ESTIMATING THE SIZE OF THE INFORMAL ECONOMY IN BARBADOS

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ABSTRACT

In Barbados, and the Caribbean as a whole, very little research has been done on the topic of the informal economy. This paper estimates the size of the Barbadian informal sector for the period 1972-2007. In light of our analysis of the stationary properties of the data, which suggests a mixture of I(0) *and* I(1) *variables, this study specifies an unrestricted error correction model and employs a general-to-specific (GETs) modelling procedure, allowing us to minimise the possibility of estimating spurious relations while retaining the long-run information. Our estimates indicate that this sector is quite large and has grown over time to about one-third the size of the official economy. These results are consistent with the stylised fact about the Barbadian economy, in particular the large number of persons employed in small businesses and trading as well as the number of tax returns filed on an annual basis versus the stated level of employment. The finding of a significant informal sector also has implications for the conduct of both monetary and fiscal policy. At the minimum it means that possible spillover effects between the two sectors must be taken into consideration in the design and execution of policies.*

1.0   Introduction

The informal economy is a phenomenon that spans all income classes and all economic sectors. It consists of various types of activities, ranging from domestic work (maids, mechanics, gardeners) to registered businesses that underestimate their sales and overestimate their expenditure. There have, however, always been problems in trying to estimate its size and value. Informal economy data are not reflected in the national statistics and may lead to inaccurate macro indicators.   Not taking into account economic activities in the informal sector can result in the level of GDP and other data being downward biased, giving an inaccurate impression of the economy and impeding international comparability. In addition, trend estimates may also be biased if the economic activities missing from GDP grow at different rates from those included.   For example, it is often conjectured that informal sector activities expand at precisely the time the official economy is contracting. Such data may consequently result in erroneous policy decisions.

This paper is the first stage in a proposed two-stage process in trying to assess the size and relevance of the informal economy in Barbados. In this stage, we use a general-to-specific (GETs) modelling procedure within the context of an unrestricted error-correction model, which allows us to minimise the possibility of estimating spurious relations while retaining the long-run information. To the best of our knowledge, this is the first time such an approach has been used to estimate the size of the informal economy. We chose this procedure because our results on the stationary properties of the data, which are discussed in the estimation section below, present a mixture of $I(0)$ and $I(1)$ variables and it is now widely accepted that the general-to-specific procedure is as good as, if not more appropriate than, various cointegration techniques as an alternative estimation procedure in dealing with small data samples even when the data series under consideration are nonstationary (see for example, Inder 1993; and Pagan, 1995). The second stage of the investigation will entail surveying and quantifying the

contributions of the sub-sectors to gross domestic product (GDP).   This we expect will support the findings of this paper.

The next section attempts to define the informal economy, and identify its main causes. It also discusses the advantages and disadvantages of the shadow economy and looks at the methods used in estimating its size. Section 3 deals with some of the studies that were conducted in the Caribbean and gives a review of their results. In section 4, the size of the informal economy in Barbados is estimated, using the currency demand approach. The paper concludes with some remarks and policy implications.

2.0   Understanding the Informal Economy

2.1   Definition of Terms

In the literature, several terms are commonly used to define the unmeasured economy. Terms such as informal, hidden, underground, invisible and shadow are but a few. Many of these concepts are used interchangeably to describe the same phenomenon.

Any economic activity that does not appear in the statistics of the national income and GDP is considered to be part of the hidden economy. When asked, many people think of the informal economy as being illegal activities; however this is not necessarily so. While it may be true that all illegal activities are part of the hidden economy, there are many legal ones that also contribute. For example, when a carpenter who is employed in the official economy is paid to do work for a friend outside of his working hours, and does not report this income to the tax authorities, he too is participating in the informal economy. A teacher who gets paid for out-of-class lessons may also be participating in this economy if this income is not reflected on the tax form.   Table 1 shows some of the various ways, both legal and illegal, in which people can participate in the informal economy.

Table 1
Types of Underground Economic Activities

Type of Activity	Monetary Transactions		Nonmonetary Transactions	
ILLEGAL ACTIVITIES	Trade in stolen goods; drug dealing and manufacturing; prostitution; gambling; smuggling; fraud.		Barter of drugs, stolen, or smuggled goods. Producing or growing drugs for own use. Theft for own use.	
LEGAL ACTIVITIES	**Tax Evasion** Unreported income from self-employment. Wages, salaries, and assets from unreported work related to legal services and goods	**Tax Avoidance** Employee discounts, fringe benefits	**Tax Evasion** Barter of legal services and goods	**Tax Avoidance** All do-it-yourself work and neighbour help.

Source: Lippert and Walker, *The Underground Economy: Global Evidence of its Size and Impact*. Vancouver, B.C., The Frazer Institute, 1997.

2.2 Reasons for the Increase in the Informal Economy

The growth in informal economies is creating a problem for governments and policy makers around the world. The rise in this economic activity is due to several identifiable reasons. The most important of these being increasing tax burdens and social security contributions, increased regulations in the official economy, especially in the labour markets, poor governance and the presence of significant corruption in government operations. In this regard, the Caribbean countries, including Barbados, are no exception. Vuletin (2008), in estimating the size of the informal economies in the region, noted that on average the tax burden and labour rigidity are among the most important reasons for the existence and persistence of the informal economy.

Taxes and Social Security

High tax rates lead to low tax morality which, in turn, encourages individuals to participate in the informal economy, in order to evade payment of taxes. Studies have shown that in the official economy, as net wages increase, there is a decrease in the work force of the informal

economy. Furthermore, the larger the difference between input and the after tax earnings from work, the greater the incentive for persons to participate in the informal economy. As such, the tax regime and the social security system will have significant influence on the growth of the informal economy. In the case of Barbados, Vuletin (2008, pp. 14) concludes that "the main component influencing the informal economy is the tax burden", which is not surprising since Barbados has one of the highest marginal statutory personal tax rates in the region.

Government Regulations

Research has indicated that countries with more regulations on their economies have larger informal economies (Johnson et al., 1997). Regulations such as licensing requirements, labour market regulations, restrictions for foreigners and trade barriers, all aid in increasing the cost of labour and consequently cause many people to shift to the informal economy. It is often the case that employers react to these high costs by transferring them to their employees or even by reducing their labour force. These employees then find other sources of income, often through the informal economy. Intense regulations can also cause employers to stay in the informal economy to avoid higher and non-transferable legal burdens.

Some countries, such as France, have even implemented restrictions on hours worked in order to reduce unemployment. While this is a commendable attempt to distribute limited working opportunities more fairly, it creates the incentive and the time for people to participate in the informal economy.

