The Tax Gap: A Methodological Review

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ABSTRACT

The global economic crisis has highlighted the continuing problem of tax evasion. For tax agencies to respond, an important antecedent necessitates knowing the extent of the problem. This study is the first to comprehensively review recent research on the tax gap. Our primary contributions are two-fold. First we argue that the tax gap, as conventionally defined, is conceptually flawed because it fails to capture behavioral responses by taxpayers adequately. Our second contribution is to review methods for measuring the tax gap and compare empirical estimates. We suggest that many of the most trenchant criticisms of conventional tax gap measurement (and the 'hidden economy' measures that underlie them) leave only microdata-based measures of tax non-compliance as likely to deliver more reliable tax gap estimates. Even here, however, further work is required, on both conceptual and empirical aspects, before tax gaps suitable for policy analysis (e.g. implications for enforcement policy) are likely to be delivered.

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INTRODUCTION

Tax evasion is both pervasive and endemic. Following renewed international interest in the problem by policy makers such as the OECD, this study reviews the literature on the measurement of the tax gap. The 'tax gap' – broadly, the difference between tax revenues collected and those that would be theoretically expected to be collected in the absence of any evasion or late payment – are increasingly popular as a means of assessing the degree of success with which a particular tax or tax system is implemented. They have also been proposed as possible performance indicators for tax collection agencies.

Once a theoretical tax base is established, a tax gap can, in principle, be calculated. The methods used to date relate to measures of the 'hidden economy' or 'hidden income'. As this study demonstrates, almost all of the methods proposed or implemented have been subjected to severe criticisms and they ignore any consideration of behavioral response.

The remainder of this paper is structured as follows. The next section outlines some definitional issues and highlights some conceptual problems with existing approaches. It also documents tax gap work conducted by the IRS (Internal Revenue Service) in the U.S. In the third section we examine issues concerning measurement of the tax gap, reviewing methodological issues, and reporting evidence from empirical studies of the size of the tax gap or the hidden economy. Much of this literature does not distinguish the separate contributions of different taxes within overall tax gap estimates. Sections four and five respectively provide discussion and concluding remarks.

DEFINITIONS, CONCEPTUAL ISSUES, AND THE U.S. TAX GAP

There are several possible definitions of the tax gap. Most have been developed within tax agencies to capture the aggregate tax revenue (for a specific tax or tax system) lost through non-compliance. 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".*[1]

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).

Other definitions of the tax gap found in the literature include those employed by, for example, Giles (1997b; 1999b), 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 authorities 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 taxpayers' behavioral responses.[2]

For example, an extra dollar raised in tax revenue may not always reduce the tax gap by a dollar. The condition of a 10% improvement in compliance (say, from 0.8 to 0.88) producing a 10% increase in tax revenues is achieved only if the theoretical tax base is unaffected by changes in the tax rate or changes in the proportion of income hidden from taxation. In fact it is likely that greater compliance success and/or higher tax rates which raise the taxpayer's effective tax rate would serve to *reduce* the total tax base (as distinct from changes which affect only the extent to which the tax base is *hidden*).[3]

The U.S. Tax Gap

The U.S. has by far the most extensive record, of any country, of tax gap measurement. The Taxpayer Compliance Measurement Program (TCMP) was used by the IRS to distinguish statistically between compliers and non-compliers for risk assessment purposes. It involved detailed line-by-line audits of all types of tax returns conducted on a periodic basis (the

'Individuals file' contained around 50,000 cases, the 'Corporates file' contained around 33,000 cases). TCMP audits were conducted from 1963 until 1988 when they were suspended as public officials believed the burden on taxpayers imposed by the random audits outweighed the benefits derived from the TCMP.

TCMP audits were used to measure the difference between reported taxes and taxes owed for randomly selected taxpayer samples. This information was then extrapolated to the entire population of taxpayers using the sample weights associated with each stratum of the sample (Ricketts, 1992). Thus, measures of the U.S. tax gap became commonly reported. The IRS also made TCMP data available for research projects which, in the opinion of the IRS, had the greatest potential contribution to the IRS and the community. Several of these studies were then published in the U.S. economics and tax literature; for a review, see Andreoni et al. (1998).

To overcome the burden of TCMP, the IRS in 2000 devised the NRP (Brown and Mazur, 2003), the first phase of which was completed in 2005. Under NRP, compliance data was gathered from 46,000 randomly selected individual taxpayers (with an over-sampling of high income returns). NRP first classifies each return using a group of experienced auditors to identify likely issues. Then using available information documents, classifiers categorise returns as "accepted as filed", or for a "face-to-face" audit or a "correspondence" audit. Line-by-line audits were performed on a "calibration" sample of 1,600 audits and, using comparisons between the calibration and non-calibration samples, the IRS was able to determine the efficacy of the classification process.

In 2006 revised estimates of the 2001 tax gap were released by the IRS showing an overall compliance rate of 83.7% (Bloomquist, 2006; Mazur and Plumley, 2007). Then in 2012, the IRS released estimates of the 2006 tax gap (shown in Figure 1). With 2001 figures in parentheses, the latest estimate of the gross tax gap is $450 billion ($345 billion) with a virtually unchanged overall non-compliance rate of 16.9 percent (16.3 percent). IRS enforcement activities and other late payments recover about $65 billion leaving a net direct tax gap of $385 billion ($290 billion in 2001).

The three key characteristics of the U.S. tax gap estimates are as follows:

i. Over 75% of the net tax gap is attributable to the individual income tax which is the largest single source of Federal receipts.

ii. Over 80% of the gross tax gap ($376 billion) is from underreporting (i.e. income underreporting and overstating deductions/credits) with roughly half this amount (including self-employment tax) attributable to underreporting of net business income by individuals. Around 16% of the gross tax gap is attributable to underpayments of taxes or failure to file returns.

iii. Non-compliance is highest among taxpayers whose income is not subject to third-party information reporting or withholding requirements.

Both TCMP and NRP audits did not account well for three types of compliance: (1) under-reported informal supplier income, (2) under-reported tip income; and (3) general under-reported income not subject to third party information reporting (Alm and Erard, 2005) and Plumley (2005) outlines how the IRS corrected these three areas.

