Tax Rates, the Tax Mix, and the Growth of the Underground Economy in Canada: What Can We Infer?

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PRÉCIS
Des études sur les taux d’imposition et les avoirs en monnaie ont fortement influencé l’idée que l’on se faisait ces derniers temps de la taille changeante de l’économie souterraine au Canada. Dans cet article, les auteurs examinent comment les changements dans divers taux d’imposition et dans la composition des recettes fiscales peuvent contribuer à expliquer les variations dans les avoirs en monnaie et par conséquent dans l’activité économique souterraine. L’article examine séparément les mesures de deux taux d’impôts directs moyens, de huit taux d’impôts marginaux, et d’un taux d’impôt indirect moyen.

Les estimations sont plus sensibles au choix de taux marginaux d’impôts directs qu’aux taux d’impôts directs moyens. Cependant, les estimations sont encore plus sensibles au choix de mesure de la vélocité de la monnaie souterraine, compte tenu de la marge dans laquelle cette vélocité peut se situer. Si l’on choisit les taux d’impôt théoriquement les meilleurs et si l’on utilise les valeurs de vélocité les plus plausibles, cette méthode estime que la croissance de l’économie souterraine entre 1964 et 1995 se situe entre 3 pour cent et 11 pour cent du produit national brut. La taille actuelle de l’économie souterraine n’est pas connue; elle dépend de son ampleur en 1964 (sur laquelle nous n’avons pas de données fermes), et de sa croissance depuis cette date.

Les résultats indiquent que l’économie souterraine a été en expansion jusqu’à la fin des années 1970, elle est ensuite demeurée à peu près stable jusqu’à environ 1987, année qui marque le début de la période de la croissance actuelle. Cette croissance était due aux changements intervenus dans les impôts directs (impôt sur le revenu des particuliers et

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cotisations sociales) et dans les impôts indirects (taxes provinciales sur les ventes au détail et plus récemment la taxe fédérale sur les produits et services [TPS]).

Les estimations suggèrent que les changements dans la composition des recettes fiscales visant à augmenter les impôts indirects et à diminuer les impôts directs semblent avoir peu de chance d’améliorer le niveau d’observation fiscale et de réduire la taille de l’économie souterraine. Le changement dans la composition des impôts indirects, dû à la suppression de la taxe sur les ventes des fabricants et à l’introduction de la TPS, a contribué à faire croître l’économie souterraine au cours des dernières années.

ABSTRACT
Studies of tax rates and currency holdings have played an important part in recent perceptions of the changing size of the underground economy in Canada. This article examines how changes in a variety of tax rates and in the tax mix can be used to help explain variations in currency holdings and thus in underground economic activity. Measures of two average direct tax rates and eight marginal tax rates are separately examined along with an average indirect tax rate.

The estimates are more sensitive to the choice of marginal direct rates than to average direct rates. However, the estimates are considerably more sensitive to the choice of the income velocity of underground currency, given the range within which it might lie. When the theoretically best tax rates are selected and a range of plausible velocity values is used, this method estimates underground economy growth between 1964 and 1995 at between 3 percent and 11 percent of gross domestic product. The present size of the underground economy is not known; it depends on its size in 1964, about which we have no firm knowledge, as well as its growth since then.

The results suggest that the underground economy grew until the late 1970s and remained roughly constant until about 1987, when the current period of growth began. Its growth was due to changes in both direct taxes (personal income tax and payroll taxes) and indirect taxes (provincial sales taxes and the more recent goods and services tax [GST]).

Estimates suggest that changes in the tax mix that increase indirect taxes and decrease direct taxes seem unlikely to improve tax compliance and reduce the size of the underground economy. The change in the indirect tax mix owing to the removal of the manufacturers’ sales tax and the introduction of the GST contributed to the growth of the underground economy in recent years.

INTRODUCTION
The underground economy has attracted considerable attention in Canada in recent years. The nature and extent of its growth have been a subject of
debate among academics and government officials, especially because the underground economy is seen as constraining tax policy choices. Views about the growth of the underground economy also have been featured in the media, where some of the results of academic and government studies have been reported.¹

The underground economy is defined here as “market-based production of goods and services, whether legal or illegal that escapes detection in the official estimates of GDP [gross domestic product].”² Changes in its size can be inferred in a variety of ways. Individuals may be surveyed to determine the extent of their participation in tax-evading activities, either as producers or as consumers. Data from tax audits may shed light on the areas in which income is hidden from tax authorities. Statistical discrepancies between the income and expenditure measures of the national accounts also can be evaluated. As well, in recent years, attempts have been made by Statistics Canada to determine plausible bounds on the size of the underground economy.³

Finally, the effect of taxes on underground activity has been investigated by researchers who attempt to determine how currency holdings respond to changes in tax rates. Currency is presumed to play a particularly important role in underground transactions and is an important asset in which hidden income may be saved.⁴

¹ See, for example, Deborah Wilson, “Tax Burden Spawns Subtle Revolt,” The Globe and Mail, January 28, 1995, who states that the underground economy “has been estimated at $100-billion a year.” This is about the value recently reported by Rolf Mirus, Roger S. Smith, and Vladimir Karoleff, “Canada’s Underground Economy Revisited: Update and Critique” (September 1994), 20 Canadian Public Policy 235-52; however, as we note below, it has subsequently been recognized that this value is erroneous. A similar figure appears to have been assumed in the editorial “The Silent Tax Revolt,” The Globe and Mail, October 14, 1993.

² Philip Smith, “Assessing the Size of the Underground Economy: The Statistics Canada Perspective” (May 1994) Canadian Economic Observer, Statistics Canada catalogue no. 11-010, 3.16-33, at 3.18, where other possible definitions are discussed. It is important to note that some income escaping detection by the tax authorities can still be included in GDP estimates. Generally, we will ignore this distinction in our subsequent discussion.

³ Tax evasion resulting in the holding of cash can also occur in ways that would not be counted in GDP—for example, from transactions in intermediate goods, real capital, and financial assets. See Jan Tore Klovland, “Tax Evasion and the Demand for Currency in Norway and Sweden: Is There a Hidden Relationship?” (1984), 86 Scandinavian Journal of Economics 423-39.


¹ Not all increases in tax evasion will involve increases in currency holdings. Taxpayers may overstate deductions instead of understating income. As well, underground work leading to increases in cash holdings can be motivated by factors or events other than changes in taxes.
Statistical estimates of currency holdings offer a quantitative relationship between changes in tax rates and the underground economy. Estimates are first made of the extent to which changes in tax rates are associated with changes in currency holdings. Currency holdings are then simulated supposing that tax rates had remained constant over the period in question. An assumption about the relationship between currency and income generated in underground activity—the income velocity of currency—yields an estimate of the change in the amount of income produced in the underground economy owing to changes in tax rates. This is usually expressed relative to the size of GDP.

The choice of tax rate and the velocity value are central issues in this approach. It could be, for example, that the choice of tax rate is relatively unimportant if a variety of theoretically and statistically relevant tax rates all give about the same estimate of changes in currency used in the underground economy. If this were the case, research could then focus on the difficult question of an appropriate value for the income velocity of underground currency.

Unfortunately, the appropriate tax rate to use is not clear on either theoretical or empirical grounds, nor have the effects of using a wide variety of theoretically plausible average and marginal tax rates been systematically explored in the Canadian case. We consider 12 measures of Canadian tax rates in a simple currency-demand model, reporting the results of six models in detail. These are used to estimate the change since 1964 in the size of the underground economy. We also use the models to try to assess the relative importance for underground economy growth of changes in various taxes.

These estimates of underground economy growth are somewhat sensitive to the choice of alternative tax rates and much more sensitive to the choice of currency velocity. For all the tax rates and velocity values that we explore, the estimates of the growth in the underground economy from 1964 to 1995 lie between 3 percent and 27 percent of GDP. This very broad range can be narrowed to between 3 percent and 11 percent of GDP by selecting the most theoretically and empirically satisfactory tax rates and a more reasonable range of velocity values. Rough estimates suggest that between 15 percent and 40 percent of this growth may be due to the introduction in 1991 of the goods and services tax (GST). Changes in provincial sales taxes (PSTs) have roughly the same importance, while changes in direct tax rates may account for between 25 percent and 65 percent of the growth in the underground economy.

Despite the wide range of estimates for underground economy growth since 1964 and the great uncertainty surrounding the contribution of individual taxes, we find some common results across all cases. There is unambiguous evidence of growth in the underground economy over the 1964-1995 period, with the most rapid growth in the late 1960s and the early 1970s, and again in the period since 1987.

We begin the next section by briefly surveying the way in which tax rates have been used in past studies. We then consider which tax rate
measure is the most appropriate in trying to link currency holdings and underground activity.

We go on to examine a variety of tax rates with Canadian data. The results are assessed and the implications for our knowledge of underground economy growth are set out in a concluding section. An appendix contains the details of the econometric results and a description of the data.

