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The Underground Economy in Canada

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**REVISITING THE LATENT VARIABLE/MIMIC MODEL APPROACH TO
MEASURING THE SIZE OF THE CANADIAN UNDERGROUND ECONOMY**

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ABSTRACT

There is considerable agreement internationally about the factors that determine the relative size of the underground economy (tax burden, regulation, enforcement, confidence in government, labour force characteristics, and morality) and that evidence of underground activity will be captured in several economic indicators (GDP, currency in circulation, and consumption rates). Until recently, however, the methods that have been employed to measure the underground economy focused on only a few causal factors, one indicator, and only produced an estimate for one particular point in time. There exists a modeling technique that treats the underground economy as an unobservable or latent variable and incorporates multiple indicator and multiple causal (MIMIC) variables. The MIMIC model uses information contained within relevant indicator and causal variables to estimate a time-path of the size of the hidden economy. In applying this estimation technique to Canada data, my results indicate that, the underground economy in Canada grew steadily relative to measured GDP over the period 1976 to 2001. The value of the broadly defined underground economy grew from about 7.9% of GDP in 1976 to about 16% in 2001. In real (1997) dollar terms, it increased from about \$40 billion to \$166 billion.

Keywords: Underground Economy, Structural Equation Model, Latent Variable

JEL Classification: C32, O17, 051

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INTRODUCTION

The Bougons are a French-Canadian family that has recently achieved notoriety not only in their home province of Quebec but also across Canada. The father, Paul Bougon, bribed a Canada Post letter carrier to deliver fraudulent welfare cheques to the Bougon house. His wife, Rita, is a self-employed phone sex operator. Their eldest son, Paul Jr., engages in car theft, among other illegal activities, and their daughter, Dolorès, is an exotic dancer/prostitute. The family also adopted a Chinese child, Mao, to help the family with computer scams. Not a penny of the income earned through any of these activities is reported to the appropriate tax collecting agency.

The family, however, has not attained their infamy as a result of a tax audit. Rather, the Bougon are a fictional family that is the subject of a sitcom (*Les Bougons*) that airs weekly on Radio-Canada, the French-language service of the Canadian Broadcasting Corporation (CBC), a public broadcaster. In an article entitled “Boozing scam artists steal hearts of viewers,” published in the *Globe and Mail*, 16 February 2004, Ingrid Peritz reported that the show has quickly become popular, 34% of the French-speaking population in Canada tune in, and viewers seem to admire the enterprising Bougon family, describing them as contemporary Robin Hoods.

The Bougon family is participating in what is commonly called the underground economy. With the apparent wide-scale acceptance of the lifestyle of the Bougon family, it appears timely to reexamine the phenomenon of the underground economy in Canada and provide an update to the empirical evaluation conducted by Giles and Tedds (2002). In particular, this study extends Giles and Tedds’ study by: lengthening the period under examination to 2001; including a number of new variables that the theoretical literature purport to have a sizeable impact on the underground economy; and making important modifications to the empirical techniques. The results reported in this paper are more robust than those reported in Giles and Tedds (2002) and responds to many of the contained in the discussion of Hill (2002) and Smith (2002).

Overall, the results indicate that, in general, the underground economy in Canada grew steadily relative to measured GDP over the period 1976 to 2001. The value of the broadly defined

underground economy grew from about 7.5% of GDP in 1976 to about 15.3% in 2001. In real (1997) dollar terms, it increased from about \$38 billion to \$159 billion *per annum*. The paper begins with a discussion of the definition of the underground economy, followed by a description of the six key methodologies that have been used to obtain estimates of the underground economy. A discussion of the causes and previous estimates of the Canadian underground economy is then provided. This is followed by a brief description of the modeling methodology employed in this study and a discussion of the results. The paper ends with some concluding remarks.

DEFINING THE UNDERGROUND ECONOMY

Which activities are included in the definition of the underground economy affects the interpretation of any estimate of the extent of this phenomenon. For example, a very narrow definition would include only legal, market transactions that are not included in measured GDP. A somewhat broader definition would include both legal and illegal market transactions that are not included in measured GDP. One can also approach the above definitions by considering activity that is not detected by the tax authorities, rather than that omitted from GDP. Finally a very broad definition of the underground economy would be one that included all transactions, legal and illegal, market and non-market that are either intentionally excluded from GDP or omitted from the tax base. These definitions are summarized in Table 1. The one employed in this study is the fourth.

Whichever definition is used, it has become common practice to report the size of the underground economy as a percentage of GDP. This practice is simply a way of facilitating international and intertemporal comparisons by avoiding units of currency. The authors of these studies are not suggesting that reported GDP is mis-measured by this percentage amount. This is largely for two reasons: GDP is a value-added measure rather than a measure of total economic activity, whereas many measures of the hidden economy report total hidden activity; and, depending on the definition employed, the measure of the underground economy usually includes both legal and illegal activities, the latter of which are often excluded in the definition of GDP.

Table 1
Definitions of the Underground Economy^a

1. Legal market based transactions missing from measured GDP.
 2. Legal market based transactions not reported to the revenue-gathering agency.
 3. Legal and illegal market based transactions missing from measured GDP.
 - 4. Legal and illegal market based transactions not reported to the revenue-gathering agency.^b**
 5. Legal and illegal market and non-market based transactions that escape detection or are intentionally excluded from measured GDP.
-

Source: Taken from Giles and Tedds (2002, p. 89).

Notes: a) Following from the discussion above, the relationship between the resulting estimates from these definitions can be portrayed as follows: $1 < 2 < 3 < 4 < 5$.

b) Definition employed in this study.