With the IRS work at the federal level, several U.S. states have 'piggybacked' and calculated their own tax gaps. California's annual income tax gap is estimated at $6.5 billion (12.4% of the $52.6 billion personal and corporate income taxes collected) and is based in part upon estimates from the federal gap (Legislative Analyst's Office, 2005). Minnesota Revenue (2004) conducted a study on 1999 data and found that 88% of individuals voluntarily filed and that the direct tax gap (10.5%) of $604 million was comprised of $124 million (21%) for Non-filers and $479 million (79%) for Underreporting by Filers. Almost all of the $479 million of underreporting was attributed to non-wage income. Finally, in a similar manner to Minnesota, the New York State Department of Taxation and Finance (2005) undertook a personal income tax compliance baseline study using 2002 data and estimated a direct tax gap (13.9%) of $2,838 million, comprised of $516 million (18%) for Non-filers and $2,322 million (82%) for

Underreporting by Filers. The reports from these two states show relatively consistent results using similar methodologies.

The IRS compliance measurement program involves large costs and the outputs are subject to time delays i.e. the 2006 estimates became available in 2012 (Mazur and Plumley, 2007). Thus, in most other OECD countries, there has hitherto been reluctance among tax agencies to enter into large-scale random audit programs intended to provide an overall measure of the tax gap. Conversely, many countries, e.g. Australia, do use random audit programs on a more limited basis to assess compliance and trends in specific areas of tax risk.

In sum, apart from the U.S. federal approach, there are few official country studies of tax gaps (see Table 2). Rather the approach has been to estimate other concepts such as the 'hidden' economy, from which overall tax gaps are then sometimes derived. The issues in these studies are relevant here however, and are now analysed.

MEASUREMENT ISSUES

This section first discusses alternative methods used to measure the 'conventional' tax gap (defined earlier) or 'hidden income' measures from which tax gaps are obtained. It then discusses some estimates that have been produced for a number of countries using a variety of methods and assesses the merits of these estimates, and finally discusses the role of effective tax rates as tax gap measures.

Much of the academic literature on this subject is concerned with measuring the 'hidden' economy (variously referred to as 'underground', 'shadow', 'informal', 'black', 'grey' etc.) rather than the tax gap *per se*. However, at least when certain approaches to tax gap measurement are followed, measuring the underground economy is a first stage in that process. The methods for measuring the underground economy are therefore considered below alongside direct approaches to tax gap measurement.[4]

Further, most of the literature which focuses on tax gap measurement via measurement of the hidden economy does not distinguish between types of taxes. Typically both conceptual and

empirical tax gap measures of this sort are designed to identify total missing tax revenues. In some – but relatively few – cases, this is broken down by tax type including corporate and/or personal income taxes. There is very little literature on tax gap measurement for other direct taxes, such as stamp duties, wealth taxes, property taxes etc.

A number of different approaches have been advocated to measure the tax gap or hidden economy. To measure a direct tax gap requires accurate measures of both direct tax actually collected and the theoretical (hypothetical) tax collection that would result if all direct tax liabilities were fully identified and enforced.

To identify the theoretical tax liability requires *either*

(a) an accurate measure of the full extent of tax non-compliance, including the revenue loss associated with late payment; *or:*

(b) an independent estimate of the direct tax base (e.g. from a source outside the fiscal authority) *and* an accurate estimate of the appropriate average tax rate that would be applicable to that tax base were it to be realized.

Where (b) is adopted, prior research, discussed later, tends to forget that accurate estimation of the appropriate tax rate is just as important as getting estimates of the theoretical tax base. This tax rate is likely to differ depending on the nature of the hidden income, profits etc. For example, not all income identified by some measures as 'hidden', is taxable. This applies to household production (unpaid housework, child rearing etc.) which is included in some measures of the hidden economy. Similarly some illegal activity is excluded from some hidden economy measures but is potentially taxable when identified.

Clearly the characteristics of the income or profit earner are also important in deciding the appropriate tax rate to apply to any hidden income. For example, in the U.S. if most tax evasion was by high earners the appropriate income tax rate on any hidden income is likely to be around 35%, whereas if most evasion is by low earners the appropriate tax rate may be 10% or even 0%. In the case of corporate income the effective marginal tax rate could vary widely across taxpayers, depending on legitimate deductions available to offset the corporate tax liability.

Alternative Hidden Economy and Tax Gap Measures

The literature on hidden economy / tax gap measurement can be categorized into those that use:

(A) micro approaches, based on taxpayer data or surveys to identify the extent of tax non-compliance or undeclared income; and

(B) macro approaches, which generally estimate the size of the hidden economy.

[Insert Table 1 about here]

In the macro approaches, the identified 'missing income' is usually assumed to be taxable, but most studies do not take the next step of calculating the tax gap. Those that do (e.g. Giles, 1999b), make simple assumptions, of unknown accuracy, about the relevant tax rate to apply.

Micro Methods

In Table 1, micro methods (i) and (ii) are 'direct' in the sense that they seek to measure missing tax or taxpayer income based on samples of individual taxpayers. From these, some form of 'grossing-up' exercise allows total missing tax or income, across all taxpayers, to be estimated. This is the method used by the IRS, described in the preceding section. It requires randomized survey or audit methods to select taxpayers and sufficiently large samples, otherwise the grossing up exercise will be biased. Unfortunately, identifying the required sample size is difficult and, without additional independent sources of information, it is very difficult to determine how representative the selected samples are. Alternatively if risk-based criteria are used to select samples of taxpayers for assessment of non-compliance, suitable 'grossing factors' must be identified before the extent of non-compliance across all taxpayers can be identified. Since these methods have been described in the preceding section they will not be discussed further here, but some criticisms of their application in the U.S. are discussed in a further sub-section below.

Discrepancy Methods

Methods (iii) and (iv) are 'discrepancy methods'. That is, they estimate the tax gap – or more usually the hidden economy – based on the difference between a reported income measure and an

independent measure of income that is believed to include hidden income. In practice these latter measures are likely only to capture a fraction of total hidden income. Discrepancy methods can either compare two national accounting type measures of the economy, independent of fiscal data, or can compare aggregates based on fiscal data with alternative, independently collected aggregates (as occurs with the Value Added Tax gap in the U.K.).