**TAX RATES AND CURRENCY HOLDINGS**

The use of tax rates to help to explain currency holdings goes back to Cagan’s early study of US currency and was followed a few years later by a similar study of Canadian data by Macesich (see table 1). Neither study focused specifically on the underground economy; however, both found tax rates useful in explaining changes in currency holdings over a long period of time.

Both Cagan and Macesich used a measure of average tax rates, defined as the ratio of personal income tax revenues to personal incomes. Cagan remarked that

> [the] use of this series presumes that the amount of tax evasion depends directly on the rewards. An ideal measure would be the marginal rate levied on the average level of income for which taxes are not withheld, permitting currency to be used to aid evasion. The measure used is not ideal, since it gives the average rate paid on total personal income and excludes evaded taxes.  

On the basis of his examination of US data, Cagan believed that changes in taxes affected currency holdings with some lag, because it took some time for people to begin attempts to evade them.

A similar preference for marginal tax rates was also expressed by Tanzi in an influential paper that triggered the most recent numerical investigations of taxes, currency, and the underground economy: “[I]t is the marginal tax rate on a taxpayer’s income—rather than the average tax rate—that is more likely to determine whether he evades the tax on the marginal dollar.”

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6 Cagan, supra footnote 5, at 322.

7 Subsequent empirical work has supported this hypothesis. A number of studies of currency holdings have found a role for changes in tax rates that have taken place at least several years in the past. See Klovdal, supra footnote 2; Friedrich Schneider, “Estimating the Size of the Danish Shadow Economy Using the Currency Demand Approach: An Attempt” (1986), 88 *Scandinavian Journal of Economics* 643-68; and Peter S. Spiro, “Estimating the Underground Economy: A Critical Evaluation of the Monetary Approach” (1994), vol. 42, no. 4 *Canadian Tax Journal* 1059-81. We find similar evidence.

### Table 1  A Sample of Studies of Currency Demand and Tax Rates

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Currency measure</th>
<th>Currency velocity</th>
<th>Tax rate(s) used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cagan, 1958</td>
<td>USA, 1919-1955</td>
<td>C/M2</td>
<td>na</td>
<td>PIT as percentage of personal income</td>
</tr>
<tr>
<td>Macesich, 1962</td>
<td>Canada, 1924-1958</td>
<td>C/M2</td>
<td>na</td>
<td>PIT as percentage of personal income</td>
</tr>
<tr>
<td>Tanzi, 1980</td>
<td>USA, 1929-1976</td>
<td>C/M2</td>
<td>Legal M1</td>
<td>1) PIT/personal income net of transfers</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) Top statutory marginal PIT rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3) Average tax rate on interest income</td>
</tr>
<tr>
<td>Mirus &amp; Smith, 1981</td>
<td>Canada, 1936-1976</td>
<td>C/DD</td>
<td>M1</td>
<td>PIT/personal income net of transfers</td>
</tr>
<tr>
<td>Klovland, 1984</td>
<td>Sweden, Norway, 1953-1982</td>
<td>Real currency</td>
<td>Between 2 and 7</td>
<td>1) Average of marginal PIT rates</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>2) [Peak] average marginal direct tax rate</td>
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<td></td>
<td></td>
<td>3) Total marginal (direct + indirect) tax rate</td>
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<td></td>
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<td></td>
<td></td>
<td>2) Federal PIT/declared income</td>
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<td></td>
<td>3) Marginal PIT rate of average tax filer</td>
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<td></td>
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<td></td>
<td></td>
<td>4) Maximum federal plus provincial PIT rate</td>
</tr>
</tbody>
</table>

(Table 1 is continued on the next page.)
<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Currency measure</th>
<th>Currency velocity</th>
<th>Tax rate(s) used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schneider, 1986</td>
<td>Denmark, 1955-1982</td>
<td>Real per capita currency</td>
<td>Legal M1</td>
<td>1) Marginal PIT rate for those with average taxable income</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td>2) Marginal PIT rate for the upper range of average taxable income</td>
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<td>3) Average direct taxes/taxable income</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>4) Average direct taxes/gross income</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>5) (Direct + indirect taxes)/GNP</td>
</tr>
<tr>
<td>Mirus &amp; Smith, 1989</td>
<td>Canada, 1960-1982</td>
<td>Real per capita currency</td>
<td>na</td>
<td>PIT/personal income net of transfers</td>
</tr>
<tr>
<td>Schneider, 1994</td>
<td>Austria</td>
<td>Real per capita currency</td>
<td>Legal M1</td>
<td>1) Average + marginal direct taxes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) Indirect taxes/GDP net of indirect taxes</td>
</tr>
<tr>
<td>Mirus, Smith, &amp; Karoleff, 1994</td>
<td>Canada, 1939-1990</td>
<td>C/DD; C/M2</td>
<td>M2</td>
<td>3) Index of complexity of tax system</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1) PIT/personal income net of transfers</td>
</tr>
<tr>
<td>Spiro, 1994</td>
<td>Canada, 1950-1993</td>
<td>C</td>
<td>5 (M1, 1926-1959)</td>
<td>2) (Direct + indirect taxes)/GNP</td>
</tr>
</tbody>
</table>

C = nominal currency. DD = demand deposits. GDP = gross domestic product. GNP = gross national product. GST = goods and services tax. M1 = currency + demand deposits. M2 = M1 + time deposits. PIT = personal income tax.

Table 1 Concluded

Tanzi then noted, however, that average tax rates could play a role: “If the average tax rate is also high, there could be an income effect that might reinforce the taxpayer’s propensity to evade the tax.”

Tanzi examined three alternative tax rates. The first was an average personal income tax rate, found by dividing personal income taxes by personal income net of transfers. Tanzi argued for the removal of transfer income because it is “largely non-taxable,” but in Canada that is not the case. Only if all the taxes paid from transfer payments were removed from the numerator should all transfers be removed from the denominator. As table 1 shows, some studies have removed transfers and some have not.

Tanzi also examined the top statutory marginal personal income tax rate, but he rejected it on empirical grounds, as did Éthier, who examined a similar variable for Canada. Tanzi’s third rate was an effective weighted average tax rate on interest income, a series that he thought might be “closer to some modal average taxpayers’ tax rates than would be the previous two alternatives” and would better reflect changes in the overall tax rate structure. Tanzi’s estimates of changes in the underground economy were reported only for this third measure.

Since these seminal pieces appeared, a variety of tax rate measures have been used by other researchers, as shown in table 1. Although the list is not exhaustive, it does show the wide variation in the definitions of tax rates used.

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10 Tanzi, supra footnote 8, at 79. For example, such important transfers as unemployment insurance, Canada and Quebec pension plan benefits, and old age security benefits (to some extent) are taxable under the personal income tax. The guaranteed income supplement and social assistance payments are not taxable, but expenditures made from all transfers are subject to sales taxes.

11 We prefer simply using personal income in the denominator, but as we show below, which is chosen makes very little difference in practice.


13 Tanzi, supra footnote 8, at 79-80. Statistically, this tax rate performed best in his currency-demand equations.

14 As well, there have been other currency studies that have not used tax rates in estimating equations to describe currency holdings. See, for example, Thérèse Lafleche, “The Demand for Currency and the Underground Economy” [Autumn 1994], Bank of Canada Review 39-58; and Peter S. Spiro, “Evidence of a Post-GST Increase in the Underground Economy” (1993), vol. 41, no. 2 Canadian Tax Journal 247-58.
Of the studies summarized in table 1, Schneider’s 1986 Danish study undertook the most careful examination of a variety of tax rates. Three average and two marginal tax rate measures were examined. This was also the only study we have found that reported estimates of the change in the size of the underground economy using different tax rates. As Schneider explained,

[Because] the size of the shadow economy depends heavily on the size of the tax variable, different tax variables were used in order to check the sensitivity of the choice of tax variable in regard to the size of the shadow economy.

Both theoretical and empirical considerations are involved in the choice between alternative tax rates. We consider first the general arguments for using one tax rate measure over another. Broadly speaking, the best tax rate should be that which most influences the decisions of those who participate in underground activity. To this end, we also review the Canadian evidence, such as it is, to see if it can cast any further light on the tax rates to examine.

### Selecting Appropriate Tax Rates

**Average or Marginal Rates? Direct and/or Indirect Tax Rates?**

For those individuals who work full time in the underground economy, an average direct personal tax rate most accurately measures the income and payroll tax savings from tax-evading underground activity. Simply using average personal income tax rates would be too narrow a measure.

Such broad measures of average tax rates could also be relevant if, for example, taxpayer dissatisfaction arises from rising tax rates that are perceived as yielding poor value for money. A related reason for the apparent dissatisfaction with the current tax system could be the excess of federal revenues over program spending in recent years.

