reported taxes owed).⁶

⁴ For tax base measures at a high level of aggregation, the methods currently used are often based on measures of the ‘hidden economy’ or ‘hidden income’. Almost all of the methods proposed or implemented are subjected to the same criticism of ignoring consideration of behavioural response. See Gemmell and Hasseldine (2012) for further discussion.

⁵ See http://www.irs.gov/pub/irs-utl/tax_gap_facts-figures.pdf

⁶ Other definitions of the tax gap found in the literature include those employed by, for example, Giles (1997; 1999), who first define the ‘hidden economy’ or ‘hidden income’. This is designed to capture income that is earned but is hidden from the tax authorities and, usually, official statisticians. The tax gap is then defined as hidden income multiplied by a suitable tax rate. This raises numerous conceptual and measurement issues, such as: what is included in hidden income, and what is a ‘suitable’ tax rate?

The IRS definition of the tax gap, as well as definitions used by other tax agencies, all attempt to capture the notion of revenue losses through non-compliance with the tax code. However, conventional tax gap measures do not formally consider how the ‘theoretical’ tax base from which the theoretical tax liability is calculated, may differ when tax agencies alter enforcement policy to change the extent of non-compliance, compared to estimates based on the current extent of non-compliance. That is, they ignore behavioural responses that may alter taxpayers’ total ‘theoretical’ tax base or liability rather than simply the fraction of a given total base that is declared for tax collection purposes.

However, since an extra dollar raised in tax revenue via greater compliance enforcement represents an increase in the taxpayer’s effective marginal tax rate, this need not necessarily reduce the tax gap by a dollar. The ‘one for one’ condition is achieved only if the ‘theoretical’ tax base is unaffected by changes in the effective tax rate. If the arguments and evidence from the ETI literature are accepted, greater compliance success and/or higher statutory tax rates which raise the taxpayer’s effective tax rate will tend, *ceteris paribus*, to *reduce* the total tax base (as distinct from changes which affect only the extent to which a given tax base is *hidden*).

3. Modelling tax gaps in the presence of behavioural responses

This section considers the consequences for tax gap estimates of ignoring taxpayers’ behavioural responses.⁷ It demonstrates that omitting behavioural responses biases conventional tax gap measures upwards, for both direct and indirect taxes, and can provide a perverse measure of the success of efforts to improve compliance.

Consider the following simple tax compliance model. Actual (observed) tax paid can be defined as:

$$T = tB \tag{1}$$

where B is the observed tax base (e.g. taxable incomes net of any deductions available as off-sets against that income); t is the average (and marginal) tax rate applicable to base, B , and T is actual tax revenue raised. If some tax base is hidden from taxation then we may define:

⁷ Perhaps unfortunately the term ‘theoretical’ (rather than ‘hypothetical’) tax liability has become common usage in a number of tax agencies; see, for example HMRC (2012) who use the abbreviation ‘VTTL’ for the ‘VAT Theoretical Tax Liability’.

$$B = \theta B^* \quad (2)$$

where B^* is the total tax base including that which is hidden and $0 \leq \theta \leq 1$ is the proportion observed and taxable, with $(1 - \theta)$ the proportion hidden from tax. For tax gap calculations in practice, B is observable but, whenever $\theta < 1$, B^* may or may not be observable. In some cases independent information on the total tax base, B^* , may be available, such as from consumer expenditure surveys or information on taxpayer incomes from sources independent of the tax authority). In such cases, θ may be estimated as a residual from B and B^* . Where there is no independent information on B^* , then compliance intelligence is typically used to calculate B^* from information on B and θ , such as that shown in (2). While (2) is something of a simplification of the relationship used for tax gap measurement in practice, it captures the essential property that the theoretical maximum base is obtained by ‘scaling-up’ the observed base using non-compliance fractions inferred from compliance intelligence data such as audit outcomes.

Combining (1) and (2) gives actual tax revenue of:

$$T = \theta t B^* \quad (3)$$

so that the ‘true’ effective marginal (= average) tax rate that the taxpayer faces is $dT/dB^* = T/B^* = \theta t \leq t$, except in the extreme full-compliance case where $\theta = 1$.

Labelling the conventional tax gap measure as G^* , this can be defined as: $G^* = T^* - T$, where T^* is the maximum potential, or ‘theoretical’ tax revenue with full compliance at tax rate, t , applied to the observed tax base, B . Hence, using equations (1) - (3):

$$G^* = t(B^* - B) = (1 - \theta)tB^* = \left\{ \frac{(1-\theta)}{\theta} \right\} tB \quad (4)$$

where (4) also uses $T^* = tB^*$. Thus, for a given total tax base, the tax gap increases if the tax rate rises or the compliance rate worsens (θ declines).

When conventional tax gap measures are used to judge the success of compliance efforts – which typically is their main purpose – a common presumption with such measures is that, in response to a change in compliance success, θ , the theoretical tax base, B^* , and tax liability, T^* , are unchanged.⁸ For

⁸ In the analysis which follows we do not formally model compliance effort, e , since this is not required for the argument we wish to make. However, conceptually it is straightforward to consider θ as a function of e , such that the tax revenue, or tax gap, responses of interest become $(dT/d\theta)(d\theta/de)$ or are $(dG/d\theta)(d\theta/de)$. If effort is defined in currency units (\$x or £x spent on activities to raise compliance, for example) then a reasonable minimum condition for ‘success’ might be $(dT/d\theta)(d\theta/de) > 1$. That is, an additional £1 of effort generates more than a £1 increase in the tax revenue.

a given tax rate, if the compliance rate changes, $dT^* = 0$ and $dG^*/d\theta = (dT^* - dT)/d\theta = -dT/d\theta$. That is, an extra dollar raised in revenue as a result of increased compliance reduces the tax gap, G^* , by a dollar.