MEASURING THE UNDERGROUND ECONOMY

There are essentially six key methodologies that have been used to obtain estimates of the underground economy and they will be summarized briefly here. A more detailed account can be found in Giles and Tedds (2002).

The first three approaches base their measure on the amount of currency in circulation in the economy. Gutmann's (1977) Method or the *Currency Ratio Method* dates back to Cagan (1958) and studies the ratio of currency to demand deposits. It postulates that increases in the ratio over some base year are the result of the need to hold cash for underground transactions. *Tanzi's (1980) Method* relaxes the assumption of a constant ratio of cash to the money supply by making this ratio a function of the rate of interest, per capita income, various tax variables, and the share of wages in national income. Feige's (1979) *Transaction Method* examines the relationship between the total value of transactions (measured by adding currency transactions to cheque-based transactions, except purely financial ones) and measured GDP.

The fourth approach, the *National Accounts/Judgmental Method*, involves no formal "modeling" of the underground economy, but instead rests on a detailed breakdown of either the expenditure

or income side of the national accounts into its component parts, and the application of subjective judgments as to the maximum likely levels of unrecorded incomes or expenditures.

Fifth is the *Latent variable or MIMIC model*, which involves the use of is a structural econometric model. The application treats the size of the underground economy as an unobservable "latent" variable that is linked on the one hand to a collection of (observable) indicators which "reflect" changes in the size of the underground economy and on the other hand to a set of (observed) causal variables which are believed to be important driving forces behind underground economic activity. It is this method of estimating the size of the underground economy that is employed in this paper.

These macroeconomic measures, however, have been criticized for not being based on consumer theory and for employing flawed econometric techniques (Thomas, 1999). A technique developed by Dilnot and Morris (1981) and modified by Pissarides and Weber (1989) and Lyssiotou et al. (2004) responds to these criticisms. This *Expenditure-based method* uses estimates of the relationship between food consumption and income (i.e., an Engel curve) to measure the size of the underground economy.¹

THE CANADIAN UNDERGROUND ECONOMY: DETERMINANTS AND PREVIOUS ESTIMATES

There is considerable agreement internationally, on both theoretical and empirical grounds, about the factors that determine the relative size of the underground economy. These factors include the tax burden, regulation, enforcement, labour force characteristics, confidence in government, and morality. The relationship of these factors to the Canadian underground economy will be briefly discussed here.

Tax Burden

Perhaps the single most commonly cited "driving force" of the underground economy is the tax burden. Since the 1970's Canada has been subject to: a rise in personal income taxes net of transfers; a rise in these taxes as a share of personal income; an increase in total tax revenue as a share of GDP; and, the replacement of the narrowly-based federal manufacturing sales tax in 1991 with the more broadly-based Goods and Services Tax (GST). This trend has only recently

been halted, with reductions in the federal marginal personal income tax rate, and decreased tax rates in many of the provinces, with the majority of the tax changes taking place in the 2000 and 2001 tax year.

The implementation of the GST in 1991 has probably received the most “credit” for increasing the size and growth of the Canadian underground economy in recent times. It is often argued that the switch from the more narrowly based federal manufacturers’ sales tax to this broadly based consumption tax may have increased the incentives and opportunities for tax evasion (Spiro, 1993; Hill and Kabir, 1996; and Giles and Tedds, 2002). This is interesting because, when the GST was first proposed (and throughout its implementation), the federal government argued that the GST would reduce the scope for tax evasion. This was based, in part, on evidence at that time from New Zealand. In fact, until the advent of the Canada Customs and Revenue Agency’s “Underground Economy Initiative” in November 1993, the Canadian government has dismissed the notion that the underground economy was of any significance, in contrast with the position of the IRS in the United States.

The “stacking” of taxes in Canada, is also a likely driver of underground activity. In Canada, both the federal and the provincial governments have the ability to utilize methods of direct and indirect taxation to raise revenue. As a rule, Canadians are taxed on the same base – whether it is income or consumption of goods and services – by both levels of government. Provincial personal taxes, for the most part, are based on a set percentage of federal personal tax collected.² In 1998, the maximum values for these ranged from a low of 42.75% in Ontario to a high of almost 70% in Newfoundland. As a result, any increase in the federal marginal tax rate automatically increased the amount of provincial tax paid, even if the provincial tax rate remained unchanged. The provinces, with the sole exception of Alberta, also charge provincial sales taxes (PST).³ The PST's are applied primarily on retail goods, are paid solely by the consumer, and, now with the existence of the GST, are paid in addition to the latter tax. While the PST rates vary from province to province, the average sales tax rate paid (including GST and PST) by consumers is 15%.

Excise taxes are also a popular revenue generating tax for both levels of government. Goods that are susceptible to high levels of excise taxation at the federal and/or provincial level (other than

those mentioned above) are alcohol, tobacco, and gasoline. For example, the Federal Excise Tax on gasoline adds 15 cents to the price of a litre of gasoline and the average provincial tax is 14.9 cents a litre. The GST is also collected, adding approximately another 3-4 cents a litre (depending upon the actual pump price), and some provinces also collect municipal gas surtaxes. Combined, these taxes amount to about half of what Canadians pay for a litre of regular gas. While these taxes have received little attention in the past, in the face of rising gas prices and government surpluses, Canadians are now questioning their existence.

It is sometimes argued that due to this stacking effect Canadians may suffer from “tax fatigue”. That is, it is the number of different taxes that Canadians pay that drives them into the underground economy, and not necessarily a particular tax. According to this argument, simply lowering one tax, such as the federal marginal tax rates, would likely do little to curb underground activity, whereas eliminating a tax, such as the GST or PST, would likely have a substantial impact on curbing underground activity.