Governance and Corruption

Countries with strong and efficient government institutions have smaller informal economies. It has been found that there is an increase in the growth of the informal economy in societies where governments do not effectively and fairly carry out their tax laws and regulations.

2.3 Advantages and Disadvantages of the Informal Economy

There are several advantages that an informal economy may offer. For one, it encourages entrepreneurship and creativity. It also supports the official economy, since most of the income that is earned in the informal economy is spent in the official sector. The presence of an informal economy may also force prices in the official economy to fall in order to remain competitive. This benefits the consumers, including those who work in the official sector. The informal economy also affords displaced workers from the formal economy the opportunity to generate their own income, rather than relying on government benefit or nothing at all. Finally, perhaps the greatest benefits of the informal economy is that it provides employment, especially in times of scarce work opportunities, and gives families an avenue through which they can meet their needs and improve their way of life.

Nonetheless, there are some disadvantages. First, it takes away valuable government revenue. This may lead to increased tax rates in order to sustain revenue levels. The loss in revenue may result in a decline in the provision of public goods and services that would have otherwise benefitted the general public. Its presence also creates a problem for policymakers as it distorts economic information by overstating key ratios such as unemployment and debt-to-GDP, and understates growth rates. Consequently, policies may be erroneous and cause adverse reactions. It also generates unfair competition vis-à-vis the official economy and thereby effectively lowering the official economy's income. Lastly, it may result in increased corruption and political lobbying.

2.4 Measuring or Estimating the Informal Economy

The process of measuring the informal economy is a difficult one since there is often a lack of information, as persons prefer anonymity. Nevertheless, there are many techniques used to estimate the size and structure of the informal economy. These methods can be placed into three main categories: Direct, Indirect, and Model approaches, with each having its own strengths and weaknesses. Most of the techniques used are indirect and may provide a wide range of estimates.

2.4.1   Direct Approaches

There are two direct approaches to estimating the size of the informal economy, the Sample Survey and the Tax Audit procedures. Both techniques provide detailed information about the structure of the hidden economy, however they only provide lower-bound estimates (minimum range which may be considered accurate) for the size of the activity. The direct approaches are sometimes referred to as micro approaches.

The Sample Survey

The survey technique is relatively new, only being actively used in the last two decades. The main benefits from using this method are the in-depth conclusions that can be drawn from its results. Useful information about the size and structure of the informal economy can be derived from this process. However, the obtained results greatly depend on the structure of the questionnaire. A badly formulated questionnaire does not give persons the incentive to reveal their participation in the informal economy and cooperate with the survey. This unwillingness can lead to unreliable results, and hence accurate estimations and inferences cannot to be made.

The Tax Audit

Differences between the income submitted for tax purposes and that which is calculated by tax audits lead to information on the informal economy (Frey and Pommerehne, 1984). Threats of fines and imprisonment force participants to reveal this hidden income, which would have otherwise provided the government with useful revenue.

The tax audit method leads to a few difficulties. The estimates based on this technique do not provide complete information about the size of the informal economy and these results tend to be biased. The data that is used (tax compliance data) may itself be a biased sample of the population. Only persons who complete tax forms are considered for

audit but most persons submitting these forms will comply and submit accurate information. However, this bias is somewhat lessened because the selection of those persons to be audited is done based on tax forms that show some possibility of fraud. This procedure only displays the fraction of the economy that the authorities were able to catch.

2.4.2 Indirect Approaches

These techniques allow for estimates to be drawn from seemingly unrelated information. This is useful because, as stated before, many persons do not want the relevant authorities to know of their participation in the informal economy, and hence try their best to conceal it. These procedures try to deal with this problem. The indirect processes are sometimes called macro approaches since they use macroeconomic indicators to extract information about the development of the informal economy. Accounting statistics, the labour statistics, the monetary balances, and the physical outputs are all types of the indirect approach.

The indirect approaches have many benefits but also have shortcomings. They provide information on the size of the economy but are unreliable when it comes to determining its structure. Another problem is that they often require some assumptions to be made, which often cannot be proven.

Accounting Statistics

The accounting statistics approach can be used at both the individual and the national level to derive estimates of the informal economy. It uses discrepancies between expenditure and income to draw conclusions (Schneider and Enste, 2000). In the presence of the informal economy, the income (and production) measure of national income will not be the same as the expenditure measure, and in fact, the latter will be much higher. Therefore, the surplus of expenditure over income is an indicator of the size of the informal economy.

The individual level, rather than at the national level, may yield better results. Processes like the Family Expenditure Survey in the United Kingdom, separately measure income and expenditure on a daily basis,

using record books and information on credit and hire purchase. It provides more detailed information about the sectors and industries in which work can be obtained. However, the figures generated are almost identical to those on the national level.

This technique is useful and easy when the relevant information on expenditure is available, however it will only capture the lowest range of estimates of the informal economy that can be considered to be accurate. Expenditure data is difficult to collect because it is almost impossible to keep accurate records of every transaction that takes place. Expenditure information may even be dependent on income information, which may lead to inaccurate estimates. In addition, the discrepancy used to make these estimates often includes errors and omissions in the accounting statistics. In fact, the difference between the two aggregates is almost always attributed to the error and omission terms and, as such, would make the resulting estimates unreliable.

Labour Force Statistics

The labour force statistics method assumes that the participation in the official labour force remains constant. Hence, any decline in the participation in the official work force can be assumed to be an estimate for growth in the informal economy, *ceteris paribus*, (O'Neill, 1983). More specifically, this approach assumes increasing informal economic activity when the ratio of employment to population is decreasing with the ratio of labour supply to population relatively constant.

However, although it is relatively simple in its calculations, this method is flawed in its major assumption, the constancy of the participation rate, as individuals may leave the official economy for reasons other than to participate in the informal economy. Furthermore, it is compounded by the fact that persons can work in both the official and informal economies. Such persons go undetected and are not considered as part of the informal economy's work force. Thus, this procedure leads to unreliable results and gives weak estimates of the size of the informal economy.

Monetary Balances

The monetary balances approach seems to be the most commonly used system to estimate the size of the informal economy. The three common procedures that fall under the monetary balances approach involve realistic assumptions about the volume of monetary transactions and the use of currency.