Unfortunately this condition, $dG^*/d\theta = -dT/d\theta$, only holds if the total hypothetical tax base, B^* , is unaffected by changes in compliance success, θ .⁹ However, as argued earlier, greater compliance success and/or higher statutory tax rates can both be expected to raise the taxpayer's effective marginal tax rate. The ETI literature proposes that these can be expected to elicit tax base reducing responses; such that:

$$B^* = B^*(t, \theta) \quad \text{where } dB^*/dt < 0, \text{ and } dB^*/d\theta < 0 \quad (5)^{10}$$

That is, increases in either the actual marginal tax rate or the compliance rate (both of which raise the effective marginal tax rate) reduces the maximum tax base to which that rate can be applied. The ETI literature has produced various estimates for these responses to effective or statutory marginal tax rates across a range of taxes; see Saez *et al.* (2012) for a review of estimates.

As a result, the so-called 'theoretical tax liability', obtained by multiplying the observed tax base when $\theta < 1$ by the tax rate, t , would not be expected to be observed, were the revenue authority successful in eliminating non-compliance. Crucially, it is the total tax base, B^* (as distinct from the fraction of the tax base that is *hidden*), that is hypothesized in (5) to respond to t and θ .

The conventional tax gap measure, G^* , therefore captures the 'missing' revenue that would have been raised *from the observed base, B, scaled up by the current compliance rate θ* (that is: $B^* = B/\theta$), and without any responses of that base to the change in compliance. However whenever this theoretical base, derived when $\theta < 1$, is different from that *which would be observed* were compliance actually to increase to $\theta = 1$, then G^* is a misleading measure of missing revenue that *can potentially be collected*. Rather, G^* represents revenue missing from the *current* base, only *some* of which could be collected were the system to achieve $\theta = 1$.

⁹ A similar argument applies if θ is held constant and t changes; i.e. $dG/dt = -dT/dt$: the induced change in the tax gap is equal to minus the change in tax revenue.

¹⁰ Higher statutory tax rates may also encourage greater non-compliance; that is, $d\theta/dt < 0$. Thus, if taxpayers' non-compliance is proportionately greater (lower θ) at higher tax rates, governments may have to expend additional resources to keep θ constant when tax rates rise, and vice versa.

The property of the conventional tax gap measure, G^* , that $dG^*/d\theta = -dT/d\theta$ therefore gives a false impression that an additional dollar of revenue raised via improved compliance will reduce the tax gap by a dollar (whenever $dT^*/d\theta \neq 0$). In fact, as shown below, when $dT^*/d\theta \neq 0$, relative to a ‘true’ measure of the tax gap, G^* overestimates the size of the current tax gap. It also overestimates the amount of additional revenue that can be raised via increased compliance, but underestimates the rate at which the ‘true’ tax gap closes as compliance increases.

Improving tax gap measures

To overcome this tax gap mis-measurement problem, we can define a new tax gap measure, G^{**} , as:

$$G^{**} = t(B^{**} - B_0) \quad (6)$$

where B^{**} is defined as the tax base that would be observed at $\theta = 1$, and B_0 is the (currently) observed tax base when the (current) compliance rate, $\theta_0 < 1$. B^{**} is also the maximum potential tax base, for a given tax rate.¹¹

This maximum tax base, B^{**} , can also be written in terms of the definition above of B^* , and differences from B^* associated with the increase in θ . Thus:

$$B^{**} = B_0^* + \left\{ \frac{\Delta B^*}{\Delta\theta} \Delta\theta \right\} \quad (7)$$

Where ‘0’ subscripts represent initial values, and from (2), $B_0^* = B_0/\theta_0$. The term $\left\{ \frac{\Delta B^*}{\Delta\theta} \Delta\theta \right\}$ is the change in B_0^* when θ increase from θ_0 to 1; i.e. $\Delta\theta = 1 - \theta_0$. These changes are represented here as discrete changes, Δ , since they reflect non-marginal changes in θ , from its observed value to its maximum of one. Equation (7) can be further expressed in terms of the ‘elasticity’ of B_0^* with respect to changes in θ_0 , $\eta^* = \frac{\Delta B^*}{\Delta\theta} \frac{\theta_0}{B_0^*}$, and after some rearranging, gives:

$$B^{**} = B_0^* \left(1 + \frac{1-\theta_0}{\theta_0} \eta^* \right) \quad (8)$$

Substituting (8) into (6), and using $B_0^* = \theta_0 B_0$ then gives:

$$G^{**} = t B_0^* \left(1 + \frac{1-\theta_0}{\theta_0} \eta^* - \theta_0 \right) = t B_0 \left\{ \frac{1-\theta_0}{\theta_0} \right\} \left(1 + \frac{\eta^*}{\theta_0} \right) \quad (9)$$

¹¹ This *ceteris paribus* condition is required if, as argued by the ETI literature, $dB^{**}/dt \neq 0$.

Note that the elasticity, η^* , measures the extent to which the maximum potential tax base obtained from equation (2), and which feeds into the conventional tax gap measure, changes when θ is raised from its current value to equal one. It is expected to be negative in the presence of tax base behavioural responses: full compliance generates a lower theoretical tax base than that obtained ‘mechanically’ as $B_0^* = B_0/\theta_0$. Using equation (4), allows equation (9) to be expressed in terms of the conventional tax gap:

$$G^{**} = G^* \left(1 + \frac{\eta^*}{\theta_0}\right) \quad (10)$$

Equation (10) thus demonstrates that a tax gap measure that allows for tax base behavioural responses will be lower than the conventional gap measure, G^* , as long as $\eta^* < 0$. Indeed, if the absolute value of η^* is greater than the compliance rate, θ_0 , then $\eta^*/\theta_0 < -1$ and G^{**} becomes negative. That is, if compliance was increased from current levels so that all non-compliance was eliminated, the resulting loss of tax base would yield a maximum hypothetical (= actual) tax revenue less than current revenue. Equation (10) also highlights that a ‘true’ tax gap measure is lower, both absolutely and relative to G^{**} , when the initial compliance rate, θ_0 , is lower, since this generates a larger (more negative) value of η^*/θ_0 .

