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ESSAYS ON TAX EVASION AND GOVERNMENT SPENDING IN DEVELOPING COUNTRIES

BY

ABEL BERHE EMBAYE

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree
of
Doctor of Philosophy
in the
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of
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ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Andrew Young School of Policy Studies of Georgia State University.

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ABSTRACT

ESSAYS ON TAX EVASION AND GOVERNMENT SPENDING IN DEVELOPING COUNTRIES

By

ABEL BERHE EMBAYE

May 2007

Committee Chair: Dr. James R. Alm

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The dissertation aims at broadening our understanding of tax evasion and government spending in developing countries. It comprises three essays. The first essay deals with estimation of tax evasion in a cross-section of developing countries by estimating their underground economies using the currency demand method. By including enforcement parameters of the tax authorities as another factor of tax evasion in the currency demand equation, it presents theory-consistent tax evasion measurement. Our estimation strategy includes the use of the Arellano-Bond dynamic panel data method that is suitable for correcting the endogeneity problem in the currency demand estimation. The study finds substantial underground economy in developing countries, ranging from 2-67 percent of GDP.

The second essay is concerned with time series measurement of the underground economy in South Africa using the currency demand method. Unlike other similar studies on South Africa, it gives sufficient attention to the unit root problem that is common in time series analysis of the currency demand method. Using the Error

Correction Method (ECM), it investigates the relationship between the tax rate and the currency demand, and presents yearly estimates of the underground economy for the period 1965-2002.

The third essay deals with the behavior of government spending in South Africa for the period 1960-2002. Since South Africa went through various political and macroeconomic shocks during this period, we augment measures of these shocks to the standard median voter model to assess the determinants of government spending in South Africa. Using the Error Correction Method (ECM), we investigate the long-run and short-run behavior of government spending. We find that, in addition to the tax share and the income of the median voter, macroeconomic and political shocks were also significant factors in determining government spending in South Africa. This study broadens our understanding of the behavior of government spending in the presence of political and macroeconomic shocks that are common in small open developing economies.

ESSAY I: INSTITUTIONS, TAX EVASION, AND CURRENCY DEMAND IN DEVELOPING COUNTRIES: TOWARDS THEORY-CONSISTENT MEASUREMENT

Introduction

There are many reasons for some economic activities to go unrecorded in the official statistics. Of these, the most prevalent is the part associated with tax evasion. Tax evasion is considerable even in countries with efficient tax administration such as the U.S., for which recent estimates put the overall noncompliance rate for individual income tax at about 16 percent (IRS 2006). The corresponding figure for developing countries is apparently higher due to the inefficiency in the tax system. Alm, Bahl, and Murray (1991), for instance, estimate the rate of tax evasion for Jamaica at about 40 percent. Because of such considerable tax evasion, tax revenue mobilization is difficult in many of these countries. As a result, these countries often resort to financial repression to meet their spending needs; however, this has led to various distortions, reduced investment, and economic growth (Alm and Buckley 1998; Roubini and Sala-i-Martin 1995).

Tax evasion causes various inefficiencies in the economy. One negative effect of tax evasion (underground economy) is that it distorts reported data, and this often causes inefficiency in the economy. For instance, the employment in the underground economy is often ignored when calculating the unemployment statistics in an economy; and this overstates the official unemployment statistics. This might create undue pressure on policy makers to take measures aimed at increasing employment such as expansionary monetary and fiscal policies. Similarly, the inflation rate measured from the consumer price index using only the official economy's basket of goods and services overstates the inflation rate.[1] This overcompensates people whose compensations are adjusted based on such inflation rate.

To avoid such misinformed decisions, policy makers need an estimate of the magnitude of tax evasion. Having an estimate of tax evasion is also important for devising appropriate policies to combat tax evasion which in turn increases revenue for the government. This is particularly important in developing countries, which are plagued by the problem of inadequate revenue in their endeavor to provide for efficient administration, public services, and economic growth.

There are different approaches of estimating tax evasion.[2] The currency demand approach is by far the most widely used method. This approach is due to Tanzi (1980), and is based on the premise that taxpayers who evade taxes use cash instead of demand deposits in transaction because cash is anonymous. This implies that currency will be held in excess of that required for the "usual" motives of holding it. By estimating the amount of currency holding that is due to these illegal transactions, one can come up with an estimate of tax evasion in an economy.

There are many empirical studies on the estimation of the size of the underground economy for OECD countries using this method. Beginning with Tanzi (1980) study on the U.S. economy, these studies include, among other, Matthews (1982) for the U.K., Klovland (1984) for Norway and Sweden, Bajada (1999) for Australia, Giles (1999) for New Zealand, Schneider (2002) for 21 OECD countries, and Giles and Tedds (2002) for

[1] This assumes that prices for goods and services produced in the underground economy are lower than that of the official economy. This is likely to be the case because firms that evade taxes have a cost advantage compared to firms that do not.

[2] For a survey of the studies and descriptions of the methods of measuring the underground economy, see Alm, Martinez-Vazquez, and Schneider (2004) and Schneider and Enste (2000; 2002).

Canada. These studies have broadened our understanding on the causes and extent of tax evasion in developed countries.

However, the use of the currency approach to estimate the underground economy in developing countries has been ignored until recently. To our knowledge, Bagachwa and Naho (1995) for Tanzania, Faal (2003) for Guyana, and Koyame (1996) for a panel of eight Sub-Saharan African countries are the only studies that apply the currency demand method to developing countries.

These studies are also fraught with various weaknesses that make it necessary to investigate the issue further. Since they include only the tax rate as a tax evasion factor, they omit the enforcement strength of the tax authorities. Thus, the estimated equations are misspecified, and the coefficient estimates from these equations are unreliable. Since this error is carried over in the calculation of the size of tax evasion, the underground economy estimates are also misleading. Thus, this essay addresses this omission by including various institutional quality indicators as a proxy for enforcement strength of tax authorities.

The other limitation of existing studies on underground economy of developing countries is that they apply directly the Tanzi currency demand method without giving proper attention to the financial environment in which the economies of these countries operate. The Tanzi model, as applied to the U.S. economy, assumes a stable monetary sector. The financial sector of developing countries is, however, unstable and prone to crisis. The instability in the financial sector in turn results in loss of confidence in the financial system. This reduces demand for domestic money including cash demand. We extend the Tanzi model by adding the effects of financial instability or crisis on the currency demand.