(a)   Currency Demand

Cagan (1958) was the first to use the currency demand method followed by Gutmann (1977). The approach is very simple, using only the ratio between currency and demand deposits. Tanzi (1980, 1983) further developed the original model. Under the assumption that all informal economic activity takes place using cash as means of exchange, it is further hypothesised that the increase in demand for cash indicates an expansion in the informal economy. Tanzi also included in his specification a factor that is identified as the main reason for participation in the informal economy, tax burdens. Thus, the basic equation that Tanzi proposed is:

$$In(C/M_2)_t = \beta_0 + \beta_1 In(1+TW)_t + \beta_2 In(WS/Y)_t + \beta_3 InR_t + \beta_4 In(Y/N)_t + u_t$$

where $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 < 0$ and $\beta_4 > 0$ and, *ln* denotes the natural logarithm, C/M_2 is the ratio of the cash holdings to currency plus deposit accounts, *TW* is a weighted average tax rate (to proxy changes in the size of the informal economy), *WS/Y* is the proportion of wages and salaries in national income (to capture changing payment and money holding patterns), *R* is the interest rate paid on savings deposits (to capture the opportunity cost of holding cash), and *Y/N* is per capita income.

The unexplained value u_t, which is the excessive increase in currency, is then attributed to factors leading individuals to participate in the informal economy. The model is estimated twice: once in its current state and again by imposing zero tax rate values. The difference between these two estimates represents the volume of currency in circulation in the informal economy. Multiplying this difference by the velocity of money yields the nominal aggregates of the informal economy.

This procedure may underestimate the size of the informal economy, because not all of the transactions that take place use cash as means of exchange. The method also assumes that there is a base year of no hidden economic activity.

(b)   Transactions

Feige (1979) developed the transaction method to estimating the size of the informal economy utilising information on the overall volume of transactions in the total economy. Information is generated by the well known Fisherian equation:

$$MV = pT$$

where M denotes money supply, V is the velocity of money, p is the price level of transactions and T is the volume of transactions.

It is assumed that there is a constant relationship between the volume of transactions and the total official GDP over time (Feige, 1979; 1989; 1996). Assumptions are also made about the velocity of money and also that there is a base year of no hidden economic activity. From this data, the total GDP can be calculated. The difference between the total and the official GDP is the GDP of the informal economy.

The assumption that there is a base year of no hidden economy is problematic. This is compounded by assuming (i) a fixed transaction ratio over time and (ii) that the informal economy is the only factor affecting a change in the transaction ratio. These are strong assumptions and raise questions about the reliability of the results.

(c)   Physical Outputs - (Electricity Consumption)

The physical outputs method assumes that electricity consumption is the best indicator for overall economic activity (official and unofficial/informal) (Kaliberda and Kaufmann, 1996). Because the electricity/GDP elasticity has been observed to be close to one, the growth rate of the official GDP can be subtracted from the growth rate of electricity consumption. The resultant value is attributed to the growth of the informal economy.

This method is easy to use because of the availability of the information required. However, there are problems that have arisen with its application. First, not all of the informal economic activity requires electricity, other sources of energy can be used. Second, due to technological advances, electricity consumption has become more efficient. Third, the electricity/GDP elasticity may vary over time.

2.4.3   The Model Approach

This technique considers both the causes and the effects of the informal economy over time. It is based on the dynamic multiple-indicators multiple-causes (DYMIMIC) model, which consists of two parts: a measurement model, linking the observed indicators to the size of the informal economy; and a structural-equations model, specifying causal relationships among the observed indicators. The three main causes identified are tax burdens, government regulations and tax morality. The three main indicators are the development of monetary aggregates, labour markets, and production market. The method is in-depth and comprehensive. However, it requires an extensive amount of data, which is often not available, thus rendering this technique inapplicable.

3.0   Previous Studies on the Informal Economy in the Caribbean

The task of estimating the size of the informal economy in the Caribbean has not been given as much attention as its importance merits. To date only a few studies have been carried out in Jamaica, Trinidad and Tobago, Guyana and Barbados.

3.1   Jamaica

Earlier information concerning the Jamaican informal economy was gathered through studies of sidewalk vendors or higglers. (see for example, LeFranc et al., 1987; and Smikle and Taylor, 1977). Investigations were done in the form of surveys. One of these targeted informal commercial importers, while the others sought to collect data on the traditional higgler, who traded in parochial and curb-side markets.

These studies did not provide information on the size of the economy. They only generated information on the kinds of activities that were taking place, giving the profile of the typical higgler and a breakdown of their average weekly costs. Smikle and Taylor (1977) estimated that 115,006 members of the higgler population traded in the markets and their environs, while another 1,046 existed in curbside markets. The surveys were unable to provide reliable data on the financial activities within the informal economy.

Witter and Kirton (1990) represented one of the first studies on the informal sectors in Jamaica to utilise rigorous econometric analysis. As part of their investigation the authors estimated excessive growth in the use of cash in the economy as a proxy of the growth of the informal economy. Their estimates show the informal economy increasing as a ratio of formal GDP from 8% in 1962 to 24% in 1984. In addition, they found that the income velocity of money in the informal sector was 10% higher than in the formal sector. Witter and Kirton also provided some estimates on employment in the informal sector which suggested that in 1985 almost 20% of the population aged 14 and over were employed in the informal economy.

A more recent study, by the Inter-American Development Bank (IADB) (2006), estimated the size of the informal sector in Jamaica and reported that the informal economy, represented a large and growing share of the overall economy; more than doubling in size since the 1980s. Using various methods, including monetary and other indirect approaches, the IADB report puts the size of the informal sector in Jamaica at just over 40% of official GDP in 2001. In addition, the report suggested that the informal sector grew significantly faster than the formal economy during the 1990s.

Vuletin (2008) estimated the size of the informal economy for 32 mainly Latin American and Caribbean countries, including Jamaica, using a DYMIMIC approach. Vuletin's estimates are consistent with the IADB (2006) report and place the informal economy of Jamaica at 35% of official GDP in 2000.

3.2   Trinidad and Tobago

Maurin et al. (2006) obtained estimates for the hidden economy in Trinidad and Tobago utilising the Tanzi currency demand approach, applied to data spanning the period 1970-1999. They employed a structural cointegration approach containing two long-run relationships linking the demand for currency with other variables. They solved the model using a Gauss-Siedel algorithm and, under the assumption that the velocity of "illegal" money is the same as that of legal money, concluded that the hidden economy rose from a low of about 14% of measured GDP in 1970 to a high of 36% in 1981, and in 1999 was about 20% of the official economy. They suggested that the use of a direct survey would yield more detailed information, which could be useful for the design of policy. Vuletin (2008) also included estimates of the size of the informal economy in Trinidad and Tobago, which suggested that the country's informal economy is around 25% of official GDP in 2000.

The size of the informal economy in Trinidad and Tobago, based on these estimates, is much larger if we consider that a significant proportion of the official economy is the energy sector, in which very little activity escapes the official GDP statistics[1]. The energy sector contributes about 40% of official GDP[2], which implies that hidden economy currently stands at 33% of non-energy GDP.