From equation (8) it can also be inferred that tax revenues with full compliance are expected to be lower using a ‘true’ measure. Equation (8) shows the relationship between the two definitions of the ‘full compliance tax base’ (B^{**} and B^*) which, for a given tax rate, t , also shows the relationship between the two measures of full compliance tax revenues. It can be seen that, since the ‘true’ full compliance tax base, B^{**} , will be lower than B^* , then the increase in actual tax revenues from current values (T_0) to full compliance levels must be less than estimated using B^* , as long as $\eta^* < 0$.

The two tax gap definitions can be illustrated with the help of Figure 1. This shows the compliance rate, θ , on the horizontal axis, and the tax base, B , on the vertical axis, *for a given tax rate*. Consider an initial compliance rate, $\theta_1 = 0.5$, so that the observed tax base is B_1 , at point D. The conventional tax gap measure (based on B_1 , and B^* when $\theta = 1$) is simply obtained as a linear extrapolation along the broken line ODH till $\theta = 1$. This gives $G_1^*/t (= (B^* - B_0))$ as the distance CD, equal to FH.

However, if the maximum tax base declines with increases in θ , this will cause the tax base at $\theta = 1$ to lie below H, such as at point E. This depicts the behavioural response, η^* , as the discrete vertical drop from C to E, as θ increases from C to H. It can be seen that this gives the ‘true’ gap in the tax base, G_1^{**}/t , equal to the distance FE, instead of FH. However, if the line CE sloped down sufficiently (a lower – i.e. more negative – elasticity, η^*), it can be seen that the point E could lie below F; namely a negative tax gap: $G_1^{**}/t < 0$ and hence $G_1^{**} < 0$. This represents a case where the condition $\eta^*/\theta_0 < -1$ above holds.

While for most taxes, the notion of a negative tax gap may seem unlikely, it could be relevant for in some circumstances. For example, if corporate investment or declared profits by multinational companies are very sensitive to the effective tax rates they face, such companies may be prepared to pay corporate tax at a given statutory rate as long as compliance enforcement is limited, keeping their *effective* average and marginal rates low. However, where a substantial enforced increase in compliance by those multinationals induces a high degree of capital flight or profit shifting in response to the higher effective rates, total tax revenues with so-called ‘full compliance’ could yield lower revenues than with the initially lower effective tax rates.

Figure 1 also shows the tax gaps calculated from a lower initial compliance rate, $\theta_0 = 0.25$. This gives a taxed base of B_0 at point I, and a conventional measure of the full-compliance tax base, $B_0^* = B_I^*$, at point A (= H). Applying the same value of η^* as previously now generates a value of B_0^{**} less than B_I^{**} : hence point J lies below E. This reflects that the estimates of a full-compliance tax base, when based on a lower current value of compliance (θ_0), involve a larger increase in compliance and hence a larger decline in the associated maximum tax base, B_0^{**} . As a result, a conventional tax gap would be based on the distance HK in Figure 1 instead of the ‘true’ gap based on the distance JK. In addition, because the trajectory of the actual tax base, B , in Figure 1 would be from D to E, not D to H (when θ_1 rises from 0.5 to 1), or from I to J, not I to H (when θ_0 rises from 0.25 to 1), observed revenue increases must also be less that would be expected from the conventional tax gap measure.

Figure 1 and the expressions for the tax gaps above, are all predicated on a constant tax rate, t . It is however important to remember that if, from (5), $dB^*/dt < 0$, then the derived tax base and tax gap estimates are conditional on the current tax rate. Thus, for example, the vertical position of points

such as A, C, E, H and J in Figure 1 are determined by the tax rate, t . An increase in the statutory tax rate, when $dB^*/dt < 0$, not only increases revenue via the mechanical application of a higher tax rate to the current tax base, but also involves a simultaneous *downward* shift in B^{**} values in Figure 1 because the higher rate, *ceteris paribus*, lowers the tax base. Hence the tax gap measure, G^{**} , at any given θ also depends on t indirectly via tax base changes, as well as directly. The conventional measure fails to account for this indirect effect.

To illustrate possible magnitudes, consider a tax rate of $t = 0.25$, a compliance rate, $\theta = 0.5$, and an observed tax base of 500 units. A conventional tax gap measure yields a theoretical maximum tax base, $B^* = 1000$ ($500/0.5$), with maximum tax revenue with full compliance of $T^* = 250$, and tax collected, $T = 125$. The tax gap, G^* , is therefore 125. If, instead, $\theta = 0.9$, the conventional tax gap would be $250 - (0.25 \times 0.9 \times 1000) = 25$.

Table 1 shows values of the two tax gap measures, G^* and G^{**} , for different assumed compliance rates and tax base elasticity values, η^* . When $\eta^* = 0$, the two measures are the same, as shown in row 1 of the table: G^* and G^{**} both fall from 125 at $\theta = 0.5$, to 25 at $\theta = 0.9$. Lower rows in the table show the case where $\eta^* < 0$ over the range -0.1 to -1 . The conventional tax gap, G^* , is unchanged at its row 1 values, while G^{**} is reduced.