The other contributions of the study include the use of dynamic panel data estimation techniques to this literature. The estimation method uses internal instruments to correct for the effects of endogeneity problem that is common in estimations of economic relationships. The panel data approach is favored for at least two reasons. First, in the context of developing countries data for a long period of time that enables the application of time series methods are not available for a wide set of countries. Thus, resorting to panel data estimation methods to overcome the data inadequacy is necessary. Second, even if some of the data were available for a long period of time, they may not show much variation over time in a given country so that their effect, though important in theory, may not be picked up adequately by time series estimation methods in a single country regression. The effects of such variables can easily be dealt in panel data estimation by accounting for the cross-sectional variation of such variables. This study is also more comprehensive in its coverage of the number of countries included in the sample compared to previous studies of the panel data approach. This is important to prevent some biases that may arise in a small sample.

The organization of the rest of the essay is as follows. Section II reviews the literature of tax evasion and currency demand method. Section III presents a model that will be a theoretical framework for tax evasion and currency holdings. Section IV presents the estimation of the currency demand that is used to estimate the underground economy. The same section also estimates the underground economy for a cross-section of developing countries. The final section concludes.

Literature Review

The objective of this section is first to review the relevant literature on tax evasion to summarize the current status of research on tax evasion. Then we show the effect of corruption and other institutional factors in tax administration of developing countries. Next we review the literature on currency demand method of estimating the size of tax evasion and indicate the major weaknesses of the current studies. Finally, we discuss our contributions to the literature.

Tax Evasion

The theoretical literature on tax evasion is based on seminal work of Allingham and Sandmo (1972) (hereafter, A-S), which in turn is based on Becker's (1968) economic approach to crime.[3] The A-S analyzes the evasion decision of an individual as a choice under uncertainty. They are interested in studying the effect of the tax rate, taxpayer's income, and enforcement parameters on the level of tax evasion.

The model assumes a taxpayer with exogenous income of y subject to a tax rate of τ on this income. The decision of the taxpayer is to report income of $x \le y$, or to hide and income of $e = y - x$. There is a probability of p that the taxpayer will be audited. Upon audit the authority learns the true income of the taxpayer, and in that case the taxpayer pays a penalty at the rate of f on the unreported income in addition to the tax

[3] The purpose of this section is to review some of the relevant studies. For a comprehensive survey of the literature on tax evasion, see Alm (1999), Andreoni, Erard, and Feinstein (1998), and Slemrod and Yitzhaki (2002).

due. There are two states that the taxpayer faces: one if he is audited (caught) and another if not. When he is not caught, his income is $y^N = (1-\tau)y + te.$ When he is caught, his income is $y^C = (1-\tau)y - (\tau + f)e.$ The taxpayer's problem is given by:

$$E(U) = (1-p)U(y^N) + pU(y^C)$$

where $E(U)$ denotes the expected utility of the taxpayer, and the utility function is assumed to be concave which implies that the taxpayer is risk averse.

Using these assumptions the authors show that the amount of income unreported is negatively related both to the probability of audit and to the penalty rate.[4]

The relationship between the amount of unreported income and the true income of the taxpayer is ambiguous. However, A-S showed that the effect of the taxpayer's before tax income on the proportion of income unreported depends only on the relative risk aversion of the taxpayer's utility function. Thus, when actual income varies, the fraction of income not declared decreases (increases) if the relative risk aversion is an increasing (decreasing) function of income.

Regarding the relationship between the tax rate and the amount of income unreported, a notable feature of the A-S model is that it lends an ambiguous result. Under the plausible assumption of decreasing absolute risk aversion, A-S show that the

---

[4] The first order condition for optimality is given by $(1-p)U'(y^N)\tau + pU'(y^C)(\tau - f) = 0$. The second order condition is $D = (1-p)U'(y^N)\tau^2 + pU'(y^C)(\tau - f)^2 < 0$. Using the first order condition we have: $\partial e^* / \partial y = -\frac{1}{D}\tau(1-p)U'(y^N)\{(f-1)R_A(y^C) - R_A(y^N)\}$; where R_A is Arrow-Pratt absolute risk aversion measure. For $f > 1$ and a decreasing absolute risk aversion utility function, $\partial e^* / \partial y > 0$.
$\partial e^* / \partial \tau = -\frac{1}{D}(1-p)e\tau[R_A(y^N) - R_A(y^C)] - \frac{1}{D}[(1-p)U'(y^N) - pU'(y^C)]$, which has ambiguous sign.
$\partial e^* / \partial p = -\frac{1}{D}\{U'(y^N)\tau + pU'(y^C)(f-\tau)\} < 0$. Finally, $\partial e^* / \partial f = \frac{1}{D}p\{U'(y^N)\tau + U'(y^C)(f-\tau)\} < 0$.

substitution and income effects of the change in the tax rate conflict each other resulting in an ambiguous overall effect. Yitzhaki (1974) resolves this ambiguity. By assuming that the penalty rate is imposed on the evaded tax rather than on the unreported income, he shows that there is no substitution effect of the change in tax rate and the remaining income effect implies that, as the tax rate increases, the amount of income unreported decreases. Although the Yitzhaki model resolves the ambiguity of the A-S model regarding the effects of the tax rate on the extent of tax evasion, its conclusion is against the commonly held view that a higher tax rate increases tax evasion.

A number of later studies have extended and generalized the A-S model of tax evasion in different ways. One of these is by including the labor supply decision with the tax evasion decision so as to make income endogenous. This extension has been investigated, among others, by Pencavel (1979), Cowell (1981), and Sandmo (1981). The salient feature of these models is that the unambiguous results regarding the effect of enforcement on tax evasion that the A-S study shows are no longer valid unless further restrictive assumptions are invoked. Sandmo (1981), however, develops a model in which an increase in the penalty rate causes a decrease in the supply of hours worked in the underground market, implying that the portion of income not reported will decrease; however, the model does not generate a clear-cut comparative statics result regarding the relationship between tax evasion and the tax rate or the probability of being caught.