Canadians are, for the most part, extremely proud of their social safety net, but it too provides incentive to hide income and to work “off the books”. Small businesses in Canada often find it difficult to pay their portion of payroll taxes, notably workers' compensation, employment insurance and pension premiums in the Canadian context. Employees can also find these so-called payroll taxes a burden. In addition, people receiving welfare or disability payments find that their payments are reduced if they earn any other income and an additional tax is imposed on those receiving Employment Insurance benefits if their total annual income exceeds about \$35,000. Put these together and you have a segment of employers and employees who prefer to hire and work off the books to avoid these costs. In fact, Lemieux *et al.* (1994) present evidence that taxes and social welfare payments do in fact distort labour-market activities away from the regular sector, and into the underground sector.

Regulation

The degree of regulation is often cited as a factor that influences people to engage in underground activity as regulations reduce an individual's freedom of choice. Canada underwent significant deregulation with the implementation of the Regulatory Reform Strategy

in 1986, one of the first comprehensive regulatory policies developed in the OECD (OECD, 2002). Since 1986, Canada has shown a declining trend in the growth rate of new legislation and regulation.

Enforcement

Greater effort put into the repression of crime and tax evasion by governments results in a greater probability of offenders being caught, thus lowering the rewards of participating in underground activity. The first important enforcement action taken by the Government of Canada was the implementation of the “Underground Economy Initiative” (UEI) by Canada Customs and Revenue Agency (CCRA) in November 1993.⁴ The UEI was introduced in response to a widespread perception that the underground economy in Canada was growing rapidly. The initiative, which was directed at the narrowly-defined underground economy, brought significant additional resources to the CCRA’s enforcement and collection programs, a redirection of the CCRA’s field-audit resources into specific areas in which the probability of underground activity is high, and it led the CCRA to work more closely with tax accountants and with community and industry groups.

A key program under the UEI is the Voluntary Disclosure program (VDP) which allows people to come forward and correct inaccurate or incomplete information or disclose material they did not report during previous dealing with CCRA, without penalty or prosecution. The program appears to be popular, with over 2,000 individuals using the VDP in 2000, up from 557 in 1993-94 (CCRA, 2000).

The UEI, however, may not be as successful in reducing underground activity as first thought. The initiative was scrutinized by the Auditor General of Canada (Canada, 1999) in 1999. The auditor general found that the reported gains in compliance were by no means all attributable to the UEI. According to CCRA, its activities to combat the underground economy had resulted in \$2.5 billion in additional tax revenue over a five-year period. However, according to the auditor general, this amount included the results of regular ongoing enforcement programs. The actual amount of additional tax revenue that could be attributed to the UEI’s audit activities over the period was actually less than \$500 million.

Labour Force Characteristics

Many studies have found that the average worker in the underground economy also holds a regular job in the official economy (Dallago, 1990 and Mogensen, 1995). Further, Lemieux *et al.* (1994), using micro data from a survey conducted in Quebec City, found that the substitution between labour market activities in the observed and underground sector was quite high and that there was high mobility between the sectors. This relationship seems to imply that there will be a strong positive causal relationship between labour force participation rates and the underground economy. Participation in the Canadian labour force steadily increased until 1990, when the Canadian economy entered into a recession from which it was slow to recover. Participation rates did not begin to improve until 1996.

The self-employed generally have greater opportunity to evade taxes than do regular employees, if they so choose. In Canada, the self-employment rate has increased dramatically over the last 25 years: from about 12% in 1976 to almost 18% in 1998, although it has decreased in recent years to just over 15% in 2001. As such, this feature of the Canadian workforce raises some interesting questions about tax evasion in this country in recent years. For example, Pissarides and Weber (1989), Apel (1994), and Mirus and Smith (1997) note that in the U.S., U.K., Sweden, and Canada respectively, only 60% to 80% of income in the self-employment sector is actually reported to the tax authorities.⁵

Confidence and Morality

Lack of confidence in the performance of government may also be a factor in the decision to participate in the underground economy. Some tax payers may have concerns about the way in which tax dollars are being spent or are perceived as being spent. Closely related to this issue is morality. Individuals may choose their level of compliance with laws and regulations to match their perception of the extent to which others comply. Recent survey evidence shows that “some 86% of Canadians believe that governments squander a lot of the money they collect in taxes. Less than one quarter of Canadians could be categorized as ‘model citizens’. Half of our respondents were categorized as ‘upset and envious’ or ‘tax anarchists’.” (Flexman, 1997, p. 72)

Table 3 summarizes the estimates for Canada, obtained by various researchers using one of the six methods described in the previous section. The estimates are reported in terms of a

percentage of nominal Canadian GDP, unless otherwise noted. The studies that used the same definition of the underground economy that is employed in this study are noted in bold type and they estimate the value of the underground economy to be approximately 11% of GDP in 1993 and about 15% of GDP in 1995.⁶

MIMIC MODEL APPROACH

The MIMIC model is a structural econometric model that treats the size of the underground economy as an unobservable “latent” variable.⁷ The MIMIC model was first applied to the problem of measuring the underground economy by Frey and Weck-Hannemann (1984). The application treats the size of the underground economy as an unobservable "latent" variable that is linked on the one hand to a collection of (observable) indicators which "reflect" changes in the size of the underground economy; and on the other hand to a set of (observed) causal variables which are believed to be important driving forces behind underground economic activity. Given data for the causes and the indicators, one estimates the model by applying fairly standard econometric procedures. The MIMIC model methodology has become generally accepted as the most comprehensive approach to this problem, with a small but growing number applications. In fact, it has been described as a “meaningful and intellectually fascinating” approach (Helberger and Knepel, 1988). Details of the model will not be provided here and readers are urged to consult Giles and Tedds (2002) for a comprehensive discussion of the model and its estimation, and a technical appendix detailing the estimation of the particular model described in this paper is available from the author upon request.