A value of $\eta^* = -0.1$ indicates that an increase in the compliance rate from, say, 0.5 to full compliance ($\theta = 1.0$; a 100% rise) would reduce the theoretical tax base (1000 at $\theta = 0.5$) by 10%, to 900. Maximum tax revenue is therefore $0.25 \times 900 = 225$, compared to actual revenue at $\theta = 0.5$ of 125. Hence the ‘true’ tax gap is not 125 but is $G^{**} = 100$ as shown in row 2 of the table, for $\theta = 0.5$. The ‘true’ tax gap is therefore around 20% lower than the conventional measure at these values of θ and η^* . With a higher initial compliance rate such as $\theta = 0.9$, the ‘true’ tax gap, at 22 is around 12% lower than the conventional measure (= 25).

[Table 1 to go here]

Table 1. Tax gap measures with/without tax base behavioural responses (in £)

Tax base responsiveness:	compliance rate: θ (initial)								
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
η^* 0	225	200	175	150	125	100	75	50	25
-0.1	0	100	117	113	100	83	64	44	22
-0.2	-225	0	58	75	75	67	54	38	19
-0.3	-450	-100	0	38	50	50	43	31	17
-0.4	-675	-200	-58	0	25	33	32	25	14
-0.5	-900	-300	-117	-38	0	17	21	19	11
-0.6	-1125	-400	-175	-75	-25	0	11	13	8
-0.7	-1350	-500	-233	-113	-50	-17	0	6	6
-0.8	-1575	-600	-292	-150	-75	-33	-11	0	3
-0.9	-1800	-700	-350	-188	-100	-50	-21	-6	0
-1	-2025	-800	-408	-225	-125	-67	-32	-13	-3

Not surprisingly, Table 1 shows that larger behavioural responses via lower η^* values, reduce the G^{**} absolutely and relative to G^* in row 1. As predicted earlier, these become negative at especially low values of η^* and θ . For example, at compliance rates below 50%, the ‘true’ tax gap becomes negative for η^* values less (more negative) than around -0.5 .

Of course, identifying suitable values of η^* for individual taxes is crucial if the conventional tax gap measure is to be adapted to allow for these tax base behavioural responses when estimating tax gaps in practice. The existing ETI literature provides some guidance on empirical values (see Saez *et al.*, 2012), but these are typically for personal income taxes, and a few for corporate income taxes. However they generally relate to responses to statutory or effective tax rates with the implication for responses specifically to compliance rates unclear. They are also acknowledged to be specific to the institutional structure of the taxes in question. Results may therefore not carry over to similar taxes in different countries with somewhat different systems – for example, where anti-avoidance legislation or practice is different.

In addition, little is currently known regarding how far taxpayer responses differ for a given increase in tax liability when this is due to a higher statutory rate versus a higher compliance rate. It seems at least plausible that for some taxes, changes in compliance effort and/or success are less visible to taxpayers than changes to explicit tax code parameters such as marginal rates, allowable

deductions, exemptions, tax credits etc. If so, responses could be much more muted for the former compared to the latter.¹²

The tax gap and the Laffer curve

The previous section, and Figure 1, illustrated the case where tax revenues change in response to a change in the compliance rate, holding the tax rate constant. For tax rate changes, the Laffer curve – the ‘inverted-U’ shaped relationship between tax revenues and the tax rate – is perhaps the best-known device used to illustrate the adverse revenue response to tax rate increases. It’s relevance to the current tax gap analysis can be seen by noting from equations (2) and (5) above that $T = \theta t B^*(t, \theta)$. Thus, increases in the *effective* tax rate, θt , have a positive ‘mechanical’ effect on total tax revenues and a negative ‘behavioural’ effect via induced reductions in the tax base from changes in either component of the effective tax rate ($dB_t^*/dt, dB_t^*/d\theta < 0$). The net effect depends on the relative strengths of these two, but the Laffer curve proposes that the net effect is positive at low tax rates and negative at high tax rates.¹³

Figure 2A illustrates a form of tax gap Laffer curve, but in (T, B^*) space rather than (T, t) space, showing the relationship between total tax revenues, T , and the total potential tax base, B^* . The horizontal axis represents the case of $\theta t = 0$; that is, the tax rate and/or compliance rate are zero. For this ‘no-tax’ case, let the exogenously determined tax base be X ; tax revenue is of course zero. The 45° line represents the case of a fully enforced ($\theta = 1$) 100% tax rate (such that $\theta t = 1$). At this extreme, standard Laffer arguments suggest tax revenue will also be zero, though an argument can be made that revenue may still be positive (though likely small).¹⁴

The curve OX shows there is a maximum revenue (between O and X) associated with the relationship, $T = \theta t B^*$, as θt rises from zero to one. Thus, with zero tax revenues at X when $\theta t = 0$, persistent increases in θ and/or t result in positive tax revenue but at a declining rate such that the negative behavioural effect eventually outweighs the mechanical effect – left of the maximum of the

¹² On the salience of different taxes to taxpayers, see Chetty et al. (2009).

¹³ Typically, zero tax revenues are predicted at the two extreme tax rates of 0% and 100%, in the latter case because the penal rate eliminates the tax base. In practice zero revenue might result at tax rates below 100%.

¹⁴ The usual argument for zero revenue is that complete appropriation of the tax base by the tax authorities makes it pointless for individuals to ‘earn’ a positive amount of the tax base. However, depending on how tax revenues are used, some individuals may nevertheless be willing to see all of their income (or other tax base) taken by the government and continue to generate positive amounts.

curve OX . To simplify the exposition, we assume here that taxpayers respond identically to changes in θ and changes in t , though as noted earlier this need not be the case ($dB_t^*/dt \neq dB_t^*/d\theta$). Indeed, it might be expected that changes in statutory tax rates would be more visible, or ‘salient’, to taxpayers than changes in the extent of compliance enforcement; hence behavioural responses may differ.