3.3   Barbados

An extensive Informal Sector Survey was conducted by the Barbados Statistical Service Department (1998). The survey sought to improve the social and economic statistics on the informal sector in the island, analyse the situation of the workers and make recommendations to assist in the design of policies to increase productivity of the sector.

The information gathered from this survey showed various forms of informal economic activity - agriculture, construction, distribution and

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[1] This is because the sector dominated by large international corporations or their affiliates, and by large state-owned companies.

[2] Based on 2004 GDP estimates.

tourism, to name a few. Distribution and agriculture were identified as being the most populous of these sectors with 2,313 and 1,562 persons respectively. It was estimated that there were 5,720 informal business operators, compared to 14,172 in the formal economy. The total employment calculated in the informal economy numbered 6,904, as opposed to 117,575 in the formal economy.

Detailed information was also gathered on the backgrounds of informal economy operators, such as, level of education, starting capital, credit information, input costs, and the duration of their informal business lives, but the size of the informal economy was not estimated. However, care must be taken when using this technique, because most interviewees tend to understate income and overstate expenses, thus obscuring results. Also several operators within the informal sector would not have identified themselves.

Vuletin (2008) is the only study we found that provided a proximate size of the informal economy in Barbados. The author's estimates suggested that, in 2000, the informal economy in Barbados was roughly 36% of GDP.

3.4   Guyana

Faal (2003) also utilised a Tanzi-type currency demand model to estimate the informal economy in Guyana. The author's findings indicate the existence of a large informal economy ranging from 27% of GDP in 1970 to as high as 101% in 1989. Thereafter, as macroeconomic reforms were implemented the size of the informal economy declined to 55% in 2000.

Faal concluded that a long-run strategy based on market-based reforms, including fiscal reforms, improved governance and stronger institutions are effective in reducing the informal economy. Thomas (1989) also investigated the structure of the informal economy in Guyana with emphasis on the foreign currency market, but failed to give estimates on the size of the sector. The estimates by Vuletin (2008) for Guyana are consistent with those of Faal, suggesting that the informal economy in Guyana was approximately 57% of official GDP in 2000.

4.0   Estimates for Barbados

The currency demand approach is chosen to estimate the size of the informal economy in Barbados because of the availability of reliable time series data for the monetary sector as well as the tax burden and, as discussed above, it is the most widely used indirect method in the literature. In this regard, we modified the Tanzi equation along the lines taken by Bajada (1999) and Faal (2003). Also, as in Bajada (1999) we utilise a general unrestricted error correction model but, instead of simply estimating the model with a set number of lags (for example, testing 1 lag against 2 and using the selected length across all variables in the model), we use the GETs approach to eliminate statistically irrelevant variables thus reducing this 'general' model to a more parsimonious, congruent one, allowing for more efficient estimation and inference.

The currency demand model specifies that:

$$C = f(YD, R, \pi, E, Tr, T) \tag{1}$$

where C is real currency per capita, YD is real disposable income per capita, R is the interest rate, π represents the rate of inflation, E denotes private consumption expenditure as a ratio of GDP, Tr is a technological trend variable, and T is the tax rate. Currency demand is expressed in real per capita terms to eliminate the impact of inflation and population growth on the demand for currency.

Real disposable income and interest rates are expected to have similar impacts on the demand for currency as they would have on the demand for money. Disposable income is substituted for income since we are examining the excess sensitivity of taxes on currency (see Bajada 1999). Inflation becomes relevant since increasing prices will either cause individuals to hold more cash to meet daily demand or induce them to hold less as its value may be eroded.

Like Bajada, private consumption expenditure to GDP is added to capture currency demand arising as a result of spending on goods and services (desired demand) in the official economy by participants of the

informal economy, which would not normally be captured by the measure utilised for disposable income.

Technological developments (ATMs, point of sale cards, etc.), which are currency substitutes and will have an impact on the demand for currency, are represented by the trend variable. Finally, our key assumption, as was Tanzi's, is that the informal economy is more cash intensive than the official economy. As such, increases in taxes lead to an expansion of the informal economy and consequently to greater use of cash.

Data and Estimation of the Currency Demand Function

The data, sourced from the Central Bank of Barbados, is of annual frequency covering the period 1972-2007. Real currency per capita is measured as the stock of notes and coins in the hands of the public deflated by the GDP deflator and further expressed as a ratio of the population. Real disposable income per capita is calculated as nominal GDP less direct taxes on incomes, also deflated by the GDP deflator and divided by the population. The interest rate is represented by the commercial banks' weighted average deposit rate. The tax rate is direct taxes on incomes expressed as a percentage of GDP. The inflation rate is the change in the consumer price index. Private consumption expenditure is taken from the national accounts and expressed as a percentage of GDP. All variables are expressed in natural logarithm.

We begin by investigating the stationary properties of the data, as this can influence the estimation procedure we choose. In this regard, a number of stationarity tests are applied to the levels and first differences of the variables. The results are presented in Table 2.

Table 2
Results of Tests for Stationarity

		C	YD	R	π	E	T
Level	ADF	-1.891	-1.782	-3.212**	-2.759**	-2.387	-1.512
	PP	-1.665	-1.522	-2.255	-2.652*	-2.444	-1.545
	KPSS	0.777***	0.628**	0.217	0.253	0.729**	0.181
	ERS	19.79	11.191	1.500***	2.544**	27.761	4.867
	MZ_a	1.073	-3.777	-19.21***	-10.34**	-1.436	-5.130
	MZ_t	0.949	-1.259	-2.948***	-2.267**	-0.742	-1.465
	MSB	0.884	0.333	-0.153***	-0.219**	0.516	0.286
	MP_T	56.58	6.533	1.804**	2.397**	14.667	5.102
Δ	ADF	-4.684***	-3.515**			-8.382***	-5.276***
	PP	-3.761**	-3.376***			-8.904***	-5.276***
	KPSS	0.061	0.070			0.396*	0.131
	ERS	0.192***	1.801***			2.707**	1.556***
	MZ_a	-140.91***	-12.74**			-20.63***	-14.99***
	MZ_t	-8.374***	-2.524**			-3.129***	-2.736***
	MSB	0.059***	0.198**			0.152***	0.183**
	MP_T	0.205***	1.922**			1.415***	1.640***

*, ** and *** are the critical values for rejection of the null hypothesis at the 10%, 5%, and 1% levels, respectively. Δ denotes the first difference of the original series.