One of the benefits of working with the MIMIC model is that it produces a time-series of the underground economy. Unfortunately, it can only generate an index for a time-series: it can tell us about changes in the ratio from year to year, but not about the actual values of the ratio in individual years. To convert the index series into a time series of values, a reliable estimate of the underground economy ratio for the sample period under consideration is required. Giles and Tedds (2002) formulated a non-linear currency demand model for Canada based on that adopted by Giles (1999) for New Zealand and by Bhattacharyya (1990) for the U.K., in each case also developed in the context of trying to measure the size of the underground economy. Essentially, the method utilizes a conventional demand for cash model that is extended to allow for two

Table 2
Empirical Measures of the Canadian Underground Economy

Study	Definition (see Table 1)	Year	UE (% of GDP)* *Unless otherwise noted
<i>GUTMANN</i>			
Mirus and Smith (1981)	3	1976	15.7%
Haas (1978)	3	1977	11.1% (of GNP)
Barthelemy (1988)	3	1978	13%
Mirus (1984)	3	1980	11%
Mirus et al (1994)	3	1980	13.5%
Mirus et al (1994)	3	1985	25.9%
Karoleff et al (1993)	3	1990	21.6%
Mirus et al (1994)	3	1990	27.6%
Schnieder and Enste (2000)		1996, 1997	14.9%
Schnieder (2000)		1997, 1998	15%-16.2%
<i>TANZI</i>			
Barthelemy (1988)	3	1976	2.5%-12.4%
Mirus and Smith (1981)	3	1976	4.9%-7.5%
Éthier (1982)	4	1980	8.8%(tax rev.)
Ethier (1985)	3	1981	5.7% (of GNP)
Ng and Karolyi (1984)	3	1982	12%-16%
Mirus et al (1994)	3	1990	5.1%
Pouftis (1993)	3	1990	7.4%-13%
Hill and Kabir (2000)	4	Increase attributable to GST	0.02%-0.3%
Spiro (1993)	4	1992	0.8% growth
Spiro (1994)	4	1993	8%-11%
Hill and Kabir (1996)	3	Growth from 1964-1995	3%-11%
<i>TRANSACTIONS METHOD</i>			
Mirus and Smith (1981)	3	1976	27.5%
Mirus (1984)	3	1976	10%
Barthelemy (1988)	3	1979	22%
Mirus (1984)	3	1980	13.5%
Mirus and Smith (1989)	3	1982	10.96%-12.36%
Karoleff et al (1993)	3	1984	19.3%
Mirus et al (1994)	3	1984	23.9%
<i>NATIONAL ACCOUNTS/JUDGEMENT/SURVEY</i>			
Berger (1986)	1	1981	2.8%-3.3%
Gervais (1994) & Philip Smith (1997)	1 3	1992 1992	2.7% 3.7%
	4	1992	5.2%
	5	1992	47.1%
Paquet (1989)	5	1989	33%-100%
Drummond et al (1993)	3	1993	4.5%
Lemieux, Fortin and Frechette (1994)	4	1986	1.4% (Quebec)

(The table is continued on the next page)

Table 2 con't

Study	Definition (see Table 1)	Year	UE (% of GDP)* *Unless otherwise noted
<i>LATENT VARIABLE</i>			
Frey and Weck-Hannemann (1984)	4	1978	8.7%
Schneider (1997)	4	1994	15%
Tedds (1998)	4	1976-1995	4.2%-14.7%
Giles and Tedds (2002)	4	1976-1995	3.5%-15.7%
<i>EXPENDITURE BASED</i>			
Mirus and Smith (1997)	2	1990	1% (Self-Employed)
Schuetze (2002)	2	1969	20% (Degree of
		1974	12% income
		1984	15% concealing by
		1986	17% Self-Employed)
		1990	18%
		1992	21.5%

Source: Table is modified from Giles and Tedds (2002, p. 90-91).

Note: Bold type indicates studies that used the definition of the underground economy that is employed in this study.

sectors – one measured and one underground. This model, however, has subsequently been found to be extremely unstable.⁸ An alternative way to incorporate the underground economy into a demand for money equation is to treat underground output as an unobserved component and then estimate the resulting state space model by Maximum Likelihood using the Kalman (1960) filter.⁹ This was the approach taken in this paper and the author found that the results using this method were quite robust.¹⁰ The index series is then calibrated using the mean value of the underground economy obtained using the Kalman filter. The calibration process followed preserves the proportional relationships found in the original index series.¹¹

In order to ensure that the various time-series are stationary, and to avoid the consequences of estimating spurious regressions, the data are tested for unit roots.¹² The variables in the demand for money equation were found to be a mixture of I(1) and I(2) series. The series were then tested for cointegration using Haldrup's (1994) procedure and the results suggest that there is cointegration between the series. As a result, the demand for money equation is estimated using the levels of series. The variables for the MIMIC model were found to be a mixture of I(0), I(1)

and I(2) variables. Unfortunately there is no established literature to act as a guide for testing for cointegration in the context of the MIMIC model. Instead, the MIMIC model is estimated using the differenced data.