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15 Klovland, supra footnote 2, examined four tax rates, but results were presented for only one. His article is also valuable for its demonstration of the sensitivity of the results of the currency-demand approach to alternative and plausible definitions of other crucial explanatory variables: interest rates and the income or expenditure variable. As reported in table 1, Éthier, supra footnote 12, also examined a wide variety of tax rates but found that only the marginal tax rate of the average tax filer both was statistically significant and had the effect on currency holdings that would be predicted by theory.

16 Schneider, supra footnote 7, at 653. He found that all the tax rates used appeared acceptable from a theoretical and statistical point of view. Using these tax rates and a single velocity value, his estimates of growth in the Danish underground economy ranged between 7 percent and 13 percent of official gross national product (GNP).

17 Alan Lewis, *The Psychology of Taxation* (Oxford: Martin Robertson, 1982), 218, also notes some evidence for widespread “fiscal ignorance.” It may be the case that individuals have a better idea of their average tax rate than of the marginal rate that they face. This could provide a further argument for the use of average tax rates.

18 This point is made by Don Drummond, Mireille Éthier, Maxime Fougère, Brian Girard, and Jeremy Rudin, “The Underground Economy: Moving the Myth Closer to Reality” (Summer 1994), 2 *Canadian Business Economics* 3-17, at 12. People also make (The footnote is continued on the next page.)
There is also a strong case for considering marginal tax rates, as shown by the arguments of Cagan and Tanzi cited earlier. However, despite what we perceive to be the greater theoretical attractiveness of marginal rates, strong direct empirical support for the link between marginal tax rates and taxpayer compliance is still lacking.\(^{19}\)

In short, broad theoretical considerations do not clearly rule out either marginal or average tax rate measures. Many authors have seen fit to examine the effects of one or the other.

If only an average direct tax rate is used to explain currency holdings (as is often done, as shown in table 1), the implicit assumption is being made that a change in the tax mix involving a decrease in direct taxes and an increase in indirect taxes (that is, provincial retail sales taxes and value-added taxes) will lower tax evasion and related currency demand. However, Kesselman has recently argued against this widespread view.\(^{20}\) He has shown that if evasion is concentrated in particular industries and if those who evade income taxes also evade to a similar extent the indirect taxes on the value of what they sell, then a change in the direct-indirect tax mix is likely to have little effect on the extent of tax evasion. Indeed, greater reliance on indirect taxes could even worsen tax evasion in some circumstances.

Some researchers have instead used a single broad tax rate consisting of average direct and indirect tax revenues as a percentage of personal income. This presumes that a change in the direct-indirect tax mix (leaving overall tax revenues unchanged) would have no effect on tax evasion and currency demand. We prefer not to prejudge the outcome and include a separate average indirect tax rate to help explain changes in currency. In a recent article, Schneider examined measures of direct and indirect taxes at the same time.\(^{21}\) This permitted tax-induced changes in the underground economy to be divided up into those owing to changes in direct and indirect taxes.

To the extent that the introduction of the GST increased opportunities for evasion, a case can be made for including it along with PSTs in the indirect tax rate measure, while omitting revenues from the former manufacturers’ sales tax, for which evasion associated with increased cash

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\(^{18}\) Continued . . .

\(^{19}\) For further references to this literature, see Yaniv, supra footnote 9, at 107.


holdings was likely negligible. This would also capture the timing of this change in the indirect tax mix, which may be associated with greater evasion.

Who Participates in the Underground Economy?

Exactly which average or marginal direct tax rate is best used depends on the behaviour of the group that participates in the underground economy. Because of the importance of withholding taxes, Cagan suggested that most tax evasion would occur among small unincorporated businesses where taxes are not withheld. Because it is likely that in most cases some fraction of income would be unreported by tax evaders, the marginal tax rates on true business income would likely be relevant in describing individuals’ incentives to take payments in cash. 22 Such “skimming” by small business remains a major concern and may well form the largest part of the underground economy in Canada. 23 Understatement of income would be accompanied by understatement of sales and thus underpayment of applicable sales, income, and payroll taxes.

Unfortunately, the appropriate weight to give different marginal direct tax rates is not known because the nature of the incomes on which tax is being evaded remains unknown. However, the significance of this form of evasion strengthens arguments for the use of both a marginal tax rate and an indirect tax rate.

Survey data may provide information about other underground activities. Such data have seldom been gathered, but a 1986 survey carried out in the Quebec City region may provide some clues about one aspect of underground activity. 24 The survey focused on underground labour market activities and found that 8.5 percent of the sample reported some underground work with average earnings of about $2,000. Relatively high participation rates were reported for low-income individuals (including those in school, unemployed, and receiving social assistance), youths, and unmarried persons. These data suggest that relevant tax rates to

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22 In the case of the United States in 1945, Cagan did a rough calculation. He found that if all “excess” currency were attributable to such underreporting, this would imply that perhaps half of the income of unincorporated business went unreported to tax authorities. See Cagan, supra footnote 5, at 313-14.

23 See Gervais, supra footnote 3, at 19-23. Her upper estimate of the amount of “skimming” amounts to more than half her estimate of the underground economy.

24 The data are examined in Thomas Lemieux, Bernard Fortin, and Pierre Fréchette, “The Effect of Taxes on Labor Supply in the Underground Economy” (March 1994), 84 The American Economic Review 231-54. The results of a similar Norwegian survey are reported in Arne Jon Isachsen, Jan Tore Klovland, and Steinar Strøm, “The Hidden Economy in Norway,” in The Underground Economy in the United States and Abroad, supra footnote 8, 209-31. Their survey found that income earned in the underground economy was about 2.3 percent of 1979 Norwegian GDP, roughly one-third of that yielded by a monetary approach. Results from such surveys are likely to indicate lower bounds for the underground economy, because only part of underground income is being examined. Hidden business income is not measured.
consider when accounting for underground labour market activity are marginal or average rates pertaining to relatively low-income persons.

Even if most people participating in the underground economy have relatively low incomes, their activities need not account for the bulk of the cash in the underground economy. The ideal weights to combine marginal tax rates would be those that reflect individuals' underground cash holdings. As well, if the underground economy consisted of a mix of persons participating in it part time and full time, perhaps some appropriately weighted average of marginal and average tax rates would be called for.

Because the empirical evidence is so incomplete, we use a variety of alternative measures of both average and marginal direct tax rates. We examine their role, along with that of the indirect tax rate, in explaining changes in currency holdings.

**TAX RATES AND CURRENCY HOLDINGS IN CANADA**

We calculate three different average tax rates. The first two are direct tax rates. These include income and all federal and provincial payroll taxes. All of our calculations assume that income taxes are borne by those who pay them and that all payroll taxes are ultimately borne by employees. As a result, employer contributions to payroll taxes are also included in our calculations of these tax rates.\(^{25}\)

The first average direct tax rate is the ratio of all direct taxes to personal income. The second modifies this by removing transfers to persons from personal income, the denominator advocated by Tanzi. The third tax rate is an average indirect tax rate expressed as the share of PST and GST revenues in personal income. This tax rate not only incorporates the rising importance of PSTs over the period, but also captures the change in the indirect tax mix that took place in 1991 with the introduction of the GST.

These tax rates from 1947 to 1995 are illustrated in figure 1. As can be seen, average direct tax rates in the immediate postwar period fell from their wartime highs, increased at the time of the Korean War, and remained fairly stable until the mid-1960s. Average indirect tax rates, as defined here, began a period of growth in the early 1960s, corresponding to increases in provincial expenditures, and levelled out by 1970. Because manufacturers’ sales tax revenues are not included, the indirect tax rate takes a sharp jump with the introduction of the GST in 1991. (The appendix contains further details on the calculation of all tax rates, including the data sources.)

\(^{25}\) The incidence of payroll taxes has recently been reviewed by Bev Dahlby, “Payroll Taxes,” in Allan M. Maslove, ed., Business Taxation in Ontario (Toronto: University of Toronto Press in cooperation with the Fair Tax Commission, 1993), 80-170. He notes the conditions under which a share of payroll taxes would be borne by capital income as well as by wages and salaries.
Eight different measures of marginal tax rates are examined in conjunction with the average indirect tax rate. The first four are measures of marginal federal plus provincial personal income tax rates.

The first marginal personal income tax rate is that faced by the average filer of a tax return. The second is the marginal personal income tax rate paid by a person with the average taxable income. (This income is higher than the taxable income of the average tax return filer because not all filers of returns have taxable income.) These tax rates were calculated from 1944 to 1995 and are illustrated in figure 2.

These two measures have the disadvantage of focusing on only one of many existing marginal tax rates, which depend on taxpayers’ taxable incomes as well as their province of residence. As seen in figure 2, the income of this “typical” taxpayer may drift over time into a new tax bracket, making it appear that there has been a sharp change in tax rates and/or in the characteristics of the taxpayers, even though this might not be the case.