The first test is that of augmented Dickey-Fuller, ADF, (1979) test for unit root based on the regression:

$$\Delta x_t = \alpha_1 + \beta_{1t} + \delta_1 x_{t-1} + \sum_{j=1}^{j} \alpha_j \Delta x_{t-j} + \varepsilon_t$$

where *j* in the regression is chosen so that it is sufficiently large to ensure that the error term is free of significant serial dependence. The null hypothesis of non-stationarity is rejected if δ_1 is significantly negative. The next test is the Phillips-Perron, *PP*, (1988) which, instead of adding differenced terms as explanatory variables to correct for higher order

serial correlation, makes the correction on the t-statistic of the δ coefficient. However, the *PP* test, as originally defined, suffers from severe size distortions when there are negative-moving average errors (see Perron and Ng, 1996; and Schwert, 1989).   Although the ADF test is more accurate under such conditions, its power is still significantly reduced. In lieu of this, we used both the Elliot et al. (ERS) Point Optimal test (1996), which has improved power characteristics over the ADF test, and the Ng and Perron (2001) testing procedure (NP) which exhibits less size distortions compared to the PP test. Both tests are well documented in the literature.

The other three tests, denoted as MZ_a^d, MZ_t^d *and* MSB^d, are modifications of the PP statistics (the Z_α and Z_t statistics of Phillips and Perron) and the Bhargava statistic with corrections for size distortions in the case of negatively correlated residuals.

However, all the above tests take a unit root as the null hypothesis, which means that they have a high probability of falsely rejecting the null of non-stationarity when the data generation process is close to a stationary process (Blough, 1992; Harris, 1995). Therefore we also utilised the KPSS test described in Kwiatkowski et al. (1992) where the null hypothesis is specified as a stationary process.

The results indicated that both R and π are both integrated of order zero, I(0), while the other series have a unit root in their levels but not in their first differences, hence are I(1). Note that the various tests are in agreement except in the case of the tax rate. Here the KPSS suggested that it is stationary, while the others pointed to an I(1) process. A graphical inspection showed a sharp dip in the tax rate in 1988 and when we allowed for a blip in the unit root test (using the procedure in Lanne et al., 2002; and Saikkonen and Lutkepohl, 2002) it confirmed that the series is stationary[3].

Since we have a mixture of *I(0)* and *I(1)* variables we opted to use the GETs procedure as it is still an open debate on how to appropriately

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[3] These results are available from the authors upon request.

handle combinations of stationary and non-stationary variables in standard cointegration frameworks like that of Johansen. In addition, Monte Carlo studies have shown that the GETs procedure is as good as, if not more appropriate than, other cointegration techniques in dealing with small data samples, even in the presence of *I(1)* variables[4]. With the GETs procedure we can minimise the possibility of estimating spurious relations while retaining long-run information and at the same time derive a currency demand model that is suitable for economic interpretation.

To apply the GETs procedure we estimate equation 1 in an unrestricted model with two lags (two lags are considered appropriate when dealing with annual data) and progressively reduce it by eliminating statistically insignificant coefficients and reformulating the lag structure where appropriate in terms of levels and differences to achieve orthogonality. The final parsimonious representation of the model is presented below along with some standard diagnostic statistics and long-run elasticities.

$$\Delta \ln C_t = -7.755 + 0.881\Delta \ln YD_t + 0.872\ln YD_{t-1} + 0.136\Delta \ln T_t + 0.148\ln T_{t-1} - 0.086\Delta \ln R_t$$
$$\quad (-2.88**) \quad (4.102***) \quad (2.917**) \quad (2.157**) \quad (1.987**) \quad (-2.143**)$$

$$-0.126\ln R_{t-1} - 0.011\Delta \ln \pi_t - 0.450\ln C_{t-1} - 0.005Tr$$
$$\quad (-3.385**) \quad (-1.880*) \quad (-3.129**) \quad (-1.974*)$$

Diagnostics

$\bar{R}^2 = 0.76$ $DW = 1.915$ $Norn = 0.108$ $ADF(r) = -5.447$
                                       (0.947)   (0.000)

$LM = 0.292$ $RR = 0.254$ $HET = 0.125$
    (0.589)   (0.614)   (0.911)

Long-run elasticities (Long-run response of the real currency per capita with respect to):

Real Disposable Income	1.94
Interest Rate	-0.28
Average Tax rate	0.33

Notes: T-statistics are shown in parentheses. For the diagnostics the F-statistics for the respective tests are shown (unless indicated otherwise) and the associated P-value

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[4] See Krolzig and Hendry (2001) for a further discussion.

in square brackets. *DW* is the Durbin-Watson statistic. *SC* is the Lagrange multiplier test of residual serial correlation (Chi-square of degree 1). *FF* is the Ramsey RESET test for incorrect functional form using the square of the fitted values (Chi-square of degree 1). *Norn* is the test for normality of the residuals based on the Jarque-Bera test statistic (Chi-square of degree 1). *HET* is the Heteroskedasticity test based on the regression of squared residuals on squared fitted values. *ADF(r)* is the Augmented Dickey-Fuller unit root test

The model is well-behaved in terms of the diagnostic tests. The residuals do not suffer from non-normality, serial correlation or heteroskedasticity. In addition, the Ramsey RESET test suggests that the model is well specified. However, before accepting the model we also checked for possible endogeneity between real currency per capita, real disposable income, private consumption expenditure and taxes which, if present, will render our estimates biased and inconsistent. To do this we ran an auxiliary regression of the form $\Delta \ln X = \alpha_0 + \sum_{i=1}^{\rho} \Delta \ln X_{t-1} + \sum_{i=1}^{\rho} \Delta \ln C_{t-1}$ for each of the four variables of interest. The predicted values are then included in our unrestricted model. An insignificant t-statistic would suggest endogeneity is not a problem and our estimates are consistent. The results are shown below and indicate no evidence of endogeneity among the variables.

Endogeneity Tests

ρ	1	2	3
ΔT	-.2567 [0.801]	1.243 [0.233]	1.355 [0.197]
ΔYD	0.348 [0.732]	1.071 [0.299]	0.1378 [0.893]
ΔE	1.239 [0.232]	-1.688 [0.110]	-.2278 [0.822]

P-values are in square brackets

The *ADF(r)* statistic confirms that the variables in the currency demand equation form an equilibrium (cointegrated) relationship, while the coefficient on *lnC$_{t-1}$* suggests an adjustment speed of 45%. Thus, it takes approximately two years for holders of currency to fully adjust to shocks affecting their demand. All the variables of our final model are correctly signed. The coefficient on disposable income indicates that expansions in income increase the use of currency with a long-run elasticity of 1.9 percent. Interest rate has a negative effect on real currency demand which is consistent with the theory that it represents the opportunity cost of holding money. A one percentage point increase in the nominal interest rate brings about a 0.09 percentage point decline in real currency demand in the short run, with a steady-state effect of -0.28 of a percentage point. The coefficient on the average tax rate is positive indicating that an increase in the tax rate induces higher currency demand, consistent with Tanzi's postulate. A one percentage point increase in the average tax rate leads to roughly a 0.14 percentage point rise in currency demand in the short-run and over time currency demand expands to 0.33 percentage points. As expected, the increasing use of technology significantly reduces the need to use cash for transactional purposes.