Another extension is to consider the interaction of the taxpayers and the tax authority by making the probability of audit endogenous. The models in this strand of the literature can be classified into two groups (Andreoni, Erard, and Feinstein 1998; Alm 1999). The first is one in which the government can pre-commit to the level of audit it makes. Such issues are studied by employing the tools used in the standard Principal-Agent problem. In the second group of models, commitment by the tax authority is not possible, and strategic interactions between the taxpayer and the tax authority arise. Such models are analyzed using game theory tools. The pioneering works are by Graetz, Reinganum, and Wilde (1986), and Reinganum and Wilde (1985). The former develop an interactive game theoretic approach to tax evasion, while the latter develop a principal-agent framework.

A notable feature of the typical A-S type models is that they derive their results under the restrictive assumption that taxpayers report only a single piece of information to the tax authorities. Current research, however, recognizes that taxpayers report more than single piece of information. Recently, Martinez-Vazquez and Rider (2005) study the tax evasion decision of taxpayers under multiple line-items reporting such as underreporting of income and over-reporting of deductions . The authors are interested in the effect of enforcement effort on a given mode of tax evasion and on the overall tax evasion. Their model shows that income and enforcement parameters have an ambiguous effect on compliance in both modes.

There are few theoretical models that relate tax evasion to macroeconomic factors. Fishburn (1981) analyzes the effect of inflation on the level of tax evasion. One way inflation can affect the decision to evade taxes is by eroding the real value of a given level of nominal disposable income. This provides an incentive for the taxpayer to restore his purchasing power through evasion. Fishburn's results show that a risk-neutral individual's evasion decision is independent of the price level, while that of a risk-averse individual depends on the properties of the relative risk-aversion function. In particular, the observed proportion of true income unreported by a risk-averse individual is a nondecreasing (nonincreasing) function of the price level if relative risk aversion is an increasing (decreasing) function of income. Another way inflation can affect tax evasion is through tax bracket creep. Since most tax systems are not indexed, higher inflation pushes taxpayers into higher tax brackets even though their income is adjusted with cost of living index changes.

Turning to the empirical literature review of tax evasion, Clotfelter (1983) is the first to test empirically the A-S model. Using data from the 1969 Tax Compliance Measurement Program (TCMP), he tests the effect of taxpayers' after-tax income, the tax rate, and other socio-economic and demographic characteristic on the level of tax evasion by estimating a standard tobit model. He finds that the coefficient estimates for both after-tax income and tax rates are positive and significant. In particular, he finds that the estimated point elasticity of underreported income with respect to the marginal tax rate in the range of .5 to 3.

Alm, Bahl, and Murray have extensively investigated the relationship between government policy parameters and tax evasion and avoidance in the developing countries' context in several papers. Alm, Bahl, and Murray (1990) develop and test a model to examine the effect of government policy on tax evasion and avoidance decisions of taxpayers. The study includes such factors as the tax rate, the payroll tax contributions and benefits, the probability of audit, and the penalty rates. Using 1983 Jamaican individual level data, they estimate share equations for three dependent variables: avoidance, evasion, and reported income. The results show that the tax base rises with higher benefits for payroll tax contributions and falls with higher marginal tax rates, more severe penalties, and a higher probability of detection, as individuals substitute towards avoidance income.

Alm, Bahl, and Murray (1991) examine the tax evasion behavior of the self-employed. Using 1983 data, they estimate two equations: one for underreported income and another for underreported tax. Their findings indicate that in both equations the marginal tax rate is positive and highly significant. This implies that higher tax rate encourages tax evasion for this group of taxpayers. Their finding also shows that the coefficient estimate on income is positive and highly significant.

Alm, Bahl, and Murray (1993) contradict the positive relationship between tax rate and evasion. This study estimates three-equation models in which the dependent variables are evasion, reported income, and "allowance income."

Feinstein (1991) uses pooled 1982 and 1985 TCMP data in order to decipher the independent effect of the tax rate and income on tax evasion in light of the usual strong positive relationship between tax rates and income. Because marginal tax rates changed over this period for a given level of income, it is easier to identify the separate effects of the two variables. The results from the pooled data show that the coefficient on income in the evasion equation is insignificant; contrary to Clotfelter's finding, the results show a negative relationship between marginal tax rates and tax evasion.

Joulfaian and Rider (1996) examine the impact of marginal tax rates on tax evasion for lower-income taxpayers in the presence of negative income tax. Their notion of misreporting includes the possibility that taxpayers may over-report their income it is to their advantage to do so. Using 1988 TCMP data, they find that misreported income is not affected by tax rates except for the modest positive relationship between tax evasion and the marginal tax rate in the case of proprietor's income. However, their result is restricted to low income taxpayers, and hence may not apply to higher income groups who usually have higher audit rates.

Martinez-Vazquez and Rider (2005) test the effect of enforcement effort on tax evasion under multiple modes of tax evasion using the 1985 TCMP data. Their estimation results shows that increased enforcement effort has a positive effect on compliance in the targeted mode, a negative effect in the untargeted mode, and a positive overall effect on tax compliance.

Among those studies that test for the effect of macroeconomic factors on tax evasion, we mention Crane and Nourzad (1986). They test the effect of inflation on aggregate tax evasion in the U.S. over the period 1947-81, and find that tax evasion is positively related to the inflation rate.

Corruption in Tax Administration

One of the notable features of the literature on tax evasion is that it often assumes a corruption-free tax administration. The reason for this is partly because tax evasion research has assumed the institutional environment of the developed countries. In these economies corruption is not a serious problem, particularly in tax administration.

In developing countries, however, corruption poses serious concerns by affecting a wide chunk of the economy. The importance of corruption at large has been noted by many economists (Rose-Ackerman 1978; Shleifer and Vishny 1993; Mauro 1995; Bardhan 1997). It is widely believed that corruption of public officials is prevalent phenomena that can seriously hamper investment, economic growth, and the stability of socio-economic institutions in these countries. More particularly, corruption in tax administration affects the level of tax revenue that can be collected in developing countries. Some economists argue that it is more important than the tax rate policy. For instance, Casanegra de Jantscher (1990) argues that in developing countries "tax administration is tax policy."

Although a relatively extensive literature has investigated the causes and effect of corruption, relatively few studies have attempted to address the interaction between tax evasion and corruption. In general, the level of tax evasion in the economy depends on several structural and institutional factors such as the degree of risk aversion, the wealth of taxpayers, the overall tax burden of the economy, and the efficiency of the tax enforcing authority. The enforcement strength in turn depends on the extent of corruption entrenched in the tax administration, which in turn depends on the wages of public officials or the degree of monitoring or both.