Figure 2B illustrates an intermediate case. Consider an initial situation at point B , on the ray from the origin, OW , with a tax rate of t_1 and a compliance rate of θ_1 . This yields actual revenue of OC from a potential tax base of B_1^* ; the actual tax base is $\theta_1 B_1^*$ (not shown). Possible tax revenues with full compliance ($\theta = 1$) for this case are given by the ray OZ from the origin. If the tax base were to remain unaltered with full compliance, an outcome at A , with tax revenues of OE would be expected. However, taxpayer responses result in an outcome at point J in Figure 2B. As a result the conventional estimate of the tax gap, $AB = CE$, is an overestimate of the true tax gap of CD . How much of an overestimate depends on the extent of tax base response as determined by the curve $T = \theta t B^*(t, \theta)$.

Figure 2C shows the case where, for some tax and compliance rates, tax revenues can be smaller, or unchanged, when enforcement efforts succeed in eliminating all non-compliance. Consider an increase in the tax rate to t_2 from an initial situation at point B . With the same compliance rate, θ_1 , taxpayers move to L (not G). If non-compliance is eliminated, taxpayers move to K , yielding the same revenue, OC , as before the tax and compliance rate changes. Thus, the increased tax revenue delivered by the tax rate change, for given θ , is completely wiped out by the compliance “improvement”. The conventional measure of the tax gap, however, would show it falling from FB or FG to zero (where FB is the tax gap based on the tax base and revenue before both the tax rate and compliance changes).¹⁵

Finally, the analysis above has focused on tax gap measures in units of tax revenue (e.g. in dollars, euro, yen etc.) and shown that they can be quite different. Tax gap estimates are often presented as percentages of total tax revenue raised: such as $100G/T$ or $100G/T^*$. As should now be clear, the tax revenue, T or T^* , that can be expected following changes in tax rates or compliance, can be quite different from conventional ‘mechanical effect only’ estimates. As a result *percentage tax*

¹⁵ Additional revenue expected from the tax increase with no change in compliance, when taxpayers’ behavioural responses are ignored, is given by BG . If implemented, this tax rise would produce a lower tax base (at L) and tax gap given by the distance between L and a point on the ray OF vertically above L .

gap estimates could change in magnitude and even direction, quite differently from tax gap measures based on G alone. For example, the percentage gap could rise or fall even if there was no change in the gap measured in units of revenue.

Indirect Tax Gaps

The above analysis can be applied to any tax base – income, general consumption spending, or spending on specific goods or services such as tobacco, alcohol etc. In practice, ‘conventional’ tax gap analysis as described above is most often applied to general and specific consumption taxes such as VAT and excises. This reflects a view that data to estimate the theoretical (full compliance) tax base are more readily available and reliable than for direct taxes such as on personal and corporate incomes. However, though estimates of behavioural responses to tax rates have typically been calculated for ‘taxable income’ responses to personal (and, to a lesser extent, corporate) income taxes, the potential for behavioural responses to indirect tax changes could potentially be *more* relevant for tax gap analysis than those for direct income taxes.

Consider the following simple example for tobacco taxation. Assume 1 million cigarettes are sold legally for \$3 per unit, \$1 of which is tax from an excise, yielding \$1 million in tax revenue. A further 0.5 million smuggled cigarettes are sold without tax, at \$2 per unit. A conventional tax gap estimate would suggest there is an additional potential \$500,000 in tax revenue (0.5 million \times \$1). However, many cigarettes purchased illegally at \$2 will no longer be bought when the price becomes \$3. For example, those whose marginal valuation for cigarettes lies between \$2 and \$3 will smoke less or drop out of the market. Suppose formerly smuggled cigarette sales are cut in half when these are taxed and the price rises to \$3, with sales of formerly legal cigarettes unaffected, implying additional tax revenue of only \$250,000. That is, the ‘true’ tax gap is only half that estimated using the conventional definition, and depends on taxpayers’ behavioural responses to changes in θ and t .

The general case can be illustrated with the help of Figure 3. This shows the demand for cigarettes in price and quantity space. The pre-tax price is \$2 which, if this was the final consumer price, would be associated with a demand of Q_2 . With an excise tax of \$1 per unit of cigarettes, the tax-inclusive price becomes \$3 and demand falls to Q_1 . With full tax compliance, revenue equals the area $ABCD$ raised from a tax base of OQ_1 .

Now consider the case where cigarette smuggling occurs such that observed total demand for cigarettes could be as high as OQ_2 . In this case we would observe OQ_1 cigarettes purchased legally at \$3, with an additional Q_1Q_2 purchased illegally at \$2. A conventional estimate of the tax gap would be the area $BCEH$, or as a ratio of current revenue: $BCEH/ABCD$. However, with full tax compliance all cigarettes are now sold at \$3, such that demand for cigarettes contracts to OQ_1 . Hence zero additional revenue is raised as a result of a successful compliance campaign and the potential tax base has shrunk from OQ_2 to OQ_1 – the full amount of the previously non-compliant spending.

At the opposite extreme, consider the case where all smuggled cigarettes (sold at \$2 per unit prior to any compliance improvement), are consumed by individuals whose marginal valuation of each unit exceeds \$3 rather than \$2. An example is shown in Figure 4 where all smuggled cigarettes are purchased by OQ_0 consumers. They happen to have the highest marginal valuations in this illustration but the argument applies to any consumers on the segment BJ of the demand curve. For this case, initial excise revenue is area $GBCF$, while area $AGFD$ (equals area $BHEC$) is lost revenue due to smuggling. A fully successful compliance campaign that eliminates smuggling will yield additional revenue of $AGFD$ on OQ_0 cigarettes, and a ‘conventional’ measure of the tax gap would be correct. The tax base, OQ_1 , is unchanged in this case.