The Size of the Informal Economy

In order to derive estimates of the informal economy we first rearranged our model and expressed it in terms of nominal currency holdings:

$$C_t^* = \exp(A + \delta_1 \Delta \ln T_t + \varphi_1 \ln T_{t-1} + \ln C_{t-1}^* + \Delta \ln P_t + \Delta \ln N_t)$$

where C_t^* is estimated nominal currency in the hands of the public, A is all the explanatory variables of our model excluding the two tax variables, P is the GDP deflator and N is population. Now if $\delta_1 = \varphi_1 = 0$ then there is no excess sensitivity of taxes and thus no longer an incentive for persons to participate in the informal economy. Thus, in the absence of an informal economy, currency holdings will settle at its natural rate, which will be lower than C_t^*. We referred to this level as C_t^{**} where:

$$C_t^{**} = \exp(A + \ln C_{t-1}^* + \Delta \ln P_t + \Delta \ln N_t)$$

Therefore, the amount of currency in the hands of persons conducting business in the informal economy, illegal currency, is given as $H_t = C_t^* - C_t^{**}$. Assuming that the velocity of money in the informal economy is the same as that of the formal economy, then the size of the informal economy is estimated by $GDP_{IE} = H_t \times V_t$, where V, the velocity of money, is obtained by dividing GDP at market prices less consumption of fixed capital and net income paid overseas by C_t^{**}. The results of these calculations along with the size of the informal economy expressed as a ratio to GDP are presented in Table 3.

Table 3
Estimates of the Informal Economy in Barbados, 1973-2007

| Year | Currency with the Public ($ millions) | | | | Informal Economy | |
	Actual C_t	Estimate C_t^*	Legal $C_t^{**:}$	Illegal H_t	Size in $mil	% of GDP IE_GDP
1973	26.85	28.85	20.94	7.91	165.27	29.62
1974	33.88	34.11	24.42	9.69	212.05	30.33
1975	39.75	40.17	28.46	11.71	271.04	33.36
1976	46.74	45.90	32.87	13.03	250.90	28.73
1977	55.22	53.63	38.49	15.14	299.63	30.16
1978	65.85	61.99	44.41	17.59	339.17	30.50
1979	80.16	79.06	56.37	22.68	423.34	31.40
1980	101.55	101.81	74.56	27.25	505.39	29.20
1981	111.23	108.23	78.91	29.32	515.23	27.05
1982	110.57	110.28	79.82	30.46	587.92	29.54
1983	114.10	113.69	81.92	31.76	670.00	31.71
1984	118.12	120.65	87.88	32.78	725.59	31.51
1985	123.47	126.06	92.89	33.18	736.97	30.58
1986	137.36	142.81	105.51	37.30	815.09	30.80
1987	156.64	158.75	122.83	35.93	743.83	25.53
1988	171.34	164.49	131.83	32.65	657.97	21.23
1989	182.72	188.16	142.86	45.31	904.72	26.40
1990	192.85	191.80	143.39	48.40	948.54	27.57
1991	178.68	184.35	137.24	47.12	1014.75	29.90

1992	176.85	171.27	123.57	47.70	1135.68	35.75
1993	176.99	182.93	132.96	49.97	1118.29	33.88
1994	189.60	187.97	136.99	50.98	1149.89	33.11

Table 3 (Continued)
Estimates of the Informal Economy in Barbados, 1973-2007

| | Currency with the Public ($ millions) | | | | Informal Economy | |
Year	Actual C_t	Estimate C_t^*	Legal $C_t^{**:}$	Illegal H_t	Size in $mil	% of GDP IE_GDP
1995	200.33	194.89	141.06	53.83	1249.21	33.41
1996	220.05	212.50	152.51	59.99	1373.43	34.44
1997	239.60	240.34	172.22	68.12	1488.50	33.76
1998	268.16	270.70	194.04	76.66	1579.90	33.22
1999	302.69	290.19	206.29	83.90	1676.65	33.77
2000	310.66	311.03	220.62	90.41	1828.53	35.28
2001	312.36	317.07	220.53	96.54	1919.61	37.65
2002	337.47	337.32	234.96	102.37	1930.72	37.87
2003	328.97	342.19	237.47	104.72	2025.74	38.33
2004	398.73	403.99	282.8618	121.12	2163.53	38.40
2005	448.60	460.90	317.8727	143.02	2275.03	38.10
2006	465.00	473.38	329.3846	143.99	2412.32	37.80
2007	492.06	503.74	348.3855	155.35	2591.11	38.00

Source: Authors' Calculations

The first point we can perhaps note from Table 3 is that our estimates of nominal currency holdings are very close to the actual, which gives further credence to our model. The second point is that the informal economy has been and continues to be a large and significant part of overall economic activity. Figure 1 plots the size of the informal economy as a percentage of GDP, from which three episodes can be distinguished in the evolution of the informal economy. The first is from 1973 to 1986 where it fluctuated around 30 percent of official GDP. It then declined sharply to roughly 21 percent over the next two years before rising rapidly

to reach nearly 36 percent in 1992. It remained within that vicinity for the remainder of the sample; though displaying a downwards trend until 1998 and then expanding again. It should be noted that the expansionary episodes coincided with downturns in the formal economy. Our findings are also consistent with Vuletin's (2008), though he only provided an estimate of the size of the informal economy for the year 2000.

Support for the evolving size of the informal economy may be gleaned from the number of income tax returns as a ratio of the working population[5], which was 19.1 percent in 1987, increased to 26.4 percent in 1993 and then moved to 45% in 1995 before reaching its highest, 56.2 % in 2003. However, if we were to subtract the number of individuals who submitted tax returns in order to receive the reverse tax credit, which government offered from 1999 onwards, this number stays around 40 percent or less between 1999 and 2003. In fact, of those five years it only exceeded 40 percent once, in 2003. More support can be found in the volume of small enterprises that were created between 1998 and 2003 on account of Government's lending institution – Fund Access. A total of 406 such small businesses were created, employing just over 470 individuals. However, most of these small enterprises would not have been surveyed for national accounts purposes. Government also introduced a second such lending institution during that period – Enterprise Growth Fund Limited – to assist in the development of small and medium size enterprises, this would also have encouraged the development of small and medium size entrepreneurships and these are not normally captured in the GDP estimates. Three hundred such enterprises were created in agriculture alone during 1998 – 2003.