Martinez-Vasquez, Arze, and Boex (2004) explain why there could be an inverse relationship between corruption and the tax revenue per GDP collected by authorities as follows: *"if tax collectors or tax administration officials engage in corrupt practices (either directly stealing from the treasury, or by allowing taxpayers to evade taxes in return for a bribe), then corruption on the revenue side will result in direct decreases in overall revenue collections."*

Chander and Wilde (1992) develop a model of the effect of corruption on tax evasion. The study investigates the effect of the presence of corruption on tax evasion in a game theoretic framework. The study assumes risk neutral taxpayers, lump-sum bribery penalty costs, independence between the size of the bribe and the likelihood of bribery detection, and a constant likelihood of bribery detection. The general conclusion is that corruption defeats the effectiveness of government's deterrence policy and that there is a possibility that an increase in the tax rate or the fine rate could actually decrease government revenue. The model also clearly shows that the response of government revenue to an increase in either tax rate or the fine rate is less in the presence of corruption than otherwise.

The problem of the relationship between enforcement, corruption, and deterrence and its normative ramifications have been recently analyzed by Polinsky and Shavell (2001). These authors examine both the optimal amount of resources to be allocated to law enforcement, the detection of bribery, and the optimal fines structure. Since bribery agreements dilute deterrence of the underlying violation, it is desirable for society to attempt to detect and penalize corruption in order to preserve a given degree of deterrence. An application of this finding to the context of tax evasion would imply that taxpayers have to be audited and auditors have to be monitored since fighting corruption may be worthwhile in order to boost tax compliance. Similar to Becker (1968) conclusions, these authors find that that both the optimal fine for tax evasion and the optimal fine for bribery should be maximal (usually equal to taxpayer's wealth or income) since detecting any violation involves cost.

Besley and McLaren (1993) examine the effect of different wage schemes for tax collectors on tax evasion in the presence of corruption. These schemes are the ones that pay the reservation wage, below the reservation wage, and the efficiency wage. The study demonstrates that the efficiency wage strategy may not be a good idea much of the time for maximization government revenue. In fact, under some conditions the government may be better off paying a rate below the efficiency wage. In such cases the government should depend on monitoring tax inspectors as a means of raising revenue.

Hindriks, Keen, and Muthoo (1999) study the equity and efficiency implications of tax evasion in the presence of corruption. They include extortion (demanding money from non-violators) as well as bribery (demanding money from violators) in their notion of corruption. The model shows that the distributional effects of evasion and corruption are unambiguously regressive under the usually practiced tax collection schemes. The other result is that collecting progressive taxes without inducing evasion or corruption may require that inspectors be paid commission on high income reports only.

Alm and Martinez-Vazquez (2003) provide another way in which institutions affect the level of tax evasion in developing and transition countries. They argue that the existence of a "social norm" of compliance and the presence of an effective service-oriented tax administration are crucial in determining tax evasion. Taxpayers expect a fair service from their government for the taxes they pay. The higher the service taxpayers receive the higher the tax compliance. Conversely, in a country where the government wastes taxpayers' money because of corruption and other inefficiencies, tax evasion will be widespread.

There are some empirical studies relating indirectly corruption and inefficiency in the tax system. In analyzing the impact of political instability on seigniorage and conventional taxes, Cukierman, Edwards, and Tabellini (1992) argue that countries with more corruption have inefficient tax systems, forcing governments to resort to printing more money. Therefore, they conclude that countries with more corruption are subject to higher inflation rates. Al-Marhubi (2000) provides empirical evidence that supports this claim. Using cross-section data for 41 countries, he finds a significantly positive relationship between corruption and inflation. Ghura (1998) is another cross-section study that attempts to address the effect of corruption on government finance. The study investigates the effect of corruption and macroeconomic factors on the level of tax revenues in a panel of Sub-Saharan African countries. The study finds that corruption negatively affects the level of tax revenue, other things being equal.

In summary, tax administration is an important aspect of tax revenue collection and tax evasion policies in developing countries. The efficiency of tax administration is influenced by the existence of corruption in these countries. Thus, the extent of corruption should be included as one of the determinant of tax evasion in developing countries.

The Currency Demand Approach

In the previous sections, we discussed some of the theoretical and empirical studies on tax evasion. One of the ways in which these tax evasion studies have been useful is in furnishing the theoretical basis for the analysis of unreported economic activities at the aggregate level. One of the shortcomings of investigating tax evasion using data from audits and amnesty is that the data are from small a sample of the population, and also there is a sample selection problem in that the sample is typically taken only from those who report their income. Another approach that economists have sought to remedy this problem is to employ aggregate indicators of tax evasion activities. One of these approaches is the currency demand method pioneered by Tanzi (1980). This method begins with the premise that tax evaders, in order to leave no trace of their illegal activities, undertake their transactions using currency rather than demand deposits; thus, part of currency demand can be used as a reasonable indicator of the level of tax evasion.

The method of currency demand to measure tax evasion is grounded in Cagan's (1958) study that investigates the determinants of Currency to M2 ratio; however, he does not use the relationship to estimate the size of tax evasion. Cagan included tax variables as one of these determinants. His argument was that since currency gives anonymity to tax evasion activities, taxpayers use currency rather than other methods of payment such as checks. Thus, as the tax burden increases, tax evasion increases and hence the demand for currency relative to broader money increases. To test his hypothesis, Cagan regresses the currency to M2 ratio on the tax rate, interest rate, and income.

Tanzi uses a variant of this econometric estimation to measure the underground economy (or tax evasion) in the United States for the period 1929-76. Tanzi first establishes that the tax rate as measure of tax burden in the economy is associated with the currency ratio, ceteris paribus. The measure of tax burden used is the statutory tax rate, or the ratio of personal income taxes to personal income net of transfers. The control variables are the interest rate, per capita income, and the share of wages and salaries in personal income. He finds a positive relationship between tax rates and the currency ratio, which supports the commonly held view that an increased tax burden is associated with increased tax evasion. With the estimated coefficients of this regression, he then calculates the difference between the actual currency holding for the year 1976 and currency held if there was no tax evasion. The no tax evasion situation is assumed to be when the tax rate is zero (or at its lowest level for the period). This difference is the illegal stock of money. Then, he multiplies the illegal currency stock by the velocity of money to get the value of illegal transactions that this stock of illegal currency supports. This amount, which is the underground economy's income, is then multiplied by the tax rate to arrive at the tax revenue lost to the government. Tanzi finds that for 1976 the underground economy of the U.S. is between 10 to 31 percent, depending on the tax rate definition used.