Between these two extremes, where some smuggled cigarettes are consumed by individuals with marginal valuations exceeding \$3 and some by those with marginal valuations between \$2 and \$3, the ‘true’ tax gap will lie between zero and the conventional estimate. In practice it seems likely that, before compliance improvements, many smuggled cigarettes will be consumed by those who value them at less than \$3. Such consumers have a much stronger incentive to seek out smuggled supplies. Hence, for those goods where illegal demand for tax-free units is primarily derived from those who value them at less than the tax-inclusive price, conventional tax gap estimates are most likely to involve substantial over-estimation.¹⁶

Formally, it can be shown that the change in tax base resulting from the attempt to achieve full compliance depends directly on the Marshallian price elasticity of demand for the good. To analyse

¹⁶ For the case of tobacco in the UK, the illegality of this lost revenue can be questionable. For example, personal importing of relatively large quantities of tobacco products from other European Union countries is legally allowable at customs ports without paying excise tax provided that the amounts imported could reasonably be considered as for ‘personal use’ (i.e. not for re-sale) in an annual period. In practice for many individuals this allows quantities far in excess of actual personal consumption to be legally imported with the excess subsequently sold illegally without tax being paid, at less than tax-inclusive prices.

this we need only be concerned with the initially non-compliant – since the previously compliant face no change in their price as a result of the increased compliance effort.

Consider the case where compliance effort involves applying the tax rate to the previously untaxed element of the tax base, $(1 - \theta)B^*$. This is the theoretical tax base of the non-compliant which, for an excise, is the quantity of the goods they purchase, labelled B_n^* below. This tax base responds negatively to the newly imposed tax. Define the tax-exclusive price as q and the tax-inclusive price as p , such that $p = q + t$, and $\Delta p = \Delta t$, where $\Delta t = t$ for the previously non-compliant. Tax paid by the previously non-compliant, T_n , when all untaxed goods are subject to tax is therefore given by:

$$T_n = tB_n^* = \left(\frac{t}{p}\right)pB_n^* = t'pB_n^* \quad (11)$$

where t is the excise, t' is the tax-inclusive *ad valorem* rate equivalent of the excise: $t' = t/p$.

Differentiating (11), with respect to the excise, t , the change in tax revenue as a result of imposing the excise on B_n^* is given by:

$$\frac{\Delta T_n}{\Delta t} = B_n^* + t \frac{\Delta B_n^*}{\Delta t} \quad (12)$$

However, since $\Delta t = \Delta p$; and defining the price elasticity of demand by the non-compliant, for a discrete change in price, as $\varepsilon = \left(\frac{\Delta B_n^*}{\Delta p}\right)\left(\frac{p}{B_n^*}\right)$, (12) can be re-arranged to give:¹⁷

$$\frac{\Delta T_n}{\Delta t} = B_n^* + B_n^* \left(\frac{t}{p}\right) \left\{ \frac{p \Delta B_n^*}{B_n^* \Delta p} \right\} = B_n^* [1 + t' \varepsilon] \quad (13)$$

In (13), the ‘mechanical’ effect’ of levying the excise on the non-compliant is given by B_n^* and the ‘behavioural effect’ is given by $B_n^* t' \varepsilon$, which is negative if $\varepsilon < 0$. The mechanical effect is, of course, the only element captured by the traditional tax gap measure. Also, from our definition of $B_n^* = (1 - \theta)B^*$, both the behavioural and mechanical responses are larger the greater the initial degree of non-compliance, $(1 - \theta)$.

It can be seen from (13) that if $\varepsilon = 0$, then there is no behavioural response, such that $\frac{\Delta T_n}{\Delta t} = B_n^*$. At the other extreme, $\frac{\Delta T_n}{\Delta t} = 0$, if $t' \varepsilon = -1$; that is, $\varepsilon = -1/t'$. This latter expression captures the condition under which enforcement of the tax rate on the non-compliant yields no additional tax revenue; that is, the negative behavioural effect exactly cancels out the mechanical effect. At higher

¹⁷ For simplicity of exposition we treat this price elasticity as common across all (non-compliant) taxpayers.

tax rates, or larger tax increases, this occurs at a lower (absolute) price elasticity. For example, at $t' = 0.25$ the critical value of ε is $\varepsilon = -4$, whereas when $t' = 0.5$ the critical value falls to $\varepsilon = -2$. Conventional tax gap measures, *ceteris paribus*, are therefore more likely to overestimate potential additional revenue for goods with high tax rates, such as those with large excises (fuel, alcohol, tobacco). Where these goods have low price elasticities of demand, this will serve to counteract the above *ceteris paribus* effect of high tax rates.

In each of these cases, however, the conventional tax gap will appear to have been eliminated – there are no longer any tax-free goods. From our general definition of the tax gap earlier, we can specify it in this case as: $G^* = T_n^* - T_n$. But, as shown in (11), the imposition of the tax rate on the non-compliant yields actual tax revenue from them of $T_n = tB_n^*$ which is equal to their theoretical tax liability, T_n^* . However, whereas B_n^* is unchanged in the case of $\varepsilon = 0$, it is reduced to zero when $\varepsilon = -1/t'$.

4. Concluding remarks

Measures of ‘tax gaps’ – the difference between actual tax collected and the potential tax collection under full compliance with the tax code – have become the primary measures, used by revenue agencies, of tax non-compliance via (legal) avoidance and/or (illegal) evasion. This article has argued, however, that the tax gap as conventionally defined is flawed because it fails to capture behavioural responses by taxpayers. This is despite the fact that tax gap estimates are frequently used to motivate compliance efforts by revenue agencies that seek to elicit behavioural responses (of a different sort) from taxpayers.