RESULTS

The Canadian underground economy is estimated for the sample period 1976-2001. A number of different models based on different combinations of causal and indicator variables were estimated and it was found that the model was robust to alternative specifications and normalizing choices.¹³ The models were also subjected to various econometric tests to determine the statistical “quality” of the estimates and to assist in the choice of a final, “preferred” model.¹⁴

The preferred model incorporates three indicator variables and eleven key causal variables.¹⁵ The indicator variables are:

1. Growth rate of gross domestic product (GDP);
2. Real currency per capita (RCURR); and
3. Ratio of expenditures on goods and services to disposable income (CONSUMP).

It is argued that a change in the size of the underground economy may be mirrored in the growth rate of measured real GDP, although the directional impact that this variable has on the underground economy is debatable and may vary from country to country. Those that find a positive relationship between GDP and the underground economy using the MIMIC method include Tedds (1998), Giles (1999), Giles and Tedds (2002), and Schneider and Bajada (2003).¹⁶

It is expected that there exists a positive relationship between GDP and the underground economy in Canada. **THEORETICAL REASONS**

Another key indicator is some type of monetary aggregate, as suggested by the monetary approaches to measuring the underground economy, briefly discussed above. Most of the monetary methods advocate a ratio approach to examining this issue, which would measure changes in currency relative to a broader monetary aggregate such as M1 or M3. In Canada, however, these monetary aggregates have been distorted seriously over the sample period due to interest rate effects and banking innovations, and this makes the inclusion of a ratio of currency

to a broader monetary aggregate in our model undesirable here. Instead, real currency per capita is used as an indicator variable.

The third indicator variable is the ratio of personal expenditures on goods and services to personal measured disposable income. It is designed to measure changes in spending behaviour, based on the assumption that income earned through underground activities will be used to bolster consumption patterns rather than being used for savings (which leaves a paper trail for the authorities).

The causal variables¹⁷, the relationship to the underground economy were discussed above, are:

1. Labour force participation rate (LFPR);
2. Average direct tax rate (ADTR)¹⁸;
3. Average indirect tax rate (AITR)¹⁹;
4. Average marginal tax rate (AMTR)²⁰;
5. Average payroll tax rate (APTR)²¹;
6. Dummy variable for the Voluntary Disclosure program (VDP) that equals the marginal tax rate (AMTR) for 1994 and onwards;
7. Crime rate (CRIME);
8. Dummy variable for the implementation of the GST (GST) that equals 1 in 1991 and onwards;
9. Dummy variable for the implementation of the Underground Economy Initiative (UEI) that equals 1 in 1994 and onwards;
10. Logarithm of real self-employment income; and
11. Flow of federal regulatory transactions by the Governor in Council and individual Ministers²² (REGS).

Figure 1 displays the results of the estimation of the MIMIC model. The indicator variables enter positively and significantly, implying that the Canadian underground economy has a positive relationship currency holdings, personal consumption, and the growth rate of GDP.

Most of the causal variables are statistically significant and of the appropriate sign. Marginal tax rates are an important contributor to the underground economy whereas the average direct

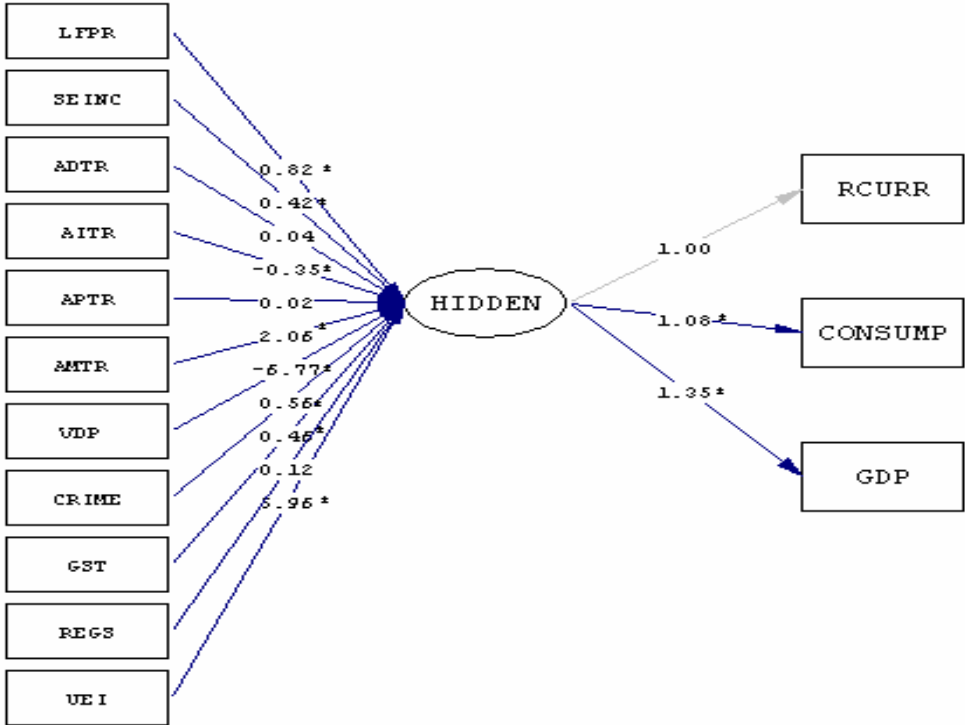
and average payroll tax rates, while positive, are not statistically significant. Indirect tax rates have a negative relationship with the underground economy, however, the implementation of the GST caused an increase in the Canadian underground economy. Generally, the Underground Economy Initiative (UEI) did not help combat underground activity, however, the specific initiative, the Voluntary Disclosure program, has had the anticipated negative effect. The fact that the MIMIC model produces an estimate that indicates that the UEI had a positive and significant impact on the underground economy in Canada is, on the surface, counter intuitive. While enforcement was increased, many of the policies enacted under the UEI, however, increased the regulatory burden on businesses and individuals. This increased burden increased, rather than decreased, the incentive to participate in the underground economy. Finally, as anticipated, regulations, the crime rate (acting as a proxy for morality), the amount of self-employment income earned and labour force participation are all positive and significant. The author believes that this is the most richly specified model of the underground economy using the MIMIC model.