With estimates of the size of the informal economy in hand some interesting questions can be asked. One such question is the relationship between growth rates in the formal and informal economies. We plotted real growth rates for the two economies in Figure 2. There is a positive correlation between the growth rates (which we confirmed to be

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[5] The data supporting this paragraph can be requested from the authors.

0.29 for the full sample), indicating that the informal economy moves procyclically to the official economy. Thus, if the official economy is experiencing good times so would the informal economy, and in times of hardship for the official economy there are spillovers to the informal economy. However, this may not always be the case and especially so for the hardship periods. Figure 3 shows GDP for both sectors and coming in to the recession of the early 1990s, as real economic activity in the official sector began to contract around 1989, that of the informal economy started to expand rapidly.
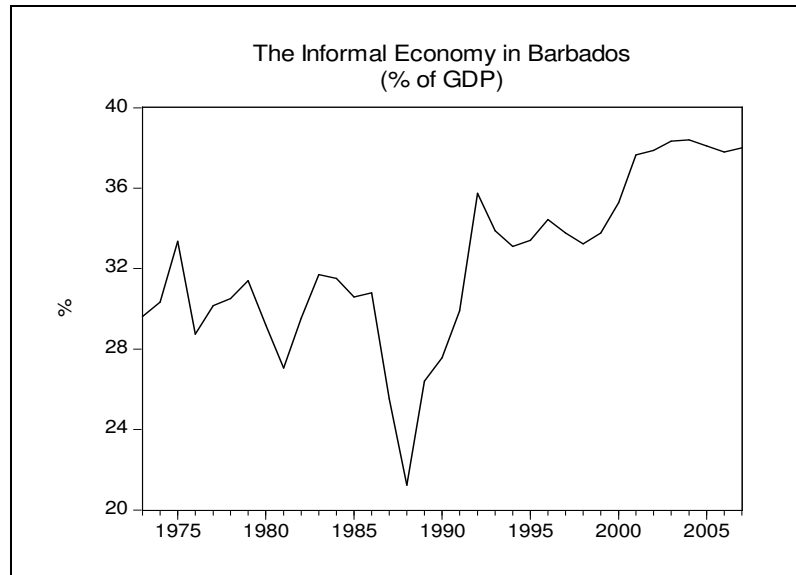
Figure 1

The Informal Economy in Barbados
(% of GDP)

Figure 2

Real Growth Rates in the Formal and Informal Economies
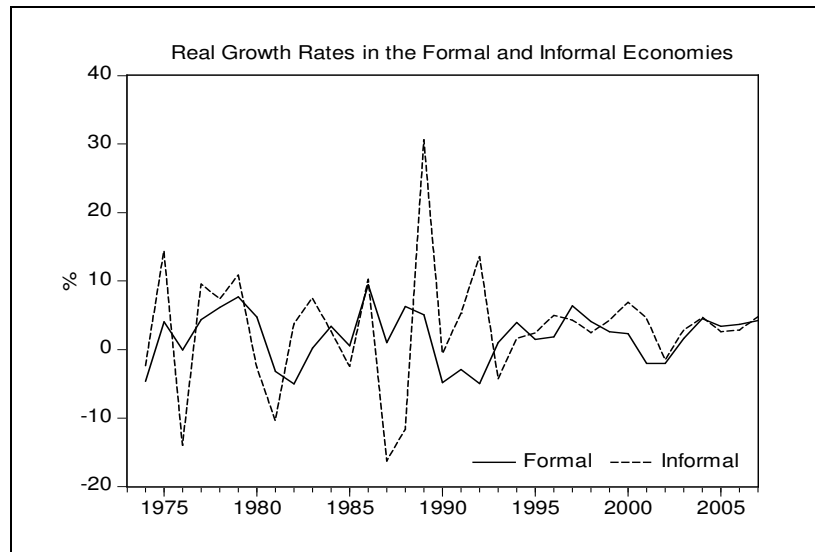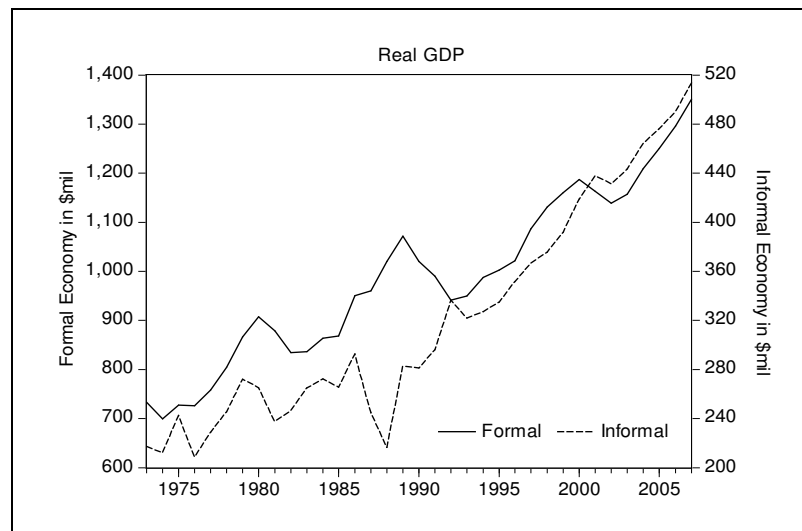
Formal ——— Informal ----

Figure 3

5.0   Concluding Remarks and Policy Implications

In this study, we estimated the size of the informal economy in Barbados using a currency demand equation and a general-to-specific modelling approach. Our findings suggest that a significantly large informal economy exists in Barbados; it is at least one third of the official economy. Its mere size implies that it cannot be ignored, especially when it comes to policy planning and execution. In this regard, we recommend moving to the "second stage" of the investigation and employing a direct method (preferably a sample survey) to gather information on the structure (composition, content, etc.), distribution of employment and the relationship between its sub-sectors and the official economy.

Our analysis also suggests a relatively high degree of complementarity between the official and unofficial economy. Thus, care must be taken in designing policies to deal with the existence of the informal economy. It is clear that there is a significant loss of direct tax revenues because of the existence of the informal economy. However, its existence also means higher indirect tax revenues (VAT, etc) and less reliance on social welfare. Thus, it may not be advisable to implement

policies (compliance policies) to force the informal sector out of existence, instead remove the incentives for participants to engage in informal sector activities (lower the tax burden, eliminate unnecessary regulations, etc.), thereby, gradually integrating the informal economy into the formal economy.