In essence, an improvement in taxpayer compliance implies an increase in those taxpayers’ effective marginal tax rates which, in turn, can be expected to induce a reduction in the relevant tax base. This may involve a loss of total tax revenue and/or a switching of the relevant tax base towards those that face lower effective tax rates, such as when personal taxpayers incorporate in response to personal marginal income tax rates in excess of corporate rates.

These tax base responses are not immutable but rather are a function of the tax code and the legal and policy parameters that represent the complete tax ‘system’. For example, the ability of taxpayers to switch between different taxes in order to reduce their tax liabilities, is partly determined by the

legal rules, administrative costs, policy choices, etc. associated with the existing tax regimes. To reduce behavioural responses, changing these ‘rules’ may be a better approach to raising compliance than seeking to reduce the tax gap associated with the existing regime.¹⁸

We have shown that tax gap measures both for indirect taxes (such as the ‘VAT-gap’) and direct (income) taxes, in the presence of behavioural responses, exaggerate the degree of collectable ‘missing revenue’. Conventional tax gap measures are often used to motivate reforms designed to increase the tax compliance rate and realise the missing revenue. However, where these efforts to reduce non-compliance are successful, in the sense of reducing the tax gap towards zero, this would be expected to be associated with a lower tax base and lower total revenues from the tax than the *ex ante* tax gap estimate implies. In short, some of the ‘missing revenue’ is not recoverable and essentially non-existent! This is not merely a case of the ‘last dollar’ of missing revenue being impossible to collect (as is well-recognised), but rather that a *fraction* of *all* so-called missing revenue may be impossible to collect.

Finally, it might reasonably be objected that the alternative tax gap measure proposed here requires information on behavioural responses that are not available or are not sufficiently reliable. However, where there is a high probability that behavioural responses to compliance improvement exist, adopting an assumption of zero response is clearly a biased ‘central estimate’. Even a low assumed value of a behavioural response elasticity would improve tax gap accuracy than the conventional approach. Uncertainties around this estimate might also serve to highlight the more general uncertainties surrounding the methods and magnitude of *all* tax gap estimates. In particular, the conventional measure can give the spurious impression of accuracy because it appears to be based more on ‘known’ data, such as the currently observed tax base, to project a full-compliance equivalent.

¹⁸ This alternative approach is referred to by IMF (2013a) as changing the ‘policy gap’ as opposed to changing the ‘compliance gap’.

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Figure 1: Comparing Tax Gap Measures

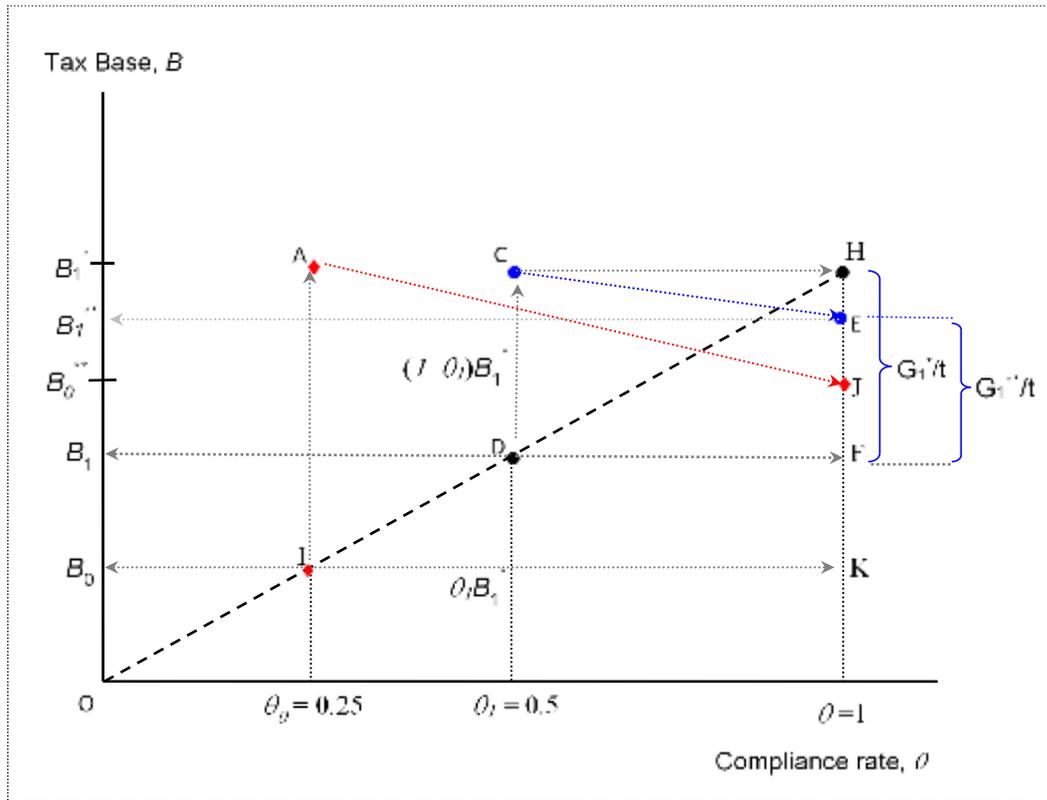


Figure 2A: The Tax Revenue – Tax Base ‘Laffer Curve’