The index series is converted into a time-series of values using the results from the demand for money equation. A long-run value of the Canadian underground economy of 11.35% was obtained, with an associated 95% confidence interval of [9.98%, 12.76%]. Figure 2 presents the resulting time-series values for the size of the Canadian underground economy (expressed as a percentage of GDP), given the preferred specification of the model shown in Figure 1. The results indicate that, in general, the underground economy in Canada grew steadily relative to measured GDP over the period 1976 to 2001. The value of the broadly defined underground economy grew from about 7.5% of GDP in 1976 to about 15.3% in 2001. In real (1997) dollar terms, it increased from about \$38 billion to \$159 billion. Figure 2 also shows the uncertainty that these results are subject to, via a 95% confidence interval.²³

The time-series depicted in Figure 2 shows that the growth of the Canadian underground economy contracted in 1977, 1991 and 1995 and experienced no change in 1982, all periods of slow or negative GDP growth. The introduction of the GST in 1991 apparently halted the contraction of the underground economy. The Canadian underground economy also contracted

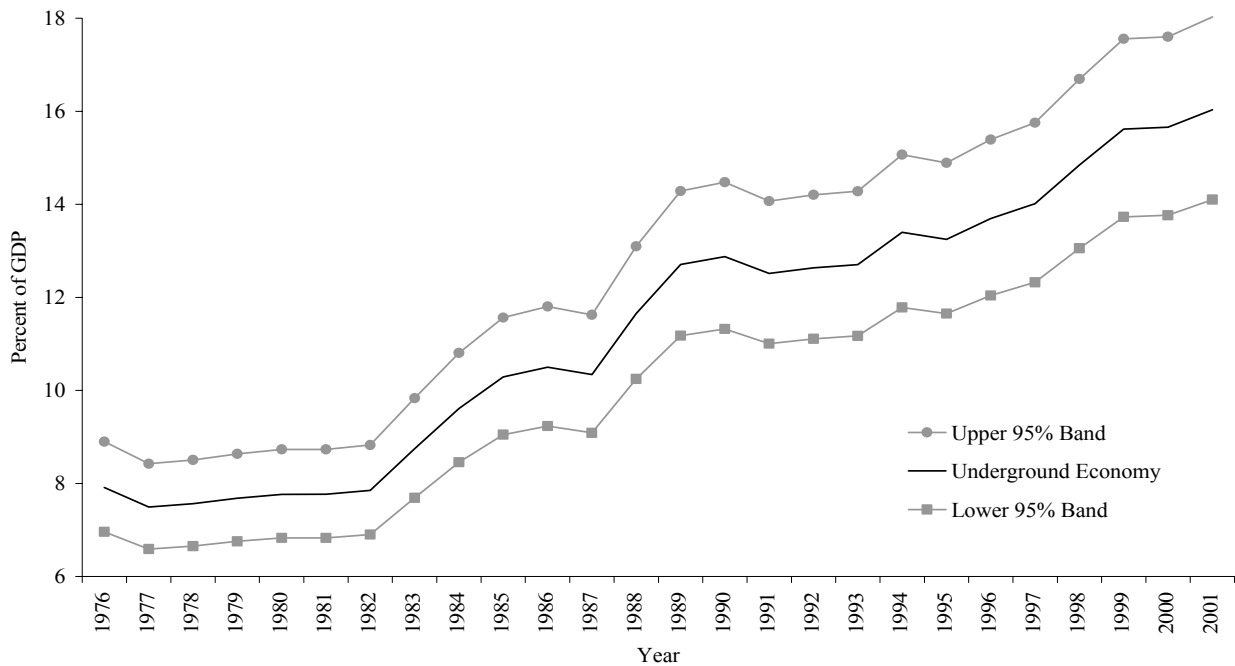
in 1987, likely a temporary reaction to regulatory reform. Figure 2 shows that the underground economy experienced a very high growth rate during the mid- to late-1980's, despite the fact that

Figure 1: MIMIC Model of the Canadian Underground Economy



* Indicates coefficient is statistically significant

Figure 2: The Canadian Underground Economy and Approximate 95 Percent Confidence Interval



there were a number of tax reforms during the 1970's and 1980's. These reforms included base broadening and lower rates, the intent of which was to address issues of fairness, complexity and distortions.²⁴ A complex and inequitable tax system, however, allows for more legal tax avoidance by providing various tax exemptions and reductions (Schneider and Neck, 1993). Broadening the income tax base and removing tax exemptions, therefore, caused an increase in the size of the Canadian underground economy.

CONCLUSIONS

According to the estimates of this study, the underground economy in Canada is sizable and continues to grow, despite the increased enforcement efforts of CCRA. The results show that, not surprisingly, the underground economy responds positively to marginal tax rates, the GST, the amount of self-employment income, labour force participation, the overall crime rate and regulatory reform. Additionally, while CCRA's enforcement activities under the UEI may have been unsuccessful, the Voluntary Disclosure program appears to play an important role in encouraging less underground activity. The findings indicate that the underground economy in

Canada grew from about 7.5% of GDP in 1976 to about 15.3% in 2001. These figures are consistent with previous studies employing the same definition as this study.