For income estimates from which a personal or corporate tax gap may be estimated, this is more difficult for a number of reasons. Firstly, comparisons of national income derived from the income and expenditure methods are often used to measure hidden income. This generally uses the balancing item, required to reconcile estimates from the two methods, to infer information about the size of the hidden economy.

While the two ways of measuring national income likely differ in the extent to which they capture hidden economic activities, the balancing item can be expected to be influenced by numerous other factors so that, at best, only crude estimates of the size or growth of hidden (and taxable) income can be expected from this method. In particular, year to year changes in these types of measures are likely to have much more to do with measurement error and other factors affecting the data series than genuine changes in the extent of hidden income (Breusch, 2005a; 2005b; 2005c).

In addition, national income estimates sometimes rely on income data provided by the fiscal authorities so that comparisons with fiscal income data are not valid. In the UK, for example, National Account data on corporate profits are derived, in part, by adjusting tax agency sourced taxable profit data. As a result the two data series cannot be used to measure 'hidden profits', potentially liable to corporation tax. For examples and critiques of this method, see McAfee (1980), Tanzi (1983), O'Higgins (1989), Thomas (1999).

Single Indicator Methods

Method (v) generally assumes that there is a direct link between the size of hidden income (or reported plus hidden) and some other variable, such as the amount of cash in the economy. Using

the level of, or trend in, this latter variable to proxy the level or growth of hidden/total income allows this to be compared with reported income levels or growth.

Two major weaknesses of this approach are:

1. To identify (or 'anchor') the *size* of hidden income at any point in time requires either that there was no hidden income at some point or the relationship of hidden income to the proxy variable is known for at least one year.

2. The change over time in the proxy variable is *entirely* due to changes in hidden income.

Consider, for example, currency demand models (e.g. Tanzi, 1983) where the idea is to relate the amount of currency in circulation in the economy to various determining factors including the size of the economy (GDP), payment methods, interest rates etc. Any residual currency, unexplained by those variables, is then typically regarded as due to hidden economy transactions (which are assumed to be in cash). This residual is then related to variables such as the tax burden for different types of tax, government regulations etc. to identify factors that contribute to the hidden economy. Clearly if the growth of the hidden economy is measured by the movement over time in this 'residual' currency (or the part explained by the hidden economy proxies) then all other potential contributors to the residual are ignored.

However, by the nature of regression methods, the time-series of residuals has a zero mean which would imply that the hidden economy is negative in some years (which has no meaning!) and is positive in others. So, most such methods rely on some other observation 'anchoring' the hidden economy's size for a particular year and then using the time series of residuals to chart year-to-year changes.

Multiple Indicator Methods

Method (vi) in Table 1, 'multiple indicators, multiple causes' (MIMIC) models, are similar to method (v) but the hidden economy (though unobservable) is assumed to be capable of being partially captured by at least two 'indicators' (e.g. currency and GDP levels) and to be associated with two or more causal variables (e.g. tax rates, business or labour market regulations). As shown in Figure 2, the basic method is to treat the hidden economy as a latent (unobservable)

variable and estimate a set of parameters (the αs and βs in Figure 2) that relate the latent variable to the 'causes' and 'indicators' respectively.[5]

Applying MIMIC models to hidden economy or tax gap measurement has become increasingly popular in recent years with applications across many developed and developing countries; e.g. Giles (1997b; 1999b; Giles and Tedds, 2002b), Bajada and Schneider (2005), Schneider (2006) etc. Breusch (2005b) argues that applications of latent variables models are most appropriate for psychometric studies where, for example, individuals' "intelligence" may be unobservable but can be 'indicated' by various test scores and 'caused' by a variety of factors such as genetics, parental and social backgrounds etc.

Applied to hidden economy or tax gap measurement MIMIC models have the advantage over single indicator methods that they allow several indicators of the hidden economy to be used simultaneously and a similarly large number of potential causes. However, they suffer from the same defects as the single indicator methods outlined above: namely problems of 'anchoring' and attributing all trend growth in the resulting latent variable to the hidden economy.

Figure 3 illustrates Bajada and Schneider's (2005) application of MIMIC models to Australia. Notice that there are just two indicator variables (on the right), the parameters for which have been obtained by setting the value of one of them to 1.0. The parameters on the variables on the left-hand-side indicate the relative sizes, and statistical significance, of variables hypothesized to influence the latent variable (i.e. the 'shadow economy'). Figure 3 shows the left-hand-side variables are mostly tax- or welfare benefit-related, reflecting the authors' hypothesis that government intervention is the main measurable determinant of the hidden economy.

[Insert Figures 2 and 3 about here]

However, as Breusch (2005a, 2005b, 2005c) shows in a series of trenchant and devastating criticisms of these MIMIC applications, the estimated parameters in such models cannot identify the absolute size of the hidden economy, merely (at best) its relative size in each year. In addition he shows that, of the so-called 'causal' variables, typically only one drives almost all of the time-series variation in the latent variable. Thus, criticising Giles and Tedds'

(2002b) study of Canada, Breusch (2005a) shows that the "dominant 'cause' of the underground economy comes from price inflation". A further substantial part of the explanation derives from "movement in concert with the general expansion of the Canadian economy as measured by real GDP". That is, the factors that the original authors claimed to be key, such as tax burden variables or the growth of self-employment, turn out to be marginal or almost redundant in determining the estimated hidden economy index (the latent variable).

For the Australian case, a similar outcome can be seen from the parameter estimate for disposable income (Figure 3), which is much larger than the other tax/benefit related 'causes'. Similarly, the parameter estimate for the GDP indicator is almost three times that on the currency indicator even though it is the latter that might be expected to better represent hidden income.

Finally, Breusch demonstrates that the estimated size of the hidden economy 'index' is sensitive to the units of measurement of the causal and indicator variables (e.g. whether they are measured in absolute currency millions, billions etc.; in proportions, or percentages of GDP, etc.). This latter characteristic means that these methods cannot provide any estimate of the absolute size of the hidden economy, even though various authors continue to do so. Discussing Bajada's (1999, 2003) estimate of the size of the hidden economy in Australia, at 15%, for example, Breusch (2005c, p.394) concludes that "a key parameter is set to an unrealistic value that makes the estimates many times too high".