Finally, it would also be interesting to extend our approach to other Caribbean countries and thus be able to make direct comparisons with the findings of other studies and, more importantly, undertake cross-country analyses.

REFERENCES

Bajada, C. 1999. "Estimates of the Underground Economy in Australia", *Economic Record*, Vol. 75, No. 231, 369-384.

Barbados Statistical Service Department 1998. *Informal Sector Survey, 1997/1998,* Bridgetown, Barbados: Barbados Statistical Service..

Blough, S. R. 1992. "The Relationship between Power and Level for Generic Unit Root Tests in Finite Samples", *Journal of Applied Econometrics*. Vol. 7, No. 3, 295-308.

Cagan, P. 1958. "The Demand for Currency Relative to the Total Money Supply", *Journal of Political Economy*. Vol. 66, No. 3, 302-328.

Dickey, D. A. and Fuller, W. 1979., "Distribution of the Estimators for Autoregressive Time Series with a Unit Root". *Journal of the American Statistical Association*, Vol. 74, No. 366, 427-431.

Elliott, G., Rothenberg, T. J., and Stock, J. H. 1996. "Efficient Tests for an Autoregressive Unit Root", *Econometrica*, Vol. 64, No. 4, pp. 813-836.

Faal, E. 2003. "Currency Demand, the Underground Economy, and Tax Evasion: The Case of Guyana", *Working Paper 03/07, International Monetary Fund.*

Feige, E. L. 1979. "How Big is the Irregular Economy?". *Challenge*, Vol. 22, No. 1, 5-13.

Feige, E. L. 1989. *The Underground Economies: Tax Evasion and Information Distortion,* Cambridge: Cambridge University Press.

Feige, E. L. 1996. "Overseas Holdings of U.S. Currency and the Underground Economy," in *Exploring the underground economy: Studies of Illegal and Unreported Activity*, edited by S. Pozo, Michigan: UpJohn Institute for Employment Research.

Frey, B. S. and Pommerehne, W. W. 1984. "The Hidden Economy: State and Prospects for Measurement", *Review of Income and Wealth*, Vol. 30, No. 1, 1-23.

Gutmann, P. M. 1977. "The Subterranean Economy". *Financial Analysts Journal*, Vol. 34, No. 1, 24-27.

Harris, R. I. D. 1995. *Using Cointegration Analysis in Econometric Modelling,* London: Prentice Hall/Harvester Wheatsheaf.

Inder, B. 1993. "Estimating Long-Run Relationships in Economics: A Comparison of Different Approaches", *Journal of Econometrics*, Vol. 57, No. 1-3, 53-68.

Inter-American Development Bank 2006. "The Informal Sector of Jamaica". *Economic and Sector Studies Series, RE3-06-010.*

Johnson, S., Kaufmann, D., and Shleifer, A. 1997. "The Unofficial Economy in Transition". *Brookings Papers on Economic Activity* No. 2, 159-221.

Kaliberda, A. and Kaufmann, D. 1996. "Integrating the Unofficial Economy into the Dynamics of Post-Socialist Economies: A Framework of Analysis and Evidence". *The World Bank Policy Research Working Paper Series,* No. 1691.

Krolzig, H. M. and Hendry, D. F. 2001. "Computer Automation of General-to-Specific Model Selection Procedures". *Journal of Economic Dynamics and Control*, Vol. 25, No. 6-7, 831-866.

Kwiatkowski, D., Phillips, P. C. B., Schmidt, P., and Shin, Y. 1992. "Testing The Null Hypothesis Of Stationarity Against The Alternative Of A Unit Root: How Sure Are We That Economic

Time Series Have A Unit Root?". *Journal of Econometrics*, Vol. 54, No. 1-3, 159-178.

Lanne, M., Lutkepohl, H., and Saikkonen, P. 2002. "Comparison of Unit Root Tests for Time Series with Level Shifts". *Journal of Time Series Analysis*, Vol. 23, No. 6, 667-685.

LeFranc, MacFarane, G., and Taylor, H. 1987. *Petty Trading and Labor Market Mobility: Higglers in the Kingston Metropolitan Area*. Paper presented at Caribbean Studies Association Conference: Belize.

Maurin, A., Sookram, S., and Watson, P. K. 2006. "Measuring the Size of the Hidden Economy in Trinidad and Tobago, 1973-1999", *International Economic Journal*, Vol. 20, No. 3, 321-341.

Ng, S. and Perron, P. 2001. "Lag Length Selection and the Construction of Unit Root Tests with Good Size and Power". *Econometrica*, Vol. 69, No. 6, 1519-1554.

O'Neill, D. M. 1983. "Growth of the Underground Economy, 1950-81: Some Evidence from the Current Population Survey". *A Study for Joint Economic Committee, Congress of the United States*.

Pagan, A. 1995. "The Three Econometric Methodologies: An Update." in *Surveys in Econometrics*, edited by L. Oxley et al., Oxford: Blackwell.

Perron, P. and Ng, S. 1996. "Useful Modifications to Some Unit Root Tests with Dependent Errors and Their Local Asymptotic Properties", *Review of Economic Studies*, Vol. 63, No. 3, 435-463.

Phillips, P. C. B. and Perron, P. 1988. "Testing for a Unit Root in Time Series Regression", *Biometrika*, Vol. 75, No. 2, 335-346.

Saikkonen, P. and Lutkepohl, H. 2002. "Testing for a Unit Root in a Time Series with a Level Shift at Unknown Time", *Econometric Theory*, Vol. 18, No. 2, 313-348.

Schneider, F. and Enste, D. H. 2000. "Shadow Economies: Size, Causes, and Consequences", *Journal of Economic Literature*, Vol. 38, No. 1, 77-114.

Schwert, G. W. 1989. "Tests for Unit Roots: A Monte Carlo Investigation", *Journal of Business and Economic Statistics*, Vol. 7, No. 2, 147-159.

Smikle, C. and Taylor, H. 1977. *Higgler Survey,* Jamaica: Agricultural Planning Unit.

Tanzi, V. 1980. "The Underground Economy in the United States: Estimates and Implications", *Banca Nazionale del Lavoro Quarterly Review* No. 135, 427-453.

Tanzi, V. 1983. "The Underground Economy in the United States: Annual Estimates, 1930-80", *International Monetary Fund Staff Papers*, Vol. 30, No. 2, 283-305.

Vuletin, G. J. 2008. "Measuring the Informal Economy in Latin America and the Caribbean". Working Paper WP/08/102, *International Monetary Fund.*

Witter, M. and Kirton, C. 1990. "The Informal Economy in Jamaica, Some Empirical Exercises". Kingston, Jamaica, *Institute of Social and Economic Research, Working Paper 36, The University of the West Indies.*