If an appropriate set of weights were applied to all marginal income tax rates to obtain a weighted average, the resulting series would be smoother and would better reflect changes in statutory tax rates and taxpayers’ characteristics. Unfortunately, as the earlier discussion suggested, the appropriate set of weights is not known. Two obvious sets of weights, however, suggest themselves. The marginal rates can be weighted by the

\[\text{Weighted average} = \sum (w_i 	imes r_i) \]

where \(w_i\) are the weights and \(r_i\) are the marginal tax rates.

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26 This measure was used by Éthier, supra footnote 12.
share of taxpayers’ assessed incomes in total assessed income or by the number of taxpayers facing each marginal rate.

Fortunately, Davies and Zhang have recently undertaken the arduous task of calculating such tax rates, and we draw on their results here.27 The third marginal tax rate we use is their income-weighted average of individuals’ marginal personal federal and provincial income tax rates. The fourth marginal rate is their weighted average using as weights the fraction of total tax returns that fall within each marginal tax bracket. These rates (which are available from 1947 to 1991) also are shown in figure 2.

As can be seen from figure 2, personal income tax rates fell from wartime highs until about 1949, rose temporarily in the early 1950s, and remained roughly constant until the mid-1960s, when a period of sustained increases began which lasted until the mid-1970s. After a period of relative stability, further increases appeared by the mid-1980s.

As we noted earlier, these marginal personal income tax rates understate the incentive to participate in underground activity and avoid taxes because payroll taxes contribute to the gap between gross-of-tax and net-of-tax earnings. We follow Klovland’s example and construct augmented marginal direct tax variables that include the contributions associated with the Canada (or Quebec) pension plan (CPP/QPP), workers’ compensation,

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27 James B. Davies and Junsen Zhang, “Measuring Marginal Income Tax Rates for Individuals in Canada: Averages and Distributions over Time” (November 1996), 29 Canadian Journal of Economics 959-75. The detailed tables on which our estimates are based can be found only in their earlier (April 1995) manuscript.
and unemployment insurance (UI).\textsuperscript{28} Figure 1 shows average payroll taxes from 1947, expressed as a percentage of the income subject to such taxes (wages and salaries, unincorporated business income, and net farm income).

The resulting augmented marginal direct tax rates are shown in figure 3. A period of stability up to the mid-1960s has been followed by a long period of steady growth.

While this selection of average and marginal tax rates reflects some of the plausible rates we could use, it is quite unlikely that the ideal measure is included here. Given the considerable uncertainty about which tax rates are most appropriate, it is important to know whether estimates of changes in the underground economy in Canada are sensitive to the definition of this key variable.

Estimates of Changes in the Size of the Underground Economy Since 1964

We estimate equations for currency demand as described in detail in the appendix. Not including the lagged values of variables, the equations were estimated for 1965 to 1995 (or 1991 in those cases where more recent tax rates were not available). Substantial increases in average and marginal direct tax rates began after 1964. This is the period in which tax-induced increases in the underground economy could be expected to be seen. For this reason, we begin our analysis in 1965.\textsuperscript{29} How the underground

\textsuperscript{28}Klovland, supra footnote 2, at 426.

\textsuperscript{29}Given the long lags, tax rate data are used back to 1957. We have thus excluded the periods of instability following the end of World War II and surrounding the Korean War.
Nominal currency holdings are assumed to depend on current and possibly past values of the following variables: a direct and an indirect tax rate; measured nominal consumer expenditures for goods and services; and a net of marginal personal income tax interest rate, which proxies the forgone income from holding non-interest-bearing cash. We considered various ways of proxying the changing transactions costs of obtaining cash. These included the number of branches of financial institutions and the number of automatic teller machines. However, these variables did not have a significant role to play either statistically or economically, and they are not included in our results.

Once such a currency-demand equation has been estimated, the effect that tax-induced underground activities have on currency holdings is simulated. This is done by calculating what the estimated equation says currency holdings would have been had both direct and indirect tax rates remained at their 1964 values while the other explanatory variables took on their actual historical values. These simulated currency values are compared with the values that the estimated equation predicts should be held given actual tax rates. The difference between the two is assumed to reflect the change in currency required to support changes in tax-induced underground activity.

An assumption about the relationship between this additional underground currency and the additional income generated in the underground economy developed before that time and how large it was in 1964, before the changes that we estimate are questions we cannot address. BEGINNING THE ANALYSIS IN SOME EARLIER YEAR DOES NOT HELP BECAUSE THERE IS NO KNOWN YEAR IN WHICH THE UNDERGROUND ECONOMY DID NOT EXIST. TANZI, supra footnote 8, at 85, also calculated what currency holdings would be if tax rates were zero (when non-criminal underground activity would be pointless) but acknowledged the dubious nature of this calculation. At zero tax rates, government would not exist, in which case much else would be different. In our view, it is also problematic to use a value for the tax rate with the estimated equation that lies so far from actually observed values. For example, if we wanted to know what underground activity would be if average direct tax rates were 90 percent, there is no reason to think that the estimated currency demand equation would reliably indicate how people would respond.

See the appendix for details on the estimation of the equations.

In this approach, only changes in the tax rate are assumed to alter the size of the underground economy relative to GDP. If observed consumer expenditures alone were to change, unobserved consumer expenditures in the hidden economy would be assumed to change in the same proportion. (That is, the elasticity of consumer expenditures with respect to disposable personal incomes in the above- and below-ground economies are implicitly assumed to be equal.) Similarly, changes in interest rates are assumed to affect currency holdings equally in the above- and below-ground sectors.

Spiro, supra footnote 7, at 1070, incorrectly compared the difference between actual currency (not its predicted value) and the simulated value. This combines the change in underground currency owing to changing tax rates with the unexplained residuals from the estimated equations. (Tanzi, supra footnote 8, at 84, sets out the correct method.)
economy (that is, the income velocity of underground currency) gives an estimate of the growth of the underground economy since 1964, the year in which the simulation begins. Because the estimate can say nothing about the initial overall size of the underground economy itself, the overall size of the underground economy relative to GDP in 1995 depends on its size in 1964 plus the estimated change since that time. We can also say nothing about the growth rate of the underground economy, because we do not know the base from which it was growing. By “the growth of the underground economy,” then, we mean changes in its absolute size, which we express relative to observed GDP to make the numbers more understandable.

For our “base case,” we use the same assumption as that used recently by Spiro—that a dollar of additional underground currency supports $5 of unobserved GDP.35 The best value to use here is most uncertain, as we discuss in more detail shortly, but this value suffices for now to demonstrate the range and nature of results.

Figure 4 shows the different estimates of the change in the relative size of the underground economy that are obtained from the different models that use broad measures of direct tax rates in conjunction with the average indirect tax rate. With a velocity of 5, these tax rates suggest a growth in the underground economy of between 3.5 percent and 6.5 percent of GDP from 1964 to 1991 (the last year when all the models can be compared). For the smaller group of models that can be compared to 1995, the estimated range is between 7.3 percent and 8 percent of GDP.

The results are fairly insensitive to the precise definition of the average direct tax rate. (Removing transfers to individuals from personal incomes in calculating the rate increases the underground economy estimate by a relatively small amount.) Estimates using marginal direct tax rates are sometimes higher and sometimes lower than those using average direct tax rates. It is clear, however, that the results are considerably more sensitive to the choice of marginal direct tax rate.

Table 2 summarizes the estimated changes in the underground economy in Canada as a percentage of GDP between 1964 and 1995 where possible, and between 1964 and 1991 for all cases. This summary permits us to see more clearly the estimates of the growth of the underground economy in recent years as well as to compare all the models.

For each marginal tax rate, we report the results using marginal personal income tax rates alone as well as the more theoretically appropriate marginal direct rates that include payroll taxes. We can compare the cases that differ only by the exclusion or inclusion of payroll taxes (labelled “A” and “B” respectively for each model using marginal rates). It seems that using only personal income tax rates and omitting payroll taxes somewhat underestimates the growth of the underground economy. We will focus our subsequent discussion on the models that incorporate all direct taxes.

35 Spiro, supra footnote 7, at 1070.
How much variation in the results comes from the choice of tax rate? If we exclude the models that use personal income tax rates alone, the highest estimate for underground economy growth between 1964 and 1991 (6.5 percent of GDP from model 6B) is not quite twice as large as the lowest estimate (3.7 percent of GDP, from model 4B). This variation, while substantial in absolute terms, is relatively small compared with the variation owing to the choice of possible velocity values. Altering the velocity measure changes the results in the same proportion, and a wide range of velocity values have been used in the literature.

The presentation of these numbers is not meant to suggest that all of these estimates are equally likely to be correct. The range of velocities used mirrors the ranges in the literature summarized in table 1. However, one may make different judgments as to which tax rate or which velocity value is more plausible. Because of its importance here, we consider the velocity question in more detail.