In addition, as the New Zealand and Canadian applications demonstrate (Giles, 1999b; Giles and Tedds 2002a, 2002b), the determination of the hidden economy index by one or two macroeconomic variables means that there is typically a long-term upward trend in the estimated size of the hidden economy or tax gap index. (This occurs despite the removal in some cases of the non-stationary properties in the original data). The authors then interpret this upward trend as evidence of an inexorably growing hidden economy, or tax gap, over time. In fact, it likely has more to do with the fact that real and nominal GDP, or currency demand and GDP, grow at different rates over the long-term. These may or may not be related to what is happening to the

size of the hidden economy in reality, but the measured index certainly cannot be relied on to capture the growth of that hidden economy accurately.

Estimates

As might be inferred from the above review (and our assessment in a sub-section below), it is our view that all the estimates of tax gaps, total tax gaps or hidden economy measures are subject to measurement error. They are often measuring quite different things yet definitions of the variable of interest can frequently be vague. Not surprisingly therefore, the estimates that we summarise in Table 2 from a variety of studies across several countries, reveal a wide range of values. Schneider (2006) reports hidden economy sizes for 145 countries, using MIMIC methods (which we do not attempt to summarize here).

Panel A of the Table 2 (adapted from Cebula and Paul, 2000) reports an assortment of estimates for the U.S. hidden economy in different years, and IRS tax gap estimates. From even a cursory glance it is clear that annual estimates can vary considerably over a short period of time. Panel B summarizes evidence for a number of countries based on results from a variety of methods.

[Insert Table 2 about here]

Assessment

In an earlier section we argued that conventional definitions of the tax gap are misleading because they omit behavioral responses. The conventional tax gap will therefore be an inaccurate estimate of the 'true' tax gap to the extent of these responses. Even ignoring this, assessing the reliability of conventional tax gap estimates (or the hidden economy estimates that underlie them), is difficult, not least because the various reported measures capture quite different things yet definitions of the variable of interest are often vague. In addition, measurement errors are generally of unknown magnitude, but are likely to be large in most cases; and may vary considerably, even within the same study.

As a result, a shift in a tax gap index of, say, 10% from one year to another (e.g. from 1.0 to 1.1), might be dominated by margins of error of, say, 30% around each estimate. Authors of

hidden economy or tax gap estimates almost never provide this kind of information, which would allow judgments to be made about the reliability of the estimates produced.

Nevertheless, from what we know about the sources of data used to produce tax gap estimates, the quality of the methods adopted, the potential for error within methods and non-comparability across them, we posit that in many cases the margins of error associated with individual estimates are just too big for these methods to form a reliable guide to year-to-year changes in tax compliance or 'tax gaps'.

In support of our contention, the absolute size of the hidden economy or tax gap estimates in any one year also appears to be subject to large margins of error. This is perhaps most evident in the case of Australian evidence, where the Australian Bureau of Statistics (ABS) estimates the hidden economy around 2% with a maximum of 4.8%, whereas Bajada (1999, 2003) claims it is around 15%. The ABS used national accounting data/methods while Bajada used MIMIC modelling.

Because most tax gap estimates are based on macro variables, which typically involve estimates of the hidden economy, they are conducted at a high level of aggregation. Thus, even if they could be measured with much smaller errors, they are unlikely ever to provide accurate indices of income tax gaps. Further, the criticisms of MIMIC methods by Breusch serve to highlight the non-robustness of this, increasingly popular but misguided, method of estimating the size of the hidden economy or tax gaps.

This leaves the use of taxpayer compliance-based measures as the most likely to yield estimates that can be associated with taxpayers' direct tax liabilities. However the problems with these are essentially two-fold: Firstly, as the IRS's experience demonstrates, these can be very resource-intensive both for fiscal authorities, and in terms of taxpayers' compliance costs. Secondly, as section two argued, at best they allow some estimate of the unpaid tax on a tax base that is grossed-up from small observed taxpayer samples, typically without any allowance for the likely behavioral responses by those taxpayers.

As an example, imagine that the IRS was able to levy all of the tax that would be legally liable on companies were all of their tax avoidance and evasion activities to be detected and rendered taxable. This would raise the effective tax rate on those companies and would serve as a signal to all companies that corporation tax was being more rigidly enforced in the U.S. In these circumstances a (possibly large) fraction of the US corporate tax base would shift to lower tax jurisdictions. To the extent that this happens such measures of the tax gap would indicate a reduced (or even eliminated) tax gap, but only because a large potential tax base has disappeared. Interestingly the U.S. Treasury Inspector General for Tax Administration (TIGTA, 2009) noted that the IRS has not yet developed an estimate for the international tax gap. Further, after reviewing and assessing the recent IRS improvements to its tax gap measurement the Inspector General (TIGTA, 2006, p. 2) concluded:

"Our analysis focused on whether there was sufficient, complete, and accurate information to determine whether the composite tax gap projections are reliable. We concluded that ... the IRS still does not have sufficient information to completely and accurately assess the overall tax gap"

Effective Tax Rates and the Tax Gap

It is often noted that different companies appear to have quite different effective (average) tax rates (ETRs – tax paid as a percentage of total profits) despite a common federal rate schedule. This is sometimes taken as an indicator of 'missing' tax. However ETRs can vary across companies for many legitimate reasons. For example, a company may be carrying forward large losses from previous periods or its profits may be largely made overseas. Any of these conditions may qualify the company for relief under the tax code and so reduce its liability. Simply observing cross-company differences in ETRs therefore says little about the amount of tax avoided.

Nevertheless, given concerns about possible effects of tax avoidance on company ETRs, these have been the subject to significant research effort since the mid-1980s. This was initially associated with a series of reports by the lobby group Citizens for Tax Justice who campaigned

that the largest U.S. multinationals were paying less than their fair share of taxes (e.g. see www.ctj.org/corpfed04pr.pdf). Accordingly empirical research focused on whether there was a link between ETRs and firm size (e.g. Callihan, 1994).

Following this strand of research (which has yielded conflicting findings), researchers also tested for associations with other characteristics such as capital intensity, leverage, industry membership as well as the influence of tax preferences (Gupta and Newberry, 1997). Difficulties with this research include the absence of a consistent and accepted underlying definition, as well as access to revenue authority data (Harris and Feeny, 2003). In addition, to the extent that research confirms 'size' or other effects on ETRs, these could reflect a number of factors unrelated to avoidance.