The results are different from those reported by Giles and Tedds (2002), who report that the underground economy grew from about 3.5% of GDP in 1976 to about 15.7% of GDP in 1995. There are three main reasons why the results differ. First, the MIMIC model presented here is more richly specified than that of Giles and Tedds (2002) and includes more of the variables that the theoretical literature purports to cause the underground economy. Second, the calibration process followed in this study preserves the proportional relationships found in the original index series. Third, this study estimated a demand for money equation the Kalman filter, which resulted in a larger long-run value of the Canadian underground economy (11.35% compared to the 9.46% obtained by Giles and Tedds (2002)).

ENDNOTES

¹ To do so, it is assumed that wage and salary earners always accurately report their income and this group is used as a baseline measure which is compared to the self-employed, who have greater opportunities to hide income from tax authorities. If the self-employed are concealing income, then it is expected that their household food consumption to be high relative to wage/salary earners households with similar reported incomes and characteristics.

² The provinces, however, have recently moved towards a tax-on-income system. Under this system, provincial income tax is now calculated on taxable income and not on basic federal tax. Ontario moved to this system starting with the 2000 tax year and all other provinces (excluding Quebec) and the three territories, implemented this system for the 2001 tax year. The province of Quebec has had an independent tax system since the change over from the Income War Tax Act.

³ In 1997, the provinces of New Brunswick, Nova Scotia, and Newfoundland signed comprehensive integrated tax co-ordination agreements (CITCAs) with the federal government to harmonize their provincial sales taxes with the goods and services tax (GST), creating the

harmonized sales tax (HST). Additionally, Quebec introduced a modified form of VAT which it collected itself, along with the GST.

⁴ An additional enforcement program is the “Anti-Smuggling Initiative” (ASI) which is a joint Canada Customs and Revenue Agency/RCMP program introduced in 1994 to crack-down on tobacco smuggling.

⁵ Schuetze (1999) in a comprehensive study on self-employment in Canada found that increases in average income tax rates have a large and positive effect on the self-employment rate which he indicates “...suggests that under-reporting of self-employment income may be a key motivating factor for becoming self employed.” (Schuetze, 1999, p. 3) This evidence allows some researchers to conclude that self-employment income should be considered as an indicator variable. There are many other factors, however, that have contributed to the increase in self-employment and self-employment income in Canada. For example, Canada has many special programs in place to assist self-employment and small businesses, financial institutions have created numerous financing options to support self-employment and small businesses, and the increasing use of contracting-out by governments and business. This leads the author to conclude that self-employment is a causal variable of the underground economy.

⁶ The exception is the estimate obtained by both Gervais (1994) and Smith (1997) of 5.2% of GDP for 1992. There are three key reasons for the difference: first, they measure the underground economy from a value-added perspective; second, they exclude such items as capital gains and inheritances from underground economy; and third, they assumed illegal activity amounted to no more than 1% of measured GDP. With respect to this latter point, Giles and Tedds (2002, p. 89-92) conduct some “back of the envelope” calculations of the size of illegal activity in Canada and obtain a minimum estimate of 5% of GDP for the same year.

⁷ The technique of modeling with an observable variable is not confined to the study of the underground economy or to economics itself. The archetypal example of an unobservable variable is intelligence. The estimation of supply and demand equations and the well known permanent-income hypothesis are probably two of the earliest examples in the field of economics of models based on unobservable variables.

⁸ In particular, the highly nonlinear model that was used in the previous work proved to be sensitive to small data changes.

⁹ There are two equations in a state space model. The first equation is called the ‘measurement equation’ or ‘signal equation’, and it describes the stochastic relationship between the dependent variable and a vector of ‘state variables’. The second equation is called the ‘state equation’ or ‘transition equation’ and contains the unobservable components. In the demand for money equation (1), the logarithm of the money stock (m_t) is the dependent variable in the measurement equation, which, in the preferred version of the model, has been modeled as a function of last periods values of the logarithms of interest rate (r_{t-1}), money (m_{t-1}), prices (p_{t-1}), and the current period’s unobserved value of the logarithm of underground output (u_t). The single state variable is the logarithm of underground output (u_t), which is modeled as a function of last period’s value of the logarithm of underground output (u_{t-1}), the logarithm of output from two previous period ago (y_{t-2}), the compounding annual rate of inflation, lagged one period ($p_{t-1} - p_{t-2}$), and a random shock (η_t).

$$m_t = \alpha_{1t} y_t + \alpha_{2t} r_{t-1} + \alpha_{3t} p_{t-1} + \alpha_{4t} m_{t-1} + u_t \quad (1)$$

$$u_t = c_1 u_{t-1} + c_2 y_{t-2} + c_3 (p_{t-1} - p_{t-2}) + \eta_t \quad (2)$$

The coefficients in equation (1) are estimated recursively.

¹⁰ Notably, the estimates were insensitive to small changes to the sample of data.