A number of studies have replicated Tanzi's study on OECD countries. Matthews (1982) studies the effect of the income tax rate and the VAT rate on the ratio of cash to demand deposits in the United Kingdom, and using this relationship he calculates the underground economy for the U.K. at about 7.5 percent of GNP.

Klovland (1984) also tests the effect of marginal tax rates on the currency demand for Norway and Sweden. While the estimations for Sweden corroborate the positive effect of marginal tax rate on currency holdings, he does not find such effects for Norway. For Sweden he calculates the hidden economy to be 3-20 percent of GDP, depending on the different specification estimated and the tax rate definition used. Not finding a robust positive relationship between the tax rate and the currency holdings in Norway's case, Klovland does not calculate the hidden economy of Norway. Other recent studies that employ the currency approach for OECD countries, include Bajada (1999) for Australia, Giles (1999) for New Zealand, Schneider (2002) for 21 OECD countries, and Giles and Tedds (2002) for Canada.

The use of the currency demand approach in studying the underground economy of developing countries has been neglected until recently. To our knowledge Bagachwa and Naho (1995) for Tanzania, Saunders and Loots (2005) for South Africa, Koyame

(1996) for eight Sub-Saharan African countries, and Faal (2003) for Guyana are the only studies that use the currency demand approach for the economies of developing countries. Except for Koyame, all these studies are time series applications of the currency equation. Koyame employs a panel data estimation approach to estimate the relationship between currency ratio and the tax rate and other control variables, and she reports estimates of the underground economy ranging from 1.5 to 17 percent of GDP.

These recent applications of the currency method for developing countries are important in lending new insights into the size and causes of tax evasion in these groups of countries. Unfortunately, these studies are infested with various weaknesses that make it necessary to investigate the issue further. First, they include only the tax rate as the cause of tax evasion, ignoring the enforcement strength of the tax authorities. Second, a direct application of the Tanzi (1980) method to the context of developing countries is not appropriate, as discussed below.

The main limitation of previous studies of the currency demand method is their omission of the enforcement strength of the authorities in the estimation of the currency equation (and in the calculation of the underground economy). The seriousness of omitting the enforcement strength in the estimation can be made more clear by taking two countries, say A and B, in which A imposes a higher marginal tax rate on income but at the same time keeps its institutions efficient to enforce the tax laws, while country B imposes a lower marginal tax rate but has institutions that are inefficient in catching and apprehending tax evaders. Therefore, empirical models that do not control for the enforcement strength will conclude that evasion will be higher in country A than B, when in fact the opposite is the case. The econometric implication of the omission is clear. The exclusion of the enforcement variable creates not only the problem associated with omitted variables but also results in faulty conclusions in applying the estimated equation in sizing the underground economy across countries. The error is that a country with higher tax burden will have typically higher tax evasion. This is particularly important in studies that focus on developing countries, which have varying degrees of institutional development. The appropriate approach is, then, to take into account both the tax rate and the enforcement variables. Therefore, in this essay we contribute to the literature by considering the effects of both.

The other limitation of existing studies of the currency equation in developing countries is that they inappropriately apply the Tanzi method in the context of these countries. The Tanzi study as applied to the U.S. economy assumes a stable monetary sector, which is not the case for most of these countries. In some developing and transition countries there is a large chunk of unrecorded foreign currency held by residents either for tax evasion purposes or just because of lack of confidence in the financial system. In this case, the use of domestic money (both currency and M2) declines. The effect of financial instability on the demand of currency relative to M2 is ambiguous. If the dependent variable is modified to include the demand for foreign currency, the effect of financial instability can be more precisely addressed. See, for example, Feige (2003). Since data on foreign currency outside banks are not available, we do not tackle this issue in this study. However, we control for the financial instability with currency to M2 ratio as the regressand, and leave the sign of the coefficient to be an empirical issue.

Moreover, our study is the first to introduce *dynamic panel data estimation* techniques to the empirical literature. This technique uses internal instruments to correct for the endogeneity problem that is common in estimations of economic relationships. A panel data approach is favored for at least two reasons. First, data for a long period of time that enables the application of time series methods are often not available. Panel data estimation overcomes the data inadequacy. Second, even if some of the data are available for a long period of time, they might not show much variation over time in a given country, so that their effect might not be picked up adequately by time series estimation methods in a single country regression. Here again, panel data estimation is necessary to capture the effect of such variables. This study is also more comprehensive in its coverage of the number of countries included. This is important to prevent some biases that might be created by small samples.

Theoretical Framework

In this section we present a theoretical model that will be the basis for the estimation part of the essay. This model relates the microeconomic theory of tax evasion and the macro model of currency demand method of estimating the size of tax evasion. While the microeconomic model is based on the model of income tax evasion of A-S, the currency demand method is based on Tanzi (1983) approach.

The Model

The model presented here is an extension of Allingham and Sandmo (1972) model as applied by Chen (2003) in a dynamic setting. Chen does not model the financial asset demand behavior of taxpayers. We build on this study to relate tax evasion and currency demand behavior of taxpayers. The model set up is as follows. Assume utility maximizing individuals whose taxable income is derived from labor income and interest payments on capital holdings. Assuming, a unit of labor is exogenously supplied by the taxpayer,

$$y = w + i_k k \,, \qquad (1.1)$$

where y is taxpayer's true income, w is the wage earnings, i_k return to capital, and k is the amount of physical capital hold by the taxpayer. The taxpayer correctly knows his income y. However, the tax authorities do not know the true income of the taxpayer and hence depend on the taxpayer's self reporting unless they decide to audit the taxpayer. The probability of being audited p depends on the efficiency of the tax administration (corruptibility of tax officials). Upon audit the taxpayer pays a penalty at a rate of f on the unreported taxes.

The taxpayer is required to pay tax on this income at a rate of τ. Suppose we denote the fraction of income y reported to the authorities by β. The amount that the taxpayer pays in taxes is $\tau\beta y$. We assume that cheating involves transaction costs. These costs include, among others, bribes paid to tax officials. To avoid corner solutions, these costs are assumed to be concave with respect to the amount of tax evasion, specifically given by $h_0(1-\beta)^2$ with the cost parameter $h_0 > 0$. h_0 is a measure of the prevalence of corruption in the tax administration with a smaller h_0 implying a more corrupt tax administration (hence it is easier to dodge taxes). This notion can easily be captured by assuming that $p = p(h_0)$ with $p'(h_0) > 0$.