Nevertheless, where companies find mechanisms of questionable legitimacy by which to reduce their tax liability, clearly this 'tax avoidance' can reduce their ETR. The crucial question for tax gap measurement is whether this 'avoidance' is deemed to be legitimate tax planning or tax evasion; if indeed it is identified and challenged at all by the tax authority. If a company has successfully hidden the full extent of its true taxable income, its ETR will be lower and for this reason, where ETRs are observed to vary across companies and sectors of the economy, they may provide a useful risk assessment tool for company tax evasion/avoidance. However, since many factors contribute to these ETR differences, aggregating them across companies or sectors to get a measure of the aggregate tax gap would not be legitimate.

It follows that, for the same reasons, using ETRs as performance measures of tax inspectors, or tax agencies more widely, would not be appropriate. ETRs *may* vary depending in part on the effort expended by the tax authorities in raising revenue; indeed it would be surprising if devoting additional resources to tax compliance did not yield some additional revenue. However, this is likely to be only one, perhaps small, contributory factor to the size of company or sectoral ETRs. The IRS does not use ETRs as performance measures; to do so would risk penalizing or rewarding a tax agency for ETR changes beyond their control, and/or failure to penalise/reward them for changes they do induce.

DISCUSSION

This review suggests that there are few, if any, reliable methods of measuring direct tax gaps as conventionally defined. All macro methods involve estimating the aggregate 'hidden' or 'shadow' economy to get a measure of hidden income. The methods used for this have been the subject of intense debate and much criticism. In addition, the failure of conventional approaches to incorporate behavioral responses by taxpayers when estimating 'theoretical tax liabilities', raises questions over the reliability of most tax gap estimates.

The areas that seem likely to deliver most progress in achieving more reliable tax gaps estimates, in our view, are the following.

(i)   Assessing the implications of the existing literature on taxpayers' behavioral responses, both to changes in statutory tax rates and the extent of compliance enforcement.

(ii)   Where necessary, use the lessons from this literature to develop estimates of the relevant behavioral responses.

(iii)   Focus research on micro methods and data which measure taxpayer non-compliance directly.

(iv)   Consider carefully the appropriate tax rates to apply to tax bases when these are shown to evade current tax.

On (i) and (ii), there is already a considerable, and expanding, literature on taxpayers' behavioral responses to a number of taxes e.g. Feldstein (1995, 1999); Slemrod (2001a, 2001b). In addition an extensive literature on the Laffer curve has sought to assess how far this particular construct captures behavioral responses. For a review and estimates using various datasets, see Goolsbee (1999).

On (iii), micro methods based on grossing-up from taxpayer compliance data seem the most likely to deliver suitable direct tax gap measures. Of the two methods used – taxpayer surveys and random audits – the latter is clearly the most accurate but also the most costly. For

this reason, even the IRS which devotes considerable resources to its random enquiries program, has not devoted the kind of resources required to produce reliable aggregate tax gap estimates.

The main problem to be overcome with current survey methods is the unreliability of revealed responses by participants. For example, Feige (1990) reports the outcome of the use of randomized response techniques to assess misreporting by respondents to an IRS taxpayer opinion survey on tax evasion. Thus, using "*both direct questions (with assurances of anonymity) and a randomized response technique, revealed that the randomized response yielded evasion estimates between 62% and 433% higher on some questions than the direct question approach.*" (Feige, 1990, p. 994).[6] Clearly these margins of error are too large to allow much credibility to be attached to any individual survey result.

Taxpayer audits therefore appear to provide the most reliable evidence on potentially taxable income (either personal or corporate) that has escaped taxation. They also yield a more direct measure of the tax gap, because the question of the appropriate tax rate to apply to the hidden income is more readily dealt with. Clearly, the reliability of grossing-up is an issue that requires further research, since this depends on how representative are the samples examined. Random, or stratified random, sampling provides the best option but often relatively large (i.e. costly) samples are required to guarantee they are representative.

An area of literature that deserves further attention is the extent to which tax compliance data from risk-based enquiries/audits could be used for tax gap measurement. Though more difficult to gross-up than random enquiry data, risk-based enquiry data are more readily available and tend to generate less resistance from taxpayers (who typically expect the most likely offenders to be targeted). The key research issue here is to identify how readily missing tax data from risk-based audits can be generalised to the less risky taxpayer segments. This is an area where assessing the merits of the academic literature on non-random sampling could be valuable, and where careful analysis of risk measures used by tax authorities could yield progress on tax gap measurement.

The main constraint on this progress at present is that tax agencies rarely have sufficient resources to devote to this kind of research, whilst academics – who tend to have a comparative advantage in this area – are not routinely allowed access to the necessary data. Research in the U.S. by, for example, Feinstein (1991), Feldstein (1995, 1999) and Slemrod (2001a) suggests that with greater access by researchers to (suitably anonymized) taxpayer data, it may well be that much greater progress towards a more reliable taxpayer audit-based tax gap measure could be made.

Finally, on (iv) above – measuring tax rates correctly – existing research is limited on the issue of whether income that currently evades tax could be taxed at the same rate as declared income, when the non-declared income is identified. Most hidden income, when it is identified is likely to be eligible for a number of tax deductions, depending on the form of the income and the type of taxpayer. Even where taxpayers do not make real behavioral changes in response to a tax agency's compliance efforts, they often respond by legitimately changing the ways in which their income or deductions are recorded for tax purposes. This suggests that the expected tax rate applicable to previously undeclared income could be quite different from that applied to initially declared income. For example, when some previously hidden self-employed income is discovered, it may become preferable (i.e. tax minimizing) to incorporate in order to qualify for corporate tax deductions not available to the self-employed. That is, though it may not have been worth incurring the costs of incorporation so long as the self-employment income remained hidden, it becomes worthwhile when the income is revealed. As a result the taxpayer's marginal tax rate is lower than that observed for previously declared income. This sort of response is not necessarily revealed directly by taxpayer audits since it may occur in future tax years as an indirect consequence of the audit. Further effects may arise if non-audited taxpayers learn from observing the behavior of those audited.