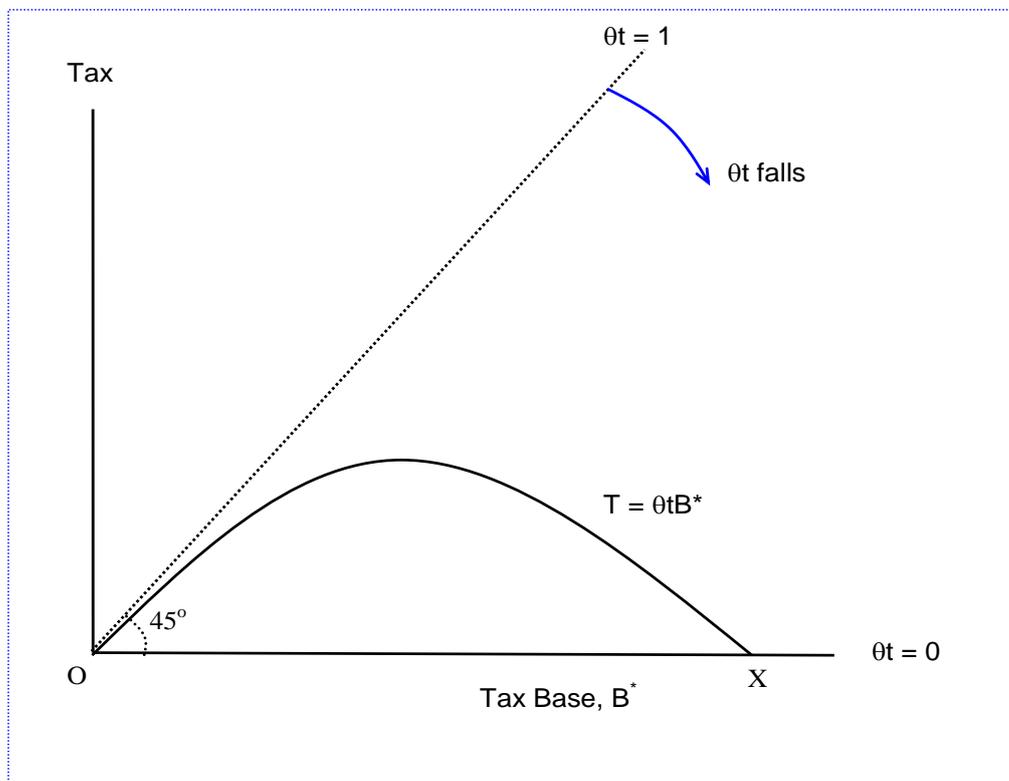
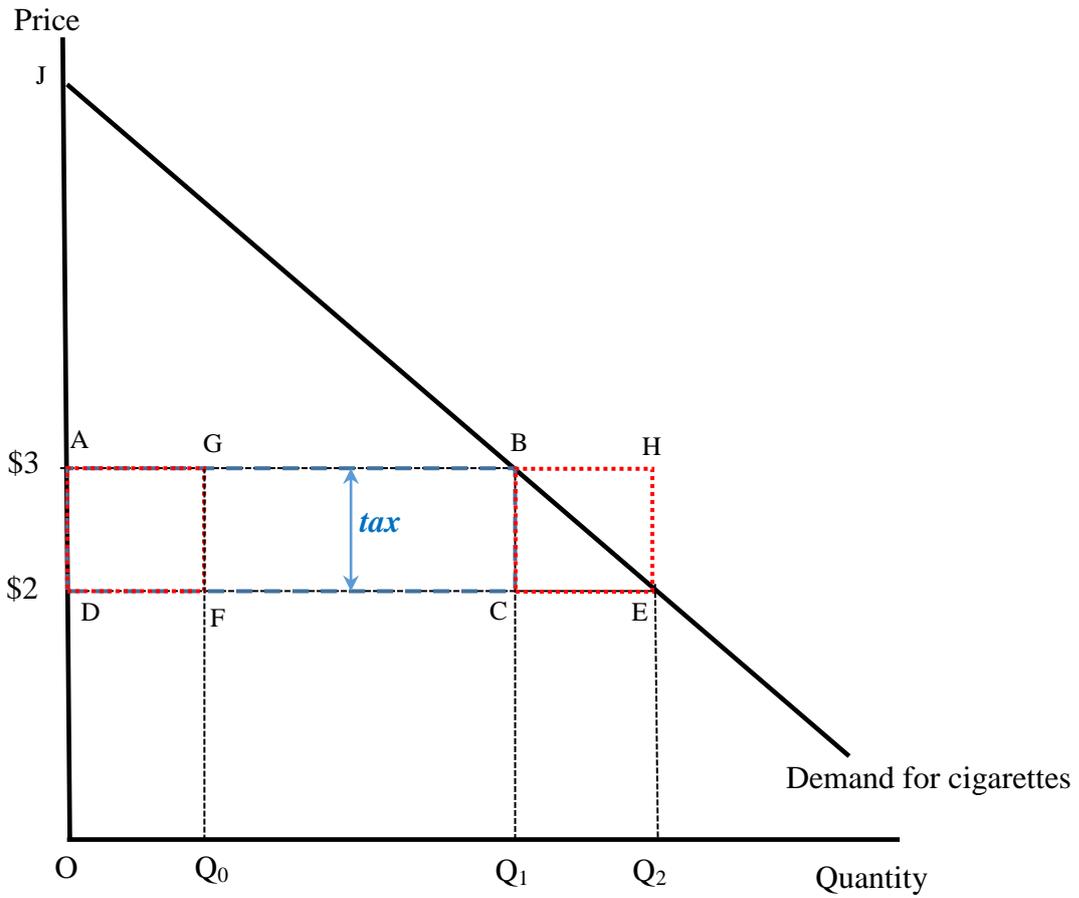


Figure 3: Indirect Tax Gaps and Cigarette Taxation



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