The taxpayer must decide how much of his income to report. Since there are two states of nature, the taxpayer's disposable income is a stochastic variable given by the following:

$$\begin{aligned} y_d &= (1-p)[(1-\tau\beta) - h_0(1-\beta)^2]y + p[(1-\tau\beta) - h_0(1-\beta)^2 \\ &\quad - f\tau(1-\beta)]y = (1-\tau_E)y, \end{aligned} \tag{1.2}$$

where $\tau_E = \tau[1-(1-\beta)(1-pf)] - h_0(1-\beta)^2$, y_d is the disposable income to be spent or used up in paying other compliance costs, and τ_E can be thought of the effective tax rate.

This disposable income is then used for consumption x and for acquiring assets. We have three assets: physical capital and two financial assets. The financial assets are currency c and demand deposits d. Demand deposits can be broadly defined to include time deposits. There are costs and benefits of holding financial assets. Holding currency has the benefit of reducing the cost of evasion in that it makes transactions (involving tax evasion) anonymous. More specifically assume that

$$r_c = g(y_u), \qquad g'(y_u) > 0 \;, \tag{1.3}$$

where $y_u = (1-\beta)y$ is the unreported income and r_c is the return to holding currency. The cost of holding currency is the erosion of purchasing power due to inflation π. Demand deposit has the benefit of earning interest. We capture these asset benefits and costs in the budget constraint of the taxpayer. The budget constraint of the taxpayer is given as follows:

$$(1-\tau_E)y + T - x + (r_c - \pi)c + i_d d - \dot{k} - \dot{d} - \dot{c} = 0, \qquad (1.4)$$

where the first term is the disposable income from (1.2) above; T_t is a lump-sum transfer from the government; r_c is the return to holding cash; π is the inflation rate; r_d is the interest rate on demand and time deposits; and $\dot{k}$, $\dot{d}$, $\dot{c}$ are, respectively, the change in physical capital, demand deposits, and currency holdings. As equation (1.4) shows, the receipt side of the budget includes the after tax earned income, government transfers, and the gross earnings from holding the assets, and the expenditure side of budget constraint includes the currency erosion due to inflation and the expenses made to acquire new asset holdings.

Finally, we have a cash (liquidity) in advance constraint that constrains the individual in his consumption and physical capital investment. Unlike the usual cash in advance constraint in which currency and demand deposits are perfect substitutes, we allow for imperfect substitutability of the two assets, as in Walsh (1984). This assumption is necessary to get well behaved asset demand functions.

$$x + \dot{k} \leq \sqrt{c} + \sqrt{d}, \qquad (1.5)$$

The liquidity constraint shows that the magnitude of consumption and physical capital investment cannot exceed the sum of the square root of the amount of the financial assets held by the taxpayer. The consumer maximizes the following utility function

$\int_0^\infty u(x_t)e^{-\rho t}dt$ subject to (1.1)-(1.5). The current value Hamiltonian of the taxpayer is as

follows:

$$H = u(x) + \lambda\left\{[1-\tau(\beta + pf(1-\beta)) - h_0(1-\beta)^2]y + \right.$$
$$\left. T - x + (r_c - \pi)c + i_d d - \dot{k} - \dot{d} - \dot{c} + \mu\left\{\sqrt{c} + \sqrt{d} - x - \dot{k}\right\}\right\}$$

The taxpayer chooses x_t, c_t, d_t, β, and the first order conditions for his optimal choices

are given, respectively, by:

$$u'(x) = \lambda + \mu \qquad (1.6)$$

$$\lambda_t[-\tau(1-pf) + 2h_0(1-\beta)]y = 0 \qquad (1.7)$$

$$\lambda(r_c - \pi) + \frac{\mu}{2\sqrt{c}} = \rho\lambda - \dot{\lambda} \qquad (1.8)$$

$$\lambda r_d + \frac{\mu}{2\sqrt{d}} = \rho\lambda - \dot{\lambda}\ .$$

(1.9)

We concentrate on the steady state behavior of our variables of interest. In the steady state, $\dot{\lambda}_t$ =0. Equation (1.7) gives the optimal tax evasion decision of the individual; and Equations (1.8) and (1.9) give the asset demand of the taxpayer. Using equation (1.7), the percentage of income unreported is give by:

$$(1-\beta) = \tau(1-pf)/2h_0 \qquad (1.10)$$

Multiply both sides of (1.9) by y to get the absolute per capita unreported income as

$$y_u = \frac{\tau(1-pf)}{2h_0}y, \qquad (1.11)$$

where $y_u \equiv (1-\beta)y$ is the unreported income. As can be seen from this optimal choice at the steady state, the amount of evaded income is directly related to the tax rate and inversely related to the enforcement parameters. Unreported income is also directly related to the true income of the taxpayer. Mathematically, we have $\frac{\partial y_u^*}{\partial \tau} > 0$; $\frac{\partial y_u^*}{\partial y} > 0$; $\frac{\partial y_u^*}{\partial f} < 0$; and $\frac{\partial y_u^*}{\partial p} < 0$. Since $p = p'(h_0)$, we can easily show that the unreported income is inversely related to the efficiency in the tax administration, as is the probability of audit.

Using equations (1.8) and (1.9) we get the relationship:

$$\frac{c}{d} = \left(\frac{\rho - r_d}{\rho - r_c + \pi} \right)^2 . \qquad (1.12)$$

This relationship shows that the currency ratio is directly related to the return on currency, r_c, and inversely related to the return on demand deposits, and the inflation rate. As defined broadly, the return to currency is the provision of anonymity for transactions involving tax evasion. The expression for the currency ratio can be easily related to the partial reporting of income using equation (1.3) and (1.11) above as follows:

$$\frac{c}{d} = \left(\frac{\rho - r_d}{\rho - g(\frac{\tau(1 - pf)}{2h_0} y) + \pi} \right)^2 . \qquad (1.13)$$

Since $g' > 0$, it can easily be shown that:

$$\frac{\partial (c/d)}{\partial \tau} > 0;$$

$$\frac{\partial (c/d)}{\partial y} > 0;$$

$$\frac{\partial(c/d)}{\partial f} < 0 \text{; and}$$

$$\frac{\partial(c/d)}{\partial p} < 0$$

The comparative statics shows that the currency ratio is higher the higher the tax evasion, which is explained by the tax rate, the true income of the taxpayer, and the enforcement parameters represented by the probability of audit and the penalty rate.