¹¹ Tedds (1998) and Giles and Tedds (2002) calibrated their resulting index series from the MIMIC model by finding the mean year of the sample, dividing each observation in the index series by the value the index series took in that mean year, and then multiplying those values by the average value of the underground economy obtained using the currency demand model. If, however, one wants to preserve the content of the original index, then the values of the time series must retain the same proportional relationships present in the index values. Suppose that I_t denotes the index for the ratio of the underground economy to the measured economy in period t ,

$$I_t = a_t I_1$$

Then to preserve the proportional relationships in I_t , one requires

$$Ratio_t = a_t Ratio_1$$

Making use of the estimated average ratio (Ratio*=11.35%) from the money demand equation, one has the additional relationship

$$Ratio^* = \frac{1}{T} \sum_{t=1}^T Ratio_t = \frac{1}{T} (Ratio_1 + \sum_{t=2}^T a_t Ratio_1) = \frac{Ratio_1}{T} (1 + \sum_{t=2}^T a_t)$$

These relationships yield T equations to be solved for the T unknown ratio values.

¹² This is a commonly ignored step in the study of the underground economy, not only in the application of the MIMIC model. It has, in fact, been applied previously only by Giles (1999), Tedds (1998), Giles and Tedds (2002) and Dell’Anno (2003) in this context. To be conservative, both the Augmented Dickey Fuller test (Said and Dickey, 1984) for non-stationarity, and the KPSS test (Kwiatkowski, Phillips, Schmidt, and Shin, 1992) for stationarity are used. Several of the series used in modeling appear to exhibit structural breaks. As the ADF and KPSS tests, as well as tests for cointegration, are adversely sensitive to the presence of breaks in the data, special attention was paid to this issue. Perron’s (1989) modified ADF test and well as Kurozumi’s (2002) modified KPSS test were applied to allow for exogenous structural breaks. All of these tests were employed by testing downwards (Dickey and Pantula, 1987), assuming that the highest possible order of integration was I(3). Mackinnon’s (1991) critical values were used in the ADF tests, Perron’s (1989) critical values were used in the modified ADF test, Kwiatkowski, Phillips, Schmidt, and Shinn’s (1992) asymptotic critical values were employed when applying the KPSS tests, and Kurozumi’s (2002) critical values were used for the modified KPSS test. In the case of conflicting conclusions, the results of the KPSS test were chosen over the results of the ADF test because of the test’s standard set up of the null hypothesis, and the fact that the ADF test has notoriously low power.

¹³ As with all structural models, normalization must be imposed in order for it to be estimated. The choice among the endogenous variables is arbitrary as the normalization does not identify the dependent variable in any formal or causal sense. The relative impacts of the underground economy on the other “indicator” variables are then measured relative to this pre-assigned value.

¹⁴ Rather than focus just on statistical significance of the resulting parameter estimates, attention has also been paid to various goodness-of-fit measures, charts of the “Q-plots” of the standardized “residuals” (in LISREL terminology, a “residual” is the difference between an observed and fitted covariance), and tests for normality of the conventional residuals.

¹⁵ The series used were obtained from Statistics Canada’s CANSIM database, the *National Economic and Financial Accounts*, Canada Customs and Revenue Agency’s *Taxation*

Statistics/Statistics on Individuals, the Canadian Tax Foundation's *The National Finances/Finances of the Nation*, and the *Canada Gazette, Part II*. A data summary is available from the author upon request.

¹⁶ Other authors argue that “[a]n increase in the underground economy means that inputs move out of the official economy...” (Frey and Weck-Hannemann, 1984, p. 38) This would, therefore, have a depressing effect on the officially measured growth rate of the economy. Frey and Weck-Hannemann (1984), Helberger and Knepel (1988), Loyaza (1996), Kaufmann and Kaliberda (1996), Schneider and Enste (2000), and Dell’Anno (2003) all find a negative relationship between GDP and the underground economy using the MIMIC model, though these studies primarily focus on developing/transition economies (with the exception of Frey and Weck-Hannemann (1984) and Helberger and Knepel (1988) who examine 17 OECD countries).

¹⁷ A dummy variable for the tax changes which began in 1998, which equaled the marginal tax rate for 1998 and onwards, was also considered as a causal variable. In the models in which it appeared, the coefficient was positive but insignificant. This latter results could be due to the limited amount of data available after the tax changes (only four years) or because there is a lag effect in behavioural changes. Alternatively, once a person becomes active in the underground, there is little incentive to transfer back to the observed economy. As a result, tax reform would simply act to stabilize the underground economy, rather than reduce its size.

¹⁸ A broad average tax rate was found by dividing annual Personal Direct Tax Revenue by Personal Income.

¹⁹ An average indirect tax rate was calculated using general provincial sales tax revenue. Annual GST revenues are included for the years 1991-2001.

²⁰ This measure combines federal and provincial marginal personal income tax rates. Average assessed income was determined by dividing total assessed income by the number of tax returns. 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 tax payer with that level of taxable income was then determined from the various annual editions of *The National Finances* (Toronto: Canadian Tax Foundation, various years). Where provincial tax rates differed, the Ontario provincial tax rate was used.

²¹ An average payroll tax rate was calculated using total contributions to social insurance plans (both federal and provincial) divided by the total payroll tax base.

²² Includes new federal regulations as well as items that amended, repealed or revised an existing regulation. Data regarding provincial regulations over the sample period were not included because similarly defined data was not available for every province. In addition, it was not clear how to weight the provincial observations.

²³ The reported confidence interval only accounts for the randomness associated with the "benchmark" estimate of 11.35%. There is, however, also the randomness associated with estimated coefficients of the "causal" variables in the MIMIC model, and these in turn translate into randomness for the year-by-year predictions of the underground economy ratio, conditional on the average benchmark figure. It is, however, unclear as to how to combine these two sources of randomness, and hence only the randomness associated with the benchmark value is reported.

²³ The tax reforms also had the effect of raising the effective marginal rate for average income workers and the top rate came down for high income earners, in part to compensate them for lost deductions.

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