Tanzi, in his original paper, measured the velocity of cash as the ratio of measured national income to currency plus demand deposits (M1) less the amount of cash estimated to be in the underground economy.\textsuperscript{36} For our estimates, these velocities lie between 16 and 22, with the resulting underground

\textsuperscript{36}Tanzi, supra footnote 8, at 86.
### Table 2

<table>
<thead>
<tr>
<th>Direct tax rate variable used</th>
<th>V = 2</th>
<th>V = 5</th>
<th>V = 7</th>
<th>Velocity of legal M1</th>
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<tr>
<td>1. Share of direct taxes in personal income</td>
<td>2.8</td>
<td>7.0</td>
<td>9.8</td>
<td>23.3</td>
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<tr>
<td></td>
<td>(1.5*)</td>
<td>(3.8*)</td>
<td>(5.3*)</td>
<td>(12.6*)</td>
</tr>
<tr>
<td>2. Share of direct taxes in personal income net of transfers</td>
<td>3.0</td>
<td>7.5</td>
<td>10.5</td>
<td>25.4</td>
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<tr>
<td></td>
<td>(1.7*)</td>
<td>(4.2*)</td>
<td>(5.8*)</td>
<td>(14.1*)</td>
</tr>
<tr>
<td>3A. Marginal federal &amp; provincial personal income tax rate: average tax return filer</td>
<td>2.6</td>
<td>6.5</td>
<td>9.1</td>
<td>21.3</td>
</tr>
<tr>
<td></td>
<td>(1.4*)</td>
<td>(3.5*)</td>
<td>(4.9*)</td>
<td>(11.4*)</td>
</tr>
<tr>
<td>3B. Marginal direct tax rate: average tax return filer</td>
<td>3.2</td>
<td>8.0</td>
<td>11.2</td>
<td>27.4</td>
</tr>
<tr>
<td></td>
<td>(1.9*)</td>
<td>(4.6*)</td>
<td>(6.5*)</td>
<td>(15.9*)</td>
</tr>
<tr>
<td>4A. Marginal federal &amp; provincial personal income tax rate: average filer with taxable income</td>
<td>2.6</td>
<td>6.5</td>
<td>9.1</td>
<td>21.3</td>
</tr>
<tr>
<td></td>
<td>(1.2*)</td>
<td>(2.9*)</td>
<td>(4.0*)</td>
<td>(9.4*)</td>
</tr>
<tr>
<td>4B. Marginal direct tax rate: average filer with taxable income</td>
<td>2.9</td>
<td>7.3</td>
<td>10.2</td>
<td>24.6</td>
</tr>
<tr>
<td></td>
<td>(1.5*)</td>
<td>(3.7*)</td>
<td>(5.2*)</td>
<td>(12.6*)</td>
</tr>
<tr>
<td>5A. Marginal federal &amp; provincial personal income tax rates weighted by income</td>
<td>1.7*</td>
<td>4.3*</td>
<td>6.0*</td>
<td>16.0*</td>
</tr>
<tr>
<td>5B. Marginal direct tax rate using income-weighted marginal personal income tax rates</td>
<td>2.2*</td>
<td>5.6*</td>
<td>7.8*</td>
<td>21.9*</td>
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<tr>
<td>6A. Marginal federal &amp; provincial personal income tax rates weighted by number of tax returns</td>
<td>3.1*</td>
<td>7.8*</td>
<td>10.9*</td>
<td>33.4*</td>
</tr>
<tr>
<td>6B. Marginal direct tax rates weighted by number of tax returns</td>
<td>2.6*</td>
<td>6.5*</td>
<td>9.1*</td>
<td>26.4*</td>
</tr>
</tbody>
</table>

* Indicates values for 1964-1991. In 1991, nominal gross domestic product (GDP) was $676.5 billion. Nominal GDP in 1995 was $776.3 billion.
economy growth shown in table 2. Tanzi opted for this velocity value out of “agnosticism,” feeling “unable to take a position between those who would argue that the velocity of money in the underground economy must be lower than in the legal economy, and those who would argue the contrary.” Tanzi’s assumption has been widely used, as table 1 shows.

As seen in table 2, Tanzi’s velocity assumption produces estimates of underground economy growth of more than 20 percent of GDP over the last 30 years. These estimates, in our judgment, are not credible in the absence of other supporting evidence. The lowest of these estimates for the 1965-1995 period that uses all direct taxes is that of equation 1, showing a growth of 23 percent of GDP in the size of the underground economy. If we make the extreme assumption that there was no underground economy at all in 1964 (so that 23 percent of GDP was also the actual size of the underground economy in 1995), this implies that each adult Canadian in 1995 made about $7,700 in underground expenditures. (If, instead, we use from equation 1 the estimate of growth of 2.8 percent of GDP associated with a velocity of 2 and continue to assume that this was growth from a zero base, we get about $940 spent per year per adult.)

Tanzi’s “agnostic” use of the velocity of M1 also ignores studies of the transactions velocity of cash, which “suggest that currency velocity is a constant, as if it were set by physical limitations to the speed of currency circulation, and that it lies between 15 and 20.” However, money transactions can take place without generating an equivalent amount of income or value added. Klovland, in his study of the Swedish underground economy, referred to the estimates of the transactions velocity of cash and stated that “to arrive at income velocities on a ‘value added’ or national accounts basis, these figures must be multiplied by the ratio of

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37 The income velocity of “legal” M1 in Canada is calculated from [Summer 1995], Bank of Canada Review tables H1 and E1. Dividing 1995 gross national expenditure (GNE) of $752 billion by average 1995 M1 of $56 billion less the estimate of the increase in tax-induced “underground” currency yields velocities between 16 and 17 for our estimates. (Values range from 18 to 22 for the 1991 estimates.) This is an underestimate, because not all underground currency is subtracted. It is not possible to subtract all underground currency without making an assumption about the overall size of the underground economy.

38 Tanzi, supra footnote 8, at 92, footnote 27.

39 This is based on 1995 GDP of $776.3 billion and an adult population of 23.2 million. Tanzi presents a similar calculation in Vito Tanzi, “A Second (and More Skeptical) Look at the Underground Economy in the United States,” in The Underground Economy in the United States and Abroad, supra footnote 8, 103-18, at 105.

40 J.S. Cramer, “Velocity of Circulation,” in John Eatwell, Murray Milgate, and Peter Newman, eds. The New Palgrave: A Dictionary of Economics, vol. 4 (London: Macmillan, 1987), 801-2, at 802. The transactions velocity is the number of transactions of all kinds that an average unit of currency undertakes in a year. As Cramer warns, this should not be confused with the very different concept of income velocity. He also notes that the velocity of M1 depends on the velocity of its constituent parts: cash and demand deposits. Demand deposits have a higher velocity than cash, making the velocity of M1 a poor proxy for the velocity of cash.
national income to transactions volume, which was estimated [for the Netherlands] at 0.18.\textsuperscript{41} Multiplying 15 and 20 by 0.18 yields a range for the income velocity of cash of between 2.7 and 3.6.

Because cash can also serve as a store of wealth when hoarded, however, it is often presumed that the velocity of cash is lower in the underground economy than in the regular economy. For this reason, Klovland considered velocities as low as 2. Drummond et al. argued for a low velocity measure such as this, suggesting that the appropriate definition of money to use when calculating an income velocity would be one that includes all chequable deposits and even savings deposits at banks and near banks.\textsuperscript{42} If the calculation were limited to chartered banks (the definition of M2), the velocity of cash would be about 2.\textsuperscript{43} This GNE velocity of M2 is the velocity that Mirus, Smith, and Karoleff chose in their recent paper.\textsuperscript{44}

Spiro recently argued that a velocity such as 5 was more reasonable than the higher velocities implied by Tanzi’s assumption.\textsuperscript{45} Klovland also considered velocity values as high as 7, warning that “estimates of the income velocity of currency in the hidden economy must be rather speculative” so that a broad range should be considered.\textsuperscript{46} Because of this, it is important to set out explicitly the range of possible values to underscore the uncertainty about the results, as we do in table 2.

If we suppose that a range of velocity values between a lower limit of 2 and an upper limit of 7 is reasonable, and if we consider only the models that include payroll taxes, our estimates of the growth of the underground economy between 1964 and 1991 lie between about 1.5 percent and 9 percent of GDP (models 1 and 6B, respectively). For those models with data up to 1995, the range of estimated growth, between the

\textsuperscript{41}Klovland, supra footnote 2, at 435. (The number is taken from J.S. Cramer, “The Work Money Does: The Transaction Velocity of Circulation of Money in the Netherlands, 1950-1978” (March 1981), 15 European Economic Review 307-26.) If a similar figure held for Canada, about 1/0.18 or 5.5 dollars of transactions would underlie each dollar of national income.

\textsuperscript{42}Drummond et al., supra footnote 18, at 14.