Equation (1.13) also yields the following two comparative statics: $\frac{\partial(c/d)}{\partial r_d} < 0$, and $\frac{\partial(c/d)}{\partial \pi} < 0$. The latter relationship, however, does not take into account the "tax bracket creep" effect of inflation that relates inflation and currency ratio positively. Thus, the sign of $\frac{\partial(c/d)}{\partial \pi}$ is ambiguous when the two effects of inflation are taken into account.

Other Determinants of the Currency Ratio

In the preceding section, we developed a model that relates tax evasion to the demand for currency relative to demand deposits. However, there are some other factors that our model does not capture. These other factors, which have been included in previous studies that use the Tanzi method, are discussed below.[5]

Individuals hold currency not only to hide their transaction of illegal activities but also to undertake legitimate transactions. Cash in hand is the most liquid asset there is. Such transactions depend on the income or spending habits of individuals. Thus, income

[5] Since M2 is currency plus demand deposits, the behavior of currency to demand ratio is similar to currency to M2 ratio, hence we use the latter to be in line with the Tanzi's.

as a proxy for the level of transactions is a determinant of currency demand, and should enter the relationship regardless of tax evasion effects. The higher income people have the more spending they make implying a positive relationship between currency demand and the level of income. This is also true for other components of M2. From a different angle, a country's income is a measure of the level of development, and, as a country grows, it uses less currency and more of demand deposits as a sign of "sophistication." Recall also that from the behavioral model of the tax evasion above, the relative currency demand and income are positively related. Thus, the overall effect of income on currency to M2 ratio is ambiguous.

Cagan (1958) discusses the degree of urbanization as a potential factor affecting the currency ratio. He argues that the effect of this factor is ambiguous because there are two conflicting effects. On the one hand, urbanization causes people to trade where they are not known, which reduces the use of checks. On the other hand, the use of checks is lower in rural areas than in cities where the populace is more sophisticated. However, the argument that parties must know each other to use checks is not convincing, and this study takes the later effect of urbanization to be more in operation; hence urbanization is expected to be negatively related to currency ratio.

Koyame (1996) includes the level of education as additional factor in the currency equation. The use of checks and other saving accounts is more prevalent when the populace is educated. Thus we also include education as a factor determining the currency ratio. We expect the sign on this coefficient to be negative.

To these factors we add the effect of financial uncertainties on the currency ratio to account for the instability or uncertainty of the financial sector of developing countries.

We attempt to capture these uncertainties by the rate of inflation and exchange rate depreciation.

Summarizing, we have the basic currency to M2 relation of:

$$C / M2 = f(\tau, y, p, f, r_d, \pi, Ub, Ed, Er),$$

where r_d is the rate of interest on components of M2 that pay interest, Ub is urbanization, Ed is a measure of the level of education, and Er is the rate of exchange rate depreciation. The other symbols are as previously defined. The expect sign on the coefficient of tax rate is positive, consistent with the notion that the general tax burden increases tax evasion. The sign on income is ambiguous. The signs of the coefficients of the two enforcement parameters (p and f) are negative, implying that the higher the probability of detection or the severe the penalty for violations the lower the currency ratio (tax evasion). The coefficient on the interest rate is expected to be negative showing that as the cost of holding currency increases the currency ratio declines. The expected signs of the coefficients of urbanization and education level are negative.

Data, Estimation Methodology and Results

In this section, we present the results of the estimation of the currency equation and estimates of the size of tax evasion for cross-section of countries. First, we briefly discuss the data for the variables and their sources. Next, we discuss the estimation methodologies we adopt. Then, we estimate the currency equation, and, using this estimated relationship, we estimate the underground economies of the countries.

Data

Our model of tax evasion and currency demand explains the currency to M2 ratio as a function of the tax rate, the income of the representative taxpayer, the probability of audit, the penalty rate, the interest rate, the inflation rate, urbanization, the education level, and the exchange rate depreciation. The probability of audit and the penalty rates are the two variables measuring the enforcement strength of the tax authorities. These two variables along with the tax rate are the main variables accounting for tax evasion in the currency equation.

The countries in our sample are non-OECD developing countries, namely Argentina, Azerbaijan, Bolivia, Botswana, Brazil, Bulgaria, Cameroon, Chile, China, Colombia, Republic of Congo, Costa Rica, Croatia, Cyprus, Czech Republic, Dominican Republic, Ecuador, El Salvador, Estonia, Gabon, Ghana, Guatemala, Guyana, Honduras, Hungary, Indonesia, Jamaica, Kenya, Latvia, Lithuania, Malawi, Malaysia, Malta, Morocco, Mozambique, Nicaragua, Nigeria, Papua New Guinea, Peru, Philippine, Poland, Russia, Senegal, Slovak Republic, Slovenia, South Africa, Sri Lanka, Tanzania, Thailand, Trinidad and Tobago, Uganda, Ukraine, Venezuela, Vietnam, Zambia, and Zimbabwe. The sources and the definitions of the data used are explained below.

Description of the Data for Enforcement Parameters

In the theoretical model of tax evasion the parameters that measure enforcement strength are the probability of detection and the penalty rate. The first measures the likelihood (certainty) that tax evaders will be caught. The second measures the severity of punishment. Ideally, the probability of audit would be measured by the number of people audited (or the number of violations detected) per total number of taxpayers; and the penalty rate would be measured by the statutory rate at which the government penalized the violators. This rate is often set proportional to unreported income or unreported tax liabilities. Such data are not available. Even if they were, they are unlikely to be of much use in countries where the tax administration is corrupt. This is because when one thinks about tax law enforcement, the letter of the laws is one thing and the zeal (efficiency) with which these "good" laws are implemented is another.

Therefore, in this study we concentrate on a general measure of the efficiency of the tax system as proxy for enforcement strength. We use the average of measures of the degree of corruption, the quality of bureaucracy, and the rule of law as proxy for the efficiency of the tax system.[6] When a taxpayers contemplate underreporting income, they take into account how efficient or strong is the bureaucracy in fighting tax evasion. In a corrupt tax administration, it would be easy to get away with tax evasion (if caught) by bribing the tax collector.