CONCLUDING REMARKS

To conclude, we argue that all of the 'conventional' estimates of the tax gap are likely to be unreliable because they ignore behavioral responses that could be large in some cases. Even ignoring this problem (as prior literature does), essentially there is only one method for calculating tax gaps for direct taxes, *directly*; that is, to use taxpayer compliance data per the IRS's approach. All other methods rely on estimating 'hidden income', or the 'hidden economy', via macroeconomic aggregates of various sorts. This latter method is also generally not capable of identifying specific tax gaps for *direct* taxes but only for taxes in aggregate. For indirect taxes such as VAT, data are often collected independently of the tax collection agency (such as household expenditure surveys) against which tax agency-sourced data can be compared. Even here however, potential inconsistencies in collection methods and definitions, suggests caution with regard to the margins of error in indirect tax gap estimates derived in this way.

For direct taxes, there is often no suitable independent data from which to estimate the theoretical tax liability against which to compare tax agency-sourced data. This is especially true for companies where national accounting data on profits (the tax base for company taxes) are either unsatisfactory – as with operating profit data for the financial sector – or are based on profits data from tax agencies. For personal incomes, survey methods can yield independent estimates for the income tax base to compare with data collected by tax authorities. However, even here there are likely to be margins of error (within each dataset) that suggest caution when comparing them. In addition, it is typically difficult to assess *which* taxes would be levied on the hidden income, were it to be revealed, and the appropriate tax rates that should be applied.

We have also argued that the appropriate size of the theoretical tax base – from which tax gap estimates would be derived - is not independent of the tax system itself. In particular, where the direct tax base is mobile between tax jurisdictions (or between taxes within the same jurisdiction), higher tax rates are likely to cause some out-migration of that base to lower tax jurisdictions (or tax types). As a result, even if the tax authority's ability to collect revenue remained unchanged, a change in tax policy could alter the total potential tax that could be raised, and hence tax gap estimates. These arguments apply equally to changes in tax enforcement.

Hence, greater effort to collect (previously uncollected) taxes from a given tax base raises the effective tax rate that taxpayers face (when these compliance efforts are successful) and hence may cause changes in that tax base in order to legitimately avoid the additional tax liability.

We have summarized our assessment of taxpayer compliance-based methods of calculating tax gaps, in sections three and four. These appear to be the most feasible means of estimating tax gaps, but are still vulnerable to the 'tax base migration' aspects discussed above. The judgment of those who have carefully reviewed the use of these methods in practice, for example in the U.S., is generally that they are highly resource intensive both for tax agencies and for taxpayers (Bloomquist, 2006).

In particular, the most reliable estimates appear to be associated with random taxpayer audits. However, since by definition these audits do not target those taxpayers which risk assessments would suggest are most likely to avoid their tax liabilities, they impose additional compliance costs on many honest taxpayers. This, in itself, could impede attempts to improve taxpayer compliance and reduce the tax gap. Even in the U.S., where tax gap measurement is most advanced, the resulting official estimates are still regarded as unreliable. For this reason, various other countries such as Australia have decided against official tax gap measures both for direct and other taxes.

Estimates that are available from the academic literature tend to confirm the view that, while there probably are observable and measurable variables that are related to 'hidden income' that is not fully taxed, these methods are not sufficiently robust, and input data are insufficiently reliable, to yield tax gap estimates that could be used for tax policy or compliance assessment purposes.

It would seem that it is difficult, if not impossible, both to measure the absolute size of unpaid tax in any one year, and how this changes from year to year. Margins of error around most estimates are not generally reported but are probably sufficiently large to render annual changes in these estimates to be well within likely error bands. Tax gap estimates using taxpayer

compliance data, such as those produced by the IRS, though hopefully more accurate, probably represent a lower bound on missing tax revenue.

Having examined various studies on tax evasion and how this may help to measure 'hard-to-tax' income, Vaillancourt (2004) aptly concludes:

"The relationship between the shadow economy and the percent of compliant income with respect to the individual income tax is not a simple one. In addition, tax compliance with respect to other taxes also needs to be related to the shadow/underground economy. … the answer is a more or less weak relation, which raises at least caution with respect to the use of the size of the underground economy to measure the importance of hard-to-tax income" (p.93).

Finally, while this study has considered the measurement and use of tax gap estimates, we leave it to others with respect to the challenging issue on exactly *how* to reduce the tax gap (e.g. GAO, 2005; 2007, 2012).

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Tax Gap "Map"
Tax Year 2006 ($ billions)

Total Tax Liability $2,660

Tax Paid Voluntarily & Timely: $2,210

| Gross Tax Gap: $450 (Voluntary Compliance Rate = 83.1%) | − | Enforced & Other Late Payments of Tax $65 | = | Net Tax Gap: $385 (Tax Never Collected) (Net Compliance Rate = 85.5%) |

Nonfiling $28

Underreporting $376

Underpayment $46

| Individual Income Tax $25 |
| Corporation Income Tax # |
| Employment Tax # |
| Estate Tax $3 |
| Excise Tax # |

| Individual Income Tax $235 | Corporation Income Tax $67 | Employment Tax $72 | Estate Tax $2 | Excise Tax # |

Non-Business Income $68	Small Corporations (assets < $10m) $19	FICA Tax on Wages $14
Business Income $122	Large Corporations (assets ≥ $10m) $48	Self-Employment Tax $57
Adjustments, Deductions, Exemptions $17		Unemployment Tax $1
Credits $28		

Categories of Estimates
- Actual Amounts
- Updated Estimates
- # No Estimates Available

| Individual Income Tax $36 |
| Corporation Income Tax $4 |
| Employment Tax $4 |
| Estate Tax $2 |
| Excise Tax $0.1 |