\textsuperscript{43} Calculated from the Bank of Canada Review, supra footnote 37, table E1, average M2 in 1995 was $378.4 billion. When GNE is divided by this figure, it yields a velocity of 2.

\textsuperscript{44}Mirus, Smith, and Karoleff, supra footnote 1, at 243. However, their conversion of a reported excess-currency estimate of $5 billion into a $98-billion increase in the underground economy implies a velocity of almost 20, incorrectly inflating their estimate of underground economy growth by a factor of 10. (This will be noted in an erratum, forthcoming in Canadian Public Policy.) When corrected, their estimate of 14.6 percent underground economy growth from 1965 to 1990 becomes 1.49 percent, a value somewhat lower than our estimates for 1964-1991.

\textsuperscript{45}Spiro, supra footnote 7, at 1063-67.

\textsuperscript{46}Klovland, supra footnote 2, at 436. His reported results for the increase in the underground economy in Sweden (as a percentage of GDP) between 1953 and 1982 ranged from 3 percent to 20 percent, depending on the velocity assumption and on the specification of the currency demand equation.
2.8 percent of model 1 and the 11.2 percent of model 3B, is more than 8 percentage points wide.\textsuperscript{47}

The size of the underground economy itself would have to be found by adding to this its relative size in 1964. If that were 2 percent of GDP, to take a hypothetical example, the current size of the underground economy could lie between about 5 percent and 13 percent of GDP. If instead the underground economy were 4 percent of GDP in 1964, it could now be between about 7 percent and 15 percent of GDP. Because the size of the underground economy in 1964 is not known, the uncertainty about its current relative size is greater than the uncertainty about its growth relative to the size of the economy.

Given the scanty evidence about the income velocity of cash in either the regular or the underground economy, we do not feel confident to narrow the range of this estimate any further. The variation of the estimates, depending on the choice of tax rates, and the very considerable uncertainty surrounding the velocity of cash limits the usefulness of this approach. Our results tend to support Klovland’s view that analysis of this method

[shows] quite clearly that the uncertainty involved in applying the currency approach is so great as to make it hazardous to rely on such estimates. Other methods are obviously necessary in order to obtain more than an obscure glimpse of the hidden economy.\textsuperscript{48}

Estimates of underground economy growth based on this currency demand approach leave a fairly wide range of uncertainty. This could be narrowed either by a better understanding of the income velocity of cash or by the use of other methods to assess the size of the underground economy. However, it is important to note that there are some results that are common across all the models examined here, and some conclusions can be drawn that are independent of the thorny questions of the choice of tax rate and velocity value.

First, all of the estimated equations show that changes in both direct and indirect tax rates are associated with current and future changes in currency holdings, and presumably underground activity. Second, as indicated by figure 4, all of the measures used here suggest that there was a fairly steady growth of the underground economy from the late 1960s until 1973. This was driven by the tax rate increases in the latter half of the 1960s shown in figures 1 and 2.

The rate of growth in the underground economy then slowed, reaching zero by the end of the 1970s. The next period of tax-induced growth began about a decade later. Both the average and the marginal tax rate

\textsuperscript{47} As seen in figure 4, it seems likely that if the Davies-Zhang average marginal tax rate series were available for the 1992-1995 period, the estimates from those models would be higher than those for the others.

\textsuperscript{48} Klovland, supra footnote 2, at 437.
estimates covering the period to 1995 provide evidence of marked growth in the 1989 to 1995 period. Indeed, there appears to have been about as much growth in this 7-year period as in all of the previous 20 years. This new period of tax-induced growth apparently began even before the introduction of the GST, and it seems to be continuing.

Our estimates permit us to attempt a very rough breakdown of the changes in the underground economy attributable to changes in direct taxes and those attributable to changes in indirect taxes. To do this, we simulated the effects on currency holdings of keeping the direct tax rate and the indirect tax rate separately at their 1964 values, while letting all other variables (including the other tax rate) take on their actual values. This permits us to divide the estimated changes in the underground economy shown in figure 4 into those associated with each type of tax.49

The results vary considerably across models, but some broad trends are worth reporting. Between 40 percent and 60 percent of the growth in the underground economy between 1964 and 1975 was attributable to direct tax rate increases. This increased to between 50 percent and 75 percent by 1985 but declined to the 45-65 percent range by 1990. For the models with data to 1995, the share of the direct tax rate in underground economy growth since 1964 falls to the 30-40 percent range. It seems that changes in indirect taxes could even account for the majority of underground economy growth over the entire period.

The indirect tax rate used here incorporates both PSTs and the GST. Using data to 1995, we can try to investigate further the separate roles played by changes in PSTs and by the introduction of the GST. Alternative values for the indirect tax rate are calculated that set GST revenues to zero but leave PST revenues at their actual values. (This eliminates the sharp rise in this tax rate seen in figure 1.) We simulate what currency holdings would then have been. The results are compared with the currency that the equations predict would have been held in the presence of the GST. Similarly, the effect of changes since 1964 in the ratio of PST revenues to personal incomes can be investigated in a simulation that keeps this ratio at its 1964 level, while permitting the introduction of the GST. The results are shown in table 3 for model 1, which uses average direct tax rates, and for models 3B and 4B, which use marginal direct tax rates.

Another way to try to determine the effect of the introduction of the GST is to re-estimate the models using an indirect tax rate defined as the share of PST revenues in personal incomes and using a dummy variable

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49 If the separately calculated effects of each tax on the growth of the underground economy are added together, the result is not equal to the estimated effect on the underground economy of the combined changes in all taxes simultaneously (the data reported in table 2). The reason is that the estimated equations explain the change in the log of currency. When the implied levels of currency are calculated, the effects on currency demand of separate simulations with each tax rate do not sum to exactly the level implied by the simultaneous changes of all tax rates. The shares for each tax reported here are shares of the sum of the effects of the separate tax simulations.
for the GST years. (This has a value of 1 for 1991 to 1995 and is zero otherwise.) The results of simulations with such equations are reported as equations 1C, 3C, and 4C in table 3. These suggest a lower relative importance of indirect taxes in underground economy growth than do the other models.50

The estimates from the different models shown in table 3 vary considerably, and only the most general and tentative conclusions can be drawn. Changes in direct tax rates, whether measured as average or marginal rates, have accounted for a substantial amount of the change in the underground economy. Changes in PSTs have had some role in underground economy growth, although the introduction of the GST seems to have had a somewhat larger effect than all the changes in PSTs since 1964.

Our study also sheds some light on the question of the effect on tax evasion of revenue-neutral changes in the mix of direct and indirect taxes. This is most clearly seen in the first model, which uses both average direct and average indirect taxes as a percentage of personal income. The estimation results detailed in the appendix show that a decrease in average direct tax revenues of one percentage point of personal income and its replacement by an increase in indirect tax revenues of the same amount would lead to an increase in currency holdings and presumably a corresponding increase in the underground economy.51

Table 3 Estimates of the Share of Changes in the Underground Economy by 1995 Owing to Changes Since 1964 in Different Taxes (Percent)

<table>
<thead>
<tr>
<th>Equation number</th>
<th>Direct tax rate</th>
<th>PST</th>
<th>GST</th>
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</thead>
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<tr>
<td>1</td>
<td>37</td>
<td>30</td>
<td>34</td>
</tr>
<tr>
<td>1C</td>
<td>64</td>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>3B</td>
<td>27</td>
<td>35</td>
<td>38</td>
</tr>
<tr>
<td>3C</td>
<td>41</td>
<td>25</td>
<td>34</td>
</tr>
<tr>
<td>4B</td>
<td>32</td>
<td>33</td>
<td>35</td>
</tr>
<tr>
<td>4C</td>
<td>63</td>
<td>19</td>
<td>18</td>
</tr>
</tbody>
</table>

Note: Totals may not sum to 100 because of rounding.
GST = goods and services tax. PST = provincial sales tax.

50 Detailed results are reported in the appendix. The GST dummy variable is a crude proxy because it implies that the growth rate of currency held by the public would rise permanently after the introduction of the new tax. If the GST increases the size of the underground economy, it could be expected that the growth rate of currency would increase temporarily until enough cash was acquired to finance the new, higher level of underground transactions. However, given that the data cover only the period 1991-1995 and that the evidence suggests that the response to changes in taxes takes place gradually, there is some reason to expect that a GST dummy could play a role. It is statistically significant in two of the three models examined.

51 This is the case because the sum of the estimated coefficients for the average indirect tax rate (11.05) greatly exceeds the sum of the coefficients for the average direct tax rate (1.89) in the first model, where the two tax bases are the same.
To see if this result was due to the effect that the 1991 introduction of the GST may have had on the weight given to indirect taxes, we reestimated the models with direct tax rates using data only up to 1990. The indirect tax rate in this case included only PSTs. Compared with the models estimated to 1995, the coefficients on direct taxes rose while those on the indirect tax rate fell, leaving the two almost equal.\(^{52}\) This implies that a change in the tax mix, reducing direct tax revenues and increasing PST revenues, would leave currency holdings and hence the underground economy almost unaffected.\(^{53}\) In either case, however, these results do not support the hypothesis that a shift in the direct-indirect tax mix would improve tax compliance and decrease the underground economy.