Internal Revenue Service, December 2011

Fig. 1. IRS Estimates of the US Federal Tax Gap for 2006

Table 1. Alternative Tax Gap Measurement Methods

(A) Micro ('direct') approaches	(B) Macro ('indirect') approaches
(i) Taxpayer auditing / compliance	(iii) National income-expenditure discrepancy methods
(ii) Taxpayer surveys	(iv) National income-fiscal discrepancy methods
	(v) 'Single indicator' models: - Labor force participation - Transactions-based - Currency-based - Electricity use-based
	(vi) 'Multiple indicator' (MIMIC) methods
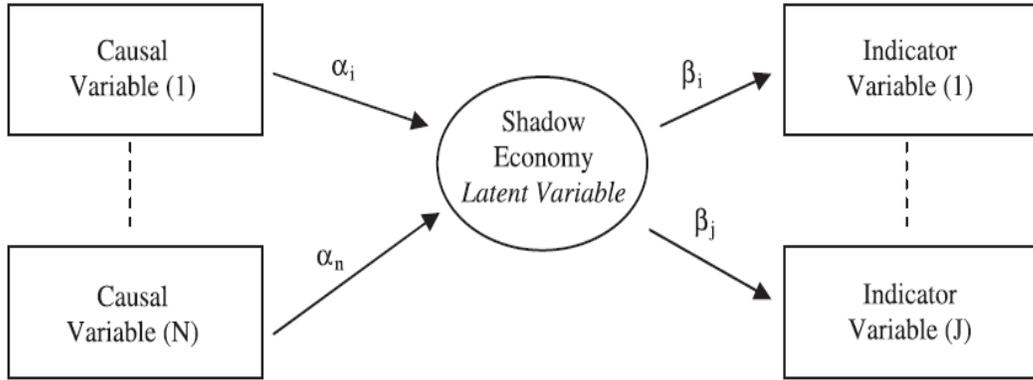
Source: Bajada and Schneider (2005)

Fig. 2. The MIMIC Model Approach
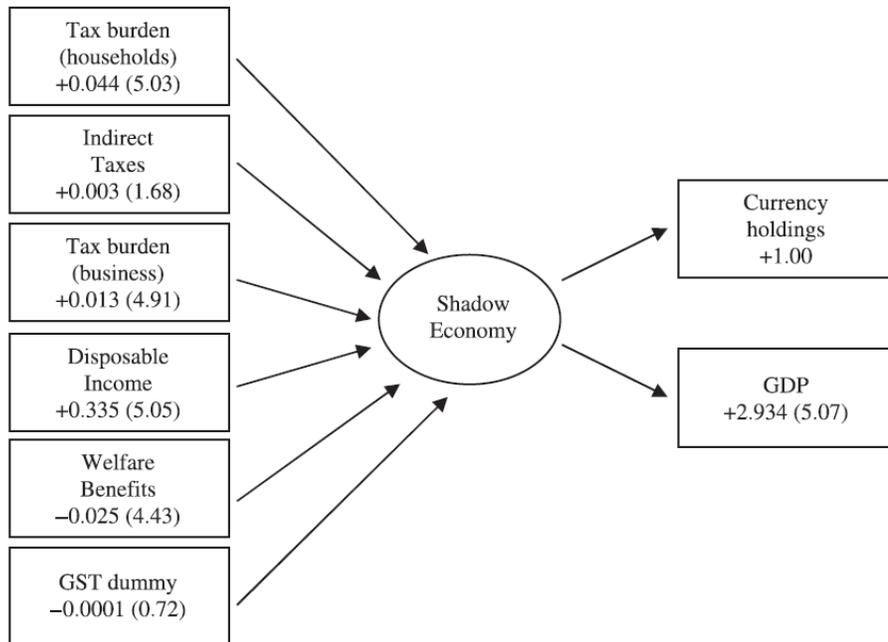
Source: Bajada and Schneider (2005)

Fig. 3. Bajada and Schneider's (2005) Results – Australia

Table 2. Hidden Economy and Tax Gap Estimates

Panel A: United States *

Study	Estimate in Current Dollars (billion)	Estimate in Percent of GDP	Year
IRS (various)	145	8.0	1976
Feige (1994)	600+	28+	1979
Tanzi (1982, 1983)	118-159	4.5-6.0	1980
Bureau of Economic Analysis (1993)	184	5.4	1983
US Dept of Labor	500	10.0	1992
IRS (2005)	312-353	15.0-16.7 (% of tax rev)	2001
IRS (2006)	345 (gross)**	16.3 (% of tax rev)	2001
	290 (net)	13.7 (% of tax rev)	
IRS (2012)	450 (gross)	16.9 (% of tax rev)	2006
	385 (net)	14.5 (% of tax rev)	

Note: * See Cebula and Paul (2000) for references in this table; ** Compares to $311 billion using 'rules' from 1988 and earlier IRS studies.

Source: Adapted from Cebula and Paul (2000), and IRS (2005, 2006, 2012).

Panel B: Multiple Countries

Study	Size of hidden economy (% GDP)	Country	Year
Frey & Weck-Hanneman (1984)*	4.1% , 8.0%	Japan , UK	1978
	8.3% , 8.8%	US , Canada	
	13.2%	Sweden	
Schneider (1997)*	15%	OECD average	1994
Park (1979)*	4%	US	1978
Feige (1982)*	33%	US	1978
Tanzi (1983)*	2.6%	US	1970
Pommerehne & Schneider (1985)*	11%	US	1970
Bhattacharyya (1990)*	3.8%		1960
	11.1%	UK	1976
	8%		1984
ABS (2004) †	2% (max. 4.8%)	Australia	2000
Bajada (1999, 2003)	15%	Australia	1995
Giles and Tedds (2002b)	3.5% (lowest)	Canada	1976
	15.6% (highest)		1995
Giles (1999b)	6.7% (lowest)		1968
	11.3% (highest)		1994
	Tax Gap:	New Zealand	
	1.6% (6.4%)**		1968
	3.9% (10.2%)**		1994
Swedish Tax Agency (2006)	6.5%***		2004
	10% & 6%***		2002
	Tax Gap:	Sweden	
	5% **		1979
	4.2% **		2000
Legislative Analyst's Office (2005)	8% (of tax revenue)	California, US	2005
HMRC	8%	UK	2010

Note: * as reported by Giles (1999b); ** = percent of total tax liability; *** using different methods: cash/GDP ratio (6.5%), national accounting (10%), & tax auditing (6%); † See Warren and McManus (2006)
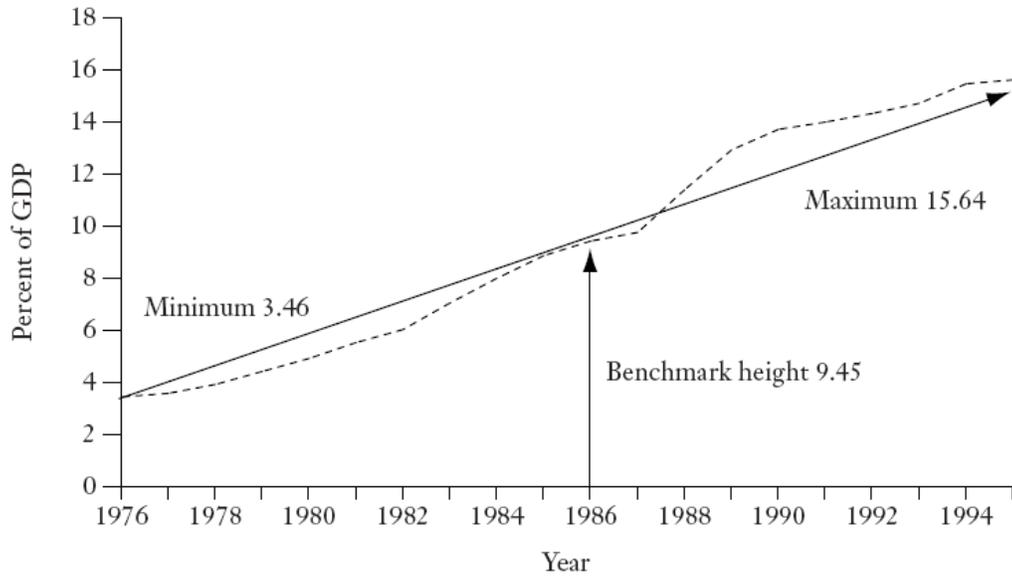
Source: Breusch (2002b)

Fig. 4.　The Canadian Hidden Economy (% of GDP)
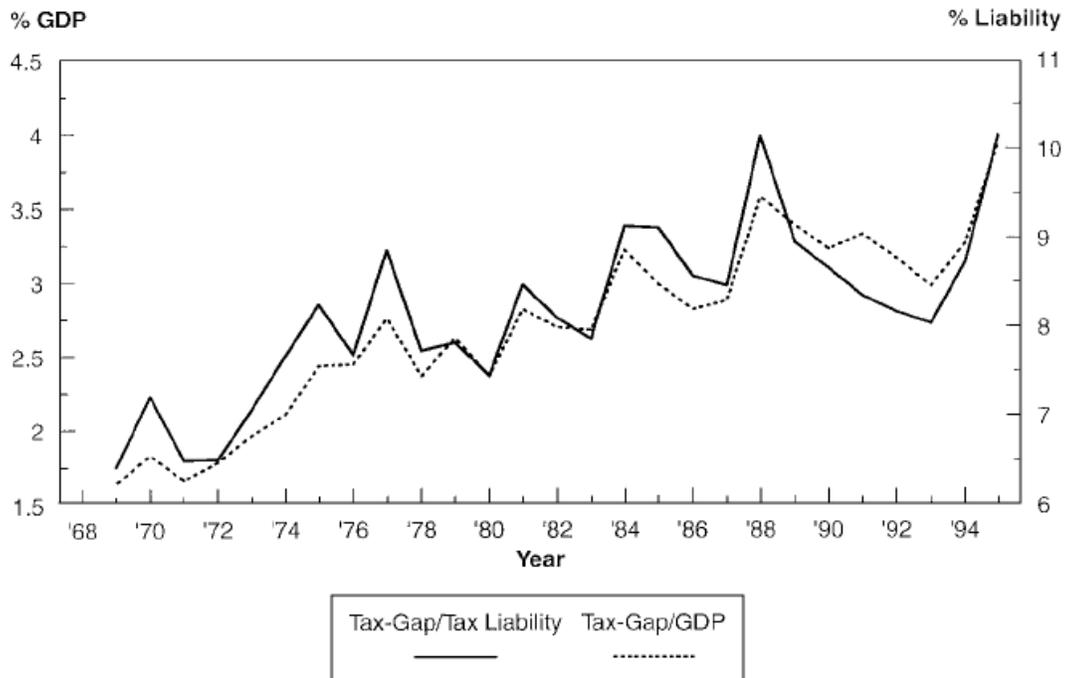
Source: Giles (1999b)

Fig. 5.　The New Zealand Tax Gap (% of GDP & tax liability)

APPENDIX

Evidence for Canada and New Zealand

The evidence for Canada and New Zealand is worth more detailed examination because it illustrates some of the difficulties with the main methods used – currency demand and MIMIC models. Figure 4 shows Giles and Tedds' (2002b) estimates of the Canadian hidden economy; Figure 5 shows Giles's (1999) tax gap estimates for New Zealand.

[Insert Figure 4 and Figure 5 about here]

As Breusch (2005b) demonstrates, the Canadian hidden economy series is 'anchored' in 1986 using a benchmark value (9.45% of GDP) obtained from a currency demand model based on dubious assumptions. The MIMIC model however determines the time-series profile which reveals a persistent upward trend: the series grows by 4.5 times (relative to real GDP) over 20 years. This implies that the real value of the Canadian hidden economy grew by a factor of seven while real GDP merely doubled. As Breusch argues, this is implausible and is driven by the MIMIC models questionable parameter estimates.

Similar upward growth over time is observed in the New Zealand estimates for the tax gap (Figure 5), but with stronger year-to-year fluctuations. Growth appears to be strongest during the twenty years from 1968, rising from around 1.6% of GDP to 3.5%.

Breusch's arguments apply here also: the tax gap is obtained from hidden economy estimates and the average level estimated for the hidden economy is an artefact of the scaling of the data. In addition, since the tax gap is obtained simply by multiplying the ratio of hidden to measured GDP by total tax revenue, the issue of the appropriate tax rate to apply to hidden income is completely sidestepped. These tax gap estimates are, of course, total tax gap estimates and not estimates of the personal or corporate tax gap.

In his assessment of Bajada's (1999, 2003) Australian evidence using MIMIC models, Breusch (2005c) also shows that results for the size of the hidden economy – around 15% on average over 1967-1995 – are non-robust due to sensitivity to the units of measurement of key variables. He shows that, when this sensitivity is removed so that results become robust, the underground economy estimates become large and *negative*. Bajada has since produced much smaller estimates for the Australian hidden economy but which Breusch (2006) shows are, again, based on erroneous methods.

NOTES

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WP01/2012 Debasis Bandyopadhyay, Robert Barro, Jeremy Couchman, Norman Gemmell, Gordon Liao and Fiona McAlister, "Average Marginal Income Tax Rates in New Zealand, 1907-2009"

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