**CONCLUSIONS**

An understanding of how underground activities respond to tax rate changes is particularly important in the determination of future tax policy. This article has shown that there is very strong evidence that tax rates, defined in a wide variety of ways, have significantly influenced currency demand and presumably the extent of tax-evading underground activity in Canada during the last 30 years. Tax rate changes have increased the size of the underground economy, and that increase has become relatively rapid in the last 10 years. Revenue Canada’s concern about tax evasion and the underground economy appears well justified.

How much that growth has been in absolute terms is much less certain. If velocities between about 2 and 7 are considered the most reasonable range, the most acceptable of the available tax rates we examined suggest growth of the underground economy from 1964 to 1995 ranging between about 3 percent and 11 percent of GDP. Whatever the overall increase has been, the results also suggest that a variety of direct and indirect tax rate changes have been responsible for it. The estimates are too imprecise for us to suggest whether changes in direct taxes or in indirect taxes have been more important; however, our results do provide empirical support for the

\(^{52}\) For reasons of space, the details of the econometric results for this variant of models 1, 3B, and 4B are not reported here. For the first model, the sum of the coefficients for the average direct tax rate was 3.4 and for the indirect tax rate, 3.6. (A similar change in the size of the indirect tax coefficient did not occur in the models using marginal direct tax rates.) These coefficients also implied that changes in PSTs were responsible for a somewhat smaller share of underground economy growth than that found in the version estimated to 1995.

\(^{53}\) This result is consistent with the theoretical predictions of the general equilibrium model developed by Kesselman, supra footnote 20, to determine the evasion effects of changes in the direct-indirect tax mix. Kesselman also notes, ibid., at 147, that a change in the indirect tax mix that replaces a manufacturers’ sales tax with a broadly applied value-added tax could increase indirect tax evasion while possibly decreasing income tax evasion. The net effect could be to increase tax evasion, as the results here suggest. (A related paper that discusses the effects of changes in the tax mix on avoidance and evasion is Jonathan R. Kesselman, “Role of the Tax Mix in Tax Reform,” in John G. Head, ed., *Changing the Tax Mix* (Sydney: Australian Tax Research Foundation, 1986), 49-94.)
view that improvements in tax compliance are not likely to be achieved by a change in the tax mix away from direct and toward indirect taxes.

Our numerical results suggest that the choice of tax rate used to describe the evolution of the underground economy is not nearly as important in influencing the final result as the choice of the value for the velocity of currency. Further progress in narrowing this range of uncertainty requires better information than now exists about the nature of cash holdings in the underground economy.54 Without such information, it does not seem possible to use the currency-demand approach to arrive at more reliable estimates of underground economy growth.

APPENDIX
Econometric Estimates
We considered the following currency demand function:

\[ \Delta c = a_0 + a_1 \Delta y_t + a_2 \Delta R_t + a_3 \Delta DT_t + a_4 \Delta IT_t + \epsilon_t \]

where

- \( \Delta c \) is the change in natural log of desired currency holdings;
- \( \Delta y_t \) is the change in the scale variable (the natural log of consumer expenditure in this case, which reflects both changes in prices and real incomes);
- \( \Delta R_t \) is the change in a nominal after-tax interest rate that measures the opportunity cost of holding currency;
- \( \Delta DT_t \) and \( \Delta IT_t \) are the changes in the direct and indirect tax rate variables, respectively; and
- \( \epsilon_t \) is an error term.

As noted in the main body of the paper, models 1C, 3C, and 4C were estimated with an additional term, a GST dummy, while only PSTs were included in the indirect tax rate measure. The model was estimated using these first differences of all variables to avoid the spurious regression problem.55

In our estimates, we use Almon polynomial lags for several of the exogenous variables.56 This structure is consistent with an assumption of

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54 This information is clearly difficult to obtain. An interesting recent attempt using survey methods has been made in the Netherlands and sheds some light on the extensive hoarding of large denomination notes. See Willem C. Boeschoten and Martin M.G. Fase, “The Demand for Large Banknotes” (August 1992), 24 Journal of Money, Credit and Banking 319-37.


56 The structure of the model is similar to that used recently by Spiro, supra footnote 7. For both direct and indirect tax rates, the current and seven lagged values were used in a polynomial of degree two. The current and two lagged values were used for the interest (The footnote is continued on the next page.)
sluggish or partial adjustment within each period to the long-run equilib-
rium value of the endogenous variable. However, it can also represent an
environment where the endogenous variable depends on the expected value
of the exogenous variables and expected values depend on past values.

As reported earlier in table 2, 10 different definitions of the direct tax
variables were used to study the sensitivity of the simulation of currency
demand in the absence of tax rate changes since 1964.

Because of the theoretically inferior nature of the personal income tax
rate variables, only the cases using broad direct tax rates are reported in
detail in table A1. With the exception of the interest rate in equation 1C,
all the independent variables have the expected signs. Most of the esti-
mated coefficients are statistically significant at the 5 percent level or
better. The exceptions are the interest rate measure in equation 3C and
the direct tax rate measures in equations 3B, 3C, and 6B, which are statisti-
cally significant at the 10 percent level, and the direct tax rate in equation
4B, which is not statistically significant. In this last case, we retained
the variable because of the theoretical appeal of including a direct tax rate.
(Dropping the direct tax rate entirely lowers the overall estimates of un-
derground economy growth to 2.7 percent by 1991 and 6.4 percent by
1995.) With the possible exception of those equations using the GST
dummy, the models appear to be reasonably well specified judged by the
signs of the estimated coefficients, the \( R^2 \), and the \( t \)-ratios.\(^{57}\)

The forecasting ability of the best models was also examined by re-
moving the last five observations and re-estimating each. The estimated
models then forecast changes in the log of currency holdings for the last
five years of the sample. To allow better comparison of all the models,
equations 1, 2, 3B, and 4B also were re-estimated to 1986 and a forecast
made to 1991 for comparisons with equations 5B and 6B. The resulting
root mean squared forecast errors are shown in table A2.

These equations forecast quite well. The marginal direct tax rate of
persons with average taxable income (used in model 4B) provides the
best forecast for 1991-1995. The average direct tax rate models are the
best forecasters for 1987-1991. It is not clear from these forecasts that
marginal tax rates can be preferred to average tax rates.

**Data Definitions and Sources**

Data were drawn from the CANSIM Mainbase unless otherwise noted.
The CANSIM series number is noted where applicable. If data are not

\(^{56}\) Continued . . .

rate and personal expenditure variables in a polynomial of degree one. No endpoint con-
straints were used. (The exception was equation 1C, where no lags were used for the
indirect tax rate and the net-of-tax interest rate.)

\(^{57}\) The Durbin-Watson (DW) statistics all provide inconclusive results in testing for
 autocorrelation. However, given the use of first differences in the regression, this is not
likely to be a serious problem.
Table A1  Regression Results for Currency Demand Models

<table>
<thead>
<tr>
<th>Eq. no.</th>
<th>Direct tax rate used in model</th>
<th>Constant</th>
<th>Direct tax rate</th>
<th>Indirect tax rate</th>
<th>GST dummy</th>
<th>Consumer expenditure</th>
<th>Interest rate</th>
<th>$R^2$</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Share of direct taxes in personal income</td>
<td>$-0.040$</td>
<td>$1.89$</td>
<td>$11.05$</td>
<td>$1.14$</td>
<td>$-0.007$</td>
<td>$0.84$</td>
<td>$2.87$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>($-1.91$)</td>
<td>($1.87$)</td>
<td>($2.97$)</td>
<td>($5.41$)</td>
<td>($2.49$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1C</td>
<td>(As equation 1, with GST dummy)</td>
<td>$0.008$</td>
<td>$2.96$</td>
<td>$4.03$</td>
<td>$0.02$</td>
<td>$0.64$</td>
<td>$0.003$</td>
<td>$0.69$</td>
<td>$1.81$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.36)</td>
<td>(3.11)</td>
<td>(1.71)</td>
<td>(1.17)</td>
<td>(3.08)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Share of direct taxes in personal income net of</td>
<td>$-0.047$</td>
<td>$1.68$</td>
<td>$11.50$</td>
<td>$1.20$</td>
<td>$-0.007$</td>
<td>$0.84$</td>
<td>$2.92$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>transfers</td>
<td>($-2.40$)</td>
<td>($1.83$)</td>
<td>($3.15$)</td>
<td>($6.06$)</td>
<td>($-2.35$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3B</td>
<td>Marginal direct tax rate (average tax filer)</td>
<td>$-0.049$</td>
<td>$0.82$</td>
<td>$16.12$</td>
<td>$1.20$</td>
<td>$-0.008$</td>
<td>$0.83$</td>
<td>$2.86$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>($-3.48$)</td>
<td>($1.29$)</td>
<td>($6.01$)</td>
<td>($8.10$)</td>
<td>($-3.13$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3C</td>
<td>(As equation 3B, with GST dummy)</td>
<td>$-0.040$</td>
<td>$1.58$</td>
<td>$12.97$</td>
<td>$0.056$</td>
<td>$1.05$</td>
<td>$-0.005$</td>
<td>$0.75$</td>
<td>$2.54$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($-2.20$)</td>
<td>($1.64$)</td>
<td>($2.43$)</td>
<td>($4.04$)</td>
<td>($5.72$)</td>
<td>($-1.60$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4B</td>
<td>Marginal direct tax rate (average taxable income)</td>
<td>$-0.056$</td>
<td>$0.60$</td>
<td>$13.65$</td>
<td>$1.31$</td>
<td>$-0.010$</td>
<td>$0.82$</td>
<td>$2.82$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>($-3.57$)</td>
<td>($0.98$)</td>
<td>($3.31$)</td>
<td>($8.64$)</td>
<td>($-3.89$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4C</td>
<td>(As equation 4B, with GST dummy)</td>
<td>$-0.05$</td>
<td>$2.19$</td>
<td>$9.95$</td>
<td>$0.30$</td>
<td>$1.15$</td>
<td>$-0.007$</td>
<td>$0.76$</td>
<td>$2.46$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($-2.79$)</td>
<td>($2.42$)</td>
<td>($1.73$)</td>
<td>($2.20$)</td>
<td>($6.86$)</td>
<td>($-2.56$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5B</td>
<td>Marginal direct tax rates weighted by income</td>
<td>$-0.048$</td>
<td>$1.22$</td>
<td>$13.16$</td>
<td>$1.15$</td>
<td>$-0.009$</td>
<td>$0.82$</td>
<td>$2.80$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>($-2.60$)</td>
<td>($1.68$)</td>
<td>($2.16$)</td>
<td>($5.59$)</td>
<td>($-3.25$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6B</td>
<td>Marginal direct tax rates weighted by number of</td>
<td>$-0.054$</td>
<td>$1.57$</td>
<td>$16.39$</td>
<td>$1.17$</td>
<td>$-0.008$</td>
<td>$0.82$</td>
<td>$2.80$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>returns</td>
<td>($-3.30$)</td>
<td>($1.45$)</td>
<td>($2.99$)</td>
<td>($6.62$)</td>
<td>($-2.74$)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Where lagged variables were used, the sum of coefficients is reported. T-statistics are in parentheses. See the appendix for a detailed description of the regressions, the sources of data, and the definitions of variables. Equations 5 and 6 have been estimated using 1964-1991 data (not including lagged values) and tax rates calculated by Davies and Zhang. In all other equations, data up to 1995 have been used.
Table A2  Root Mean Squared Error (MSE) for Five-Year Currency Demand Forecasts

<table>
<thead>
<tr>
<th>Equation number</th>
<th>1</th>
<th>2</th>
<th>3B</th>
<th>4B</th>
<th>5B</th>
<th>6B</th>
</tr>
</thead>
<tbody>
<tr>
<td>For 1991-95 forecast</td>
<td>0.0121</td>
<td>0.0104</td>
<td>0.0088</td>
<td>0.0061</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>For 1987-91 forecast</td>
<td>0.0021</td>
<td>0.0037</td>
<td>0.0065</td>
<td>0.0038</td>
<td>0.0109</td>
<td>0.0175</td>
</tr>
</tbody>
</table>

Note: The mean of the dependent variable is 0.083 for the 1964-1990 period.

annual, they are converted by averaging. First differences of tax rates and interest rates and first differences of natural logs of all other variables were used in the regressions.

Currency
Monthly observations of currency outside banks, in nominal dollars, (B2001) were averaged to obtain an annual series.

Average Direct Tax Rates
A broad average tax rate was found by dividing annual Personal Direct Tax Revenue (D11103) by Personal Income (D11083). (This measure also includes employer contributions to payroll taxes.) An alternative base for the tax is personal income less Current Transfer Payments to Persons (D11090).

Marginal Direct Tax Rates
The combined federal and provincial marginal personal income tax rate used in equation 3 uses a measure similar to that employed by Éthier.58 Average assessed income was determined by dividing total assessed income by the number of tax returns as reported by the Department of National Revenue’s Green Book data (annual editions for the 1944 tax year onward).59 The average taxable income of taxpayers with this average assessed income was calculated from detailed data by income group. For each income bracket, taxable income in that income bracket was divided by the number of tax returns.

The combined federal and provincial marginal tax rates applicable to a single taxpayer with that level of taxable income was then determined from the various annual editions of The National Finances60 and, for the years before 1952, from tax rate data in the Green Book. Where provincial tax rates differed, the Ontario provincial tax rate was used.

58 Supra footnote 12.
59 Canada, Department of National Revenue, Taxation Division (later Revenue Canada, Customs, Excise and Taxation), Taxation Statistics (Ottawa: Supply and Services, annual editions, 1946-1995) (herein referred to as “the Green Book”).
60 The National Finances (Toronto: Canadian Tax Foundation, various years).
An alternative marginal personal income tax rate is that borne by filers of taxable returns with the average taxable income, the rate used in equation 4A. This marginal rate is taken from The National Finances.

The weighted-average marginal personal income tax rates for equations 5 and 6 were calculated up to 1991 using Green Book data by Davies and Zhang. They used income and number of tax returns as alternative sets of weights to obtain weighted-average marginal federal personal income tax rates. They converted these values to an estimate of combined federal and provincial marginal income tax rates by multiplying the federal rates by the ratio of total federal plus provincial income tax collections to total federal collections.

All of these marginal personal income tax rates were then augmented by incorporating other direct taxes. Data on payroll tax payments were drawn from the following sources: Canada Pension Plan Contributions (D20246), Quebec Pension Plan Contributions (D20249), Unemployment Insurance Contributions (D11241), and Employers’ Contributions to Workers’ Compensation (D11246). Data on provincial payroll tax revenues from Quebec, Manitoba, Ontario, and Newfoundland are drawn from Kesselman.

The payroll tax rate, $t_p$, is the sum of all contributions made by both employers and employees to these social insurance programs, expressed as a fraction of the total payroll tax base. This base consists in part of Wages, Salaries and Supplementary Labour Income (D20008), augmented by the employers’ contributions to payroll taxes, whose incidence is assumed to fall on labour income. The addition of employers’ contributions gives the total cost to employers of wages and salaries.

Employers’ contributions are determined by considering the share paid in the case of each payroll tax. With the CPP/QPP, employers and employees pay equal shares. For UI, employers pay 1.4 times the contributions of employees. Workers’ compensation payments and provincial payroll taxes are paid by employers.

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61 Davies and Zhang, supra footnote 27, at appendix table A4.


63 It is also the total pre-tax income that we assume employees would get if they were required to make all statutory payroll tax payments. The measured payroll tax rate should not vary according to the arbitrary division of total payments between employers and employees. If, for example, employees were made responsible for all payroll tax payments, we assume that employers’ total costs would not change and before-tax income payments to workers would rise by the amount that employers had formerly paid. In other words, the incidence of payroll taxes falls on labour incomes (which includes the incomes of the self-employed and net farm incomes, where payroll taxes are applicable).
Added to the base are also other sources of income on which at least some payroll taxes must be paid: Accrued Net Income Farm Operators (D20005) and Net Income Unincorporated Business (D20006). The self-employed must make contributions to the CPP/QPP and to provincial payroll taxes.

The augmented marginal direct tax measure is therefore

\[ t_{PIT}(1 - t_p) + t_p \]

where \( t_{PIT} \) is the appropriate marginal personal income tax rate.

**Average Indirect Tax Rate**

An average indirect tax rate is calculated using general provincial sales tax revenue (D464273) with data before the 1965-66 fiscal year taken from the *Historical Statistics of Canada*.\(^{64}\) Annual GST revenues for 1991-1995 are derived from D459307.

**Other Data**

Data on personal expenditures on consumer goods and services were drawn from D10113. Gross domestic product data were taken from D20011.

The interest rate used is the 90-day treasury bill tender (derived from B14007) converted to an annual average. Where this is converted to an after-tax interest rate, the marginal personal income tax rate used in the model is employed to calculate it. (For the average direct tax rate models, the marginal personal income tax rate of the tax filer with average taxable income is used.) The calculation assumes that the interest income exemption in effect between 1974 and 1987 meant that the average taxpayer had a zero marginal tax rate on interest income during this period. This accords with the level of such income reported for the average taxpayer in the Green Book.

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