[6] We have also used these three indices separately as measures of enforcement strength of the tax authorities, and the results are similar with the one when the average of the indices is used. These results are not reported here.

However, the corruption data available do not measure corruption in tax administration per se. The same holds for the other institutional quality indicators mentioned above. For example, the corruption index in a given year is the average of the degree of corruption in a wide range of activities, among which tax administration is only one. But if we think of corruption as a reflection of the government's inefficiency, then corruption in one function of the government will likely be reflected in other functions. Likewise, an improvement of efficiency in one of the functions of government generally spills over to the other functions, balancing the efficiency of the bureaucracy in all other functions of the government on average. Thus, our use of these institutional indicators at large as a measure of enforcement strength in tax administration does not bias our results. It is because of this implicit assumption that Ghura (1998) uses the available corruption data in the analysis of the effect of corruption on tax revenue for a sample of Sub-Saharan African countries. Loayza (1996) likewise makes use of the quality of bureaucracy index as a proxy for enforcement strength in the estimation of underground economy in Latin American countries using the Multiple Indicators Multiple Causes (MIMIC) method.[7] The discussion of data sources for these variables is in order.

The Corruption, Quality of Bureaucracy and Rule of Law indices are drawn from the International Country Risk Guide (ICRG), which is a publication of Political Risk Services (PRS). PRS is a commercial service that provides financial, economic, and political risk assessment for international investors for a wide set of countries. ICRG's

[7] The MIMIC model is another method of estimating the underground economy. Its procedure entails identifying multiple indicators of underground economy (such as currency demand or official labor force) and multiple causes of underground economy (such as the tax rate or government regulation). Then an index of the underground economy is computed using the estimated coefficients of the cause variables. Finally, the index is converted to an absolute value of the underground economy using some extraneous information. This method has been severely criticized by Breusch (2005).

data are based on polls and ratings of experts who have working knowledge in the countries.

These data for the corruption variable available in ICRG are probably the most widely used corruption measure. The data have a wide coverage in terms of the number of countries and the series span. Annual data are available starting from 1982, and the latest data cover over 100 countries. This makes the data suitable for conducting panel data estimation.[8]

The data used here are the academic version of the ICRG data set for the period spanning 1982-2003. The original data range from 0 (high corruption) to 6 (low corruption). To facilitate discussion, the original data are modified in such a way that a higher index indicates higher corruption. As per the ICRG definition, higher corruption means that government officials are likely to demand special payments and that illegal payments are generally expected throughout lower levels of government in the form of "bribes connected with imports and export licenses, exchange controls, *tax assessment* (emphasis added), police protection or loans."[9]

The other two institutional efficiency indicators are also measured on a 0-6 scale.[10] The bureaucratic quality index measures the strength and expertise of government bureaucracy to govern without drastic changes in policy or interruption in government services. It also signifies an established mechanism for recruitment and training.

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[8] The other most widely used alternative data for corruption is the Corruption Perception Index (CPI) from Transparency International. This index is based on a survey of individuals or organizations that have had first hand experience with the corruption in those countries. This source has less country coverage and a shorter time span. More important, as the rating is based on a ranking of countries rather than a score, year-to-year comparison is impossible; so that it is not suitable for panel data estimation.

[9] See Political Risk Services (2006)

[10] In the original data, the bureaucratic quality index was changed after 1997 from a 0-6 scale to a 0-4 scale. To create a reasonably continuous time series, we multiply the 1998-current values by 1.5 to conform to the old 0-6 scale.

Similarly, the Rule of Law index is an assessment of the strength and impartiality of the legal system and the degree to which the law is observed by the populace.

Description of Other Variables

The data sources for the remaining variables of our estimation are as follows. For the dependent variable (the currency to M2 ratio), the currency and M2 measures are drawn from International Monetary Fund's *International Financial Statistics (IFS) CD-ROM (2006)*. Currency is defined as the notes and coins held outside banks (IFS item line 14), and M2 consists of money (IFS item line 35) plus quasi money (IFS item line 35b). The interest rate measure used is the bank deposit rate. The exchange rate depreciation rate is calculated from the yearly average exchange rate. The data for the bank deposit rate and the exchange rate are also drawn from *IFS CD-ROM (2006)*. We use different measures of the tax rate: the total tax rate, the direct tax rate, the indirect tax rate, and the top bracket statutory marginal income tax rate. The data for the first two measures of the tax rate are derived from World Bank's *World Development Indicators CD-ROM (2006)*. For the top bracket statutory marginal income tax rates, the data are drawn from various issues of publications of Price Waterhouse (1983-1997) for the years 1983-1997, and *World Development Indicators CD-ROM (2007)* for the years 1998-2003. The total tax rate is defined as the ratio of total tax revenue to GDP. The direct tax rate is calculated as the ratio of taxes on income and wealth to GDP. The inflation rate is calculated as the percentage change in the price level. Urbanization measures the percentage of population living in urban areas. The measure of the average income of the taxpayer is the per capita income in constant U.S. dollars. The data for the rate of inflation, urbanization, and per capita income are drawn from the *World Development Indicators CD-ROM (2006)*. Education given by the average schooling attained of the population 15 years old and above and derived from Barro and Lee (2000).

Estimation Methodology

In this section, we discuss the methodologies we adopt to estimate the currency equation. Since we expect unobserved group heterogeneity in the cross-section of countries we pool in the study, we rule out the use of simple OLS at the outset. It is well known that with the presence of group hetrogeneity simple OLS is inefficient. We employ different panel data estimation techniques to check the robustness of the results across different estimation techniques and specifications. Below we discuss fixed effects, random effects, and dynamic panel data methods. We also deal with the issue of endogeneity in the estimation of the currency equation.

<u>Fixed Effects Estimator (FE)</u>

The general form of the fixed effects model we estimate is as follows:

$$y_{it} = \beta_i x_{it} + \eta_i + u_{it} \ , \qquad (1.14)$$

where y_{it} is the currency ratio, x_{it} is a vector of explanatory variables, β_i is the vector of corresponding coefficients, η_i is unobserved country specific (time invariant) effect, and u_{it} is the disturbance term, which is assumed to be white noise. As noted, with the presence of such group heterogeneity the OLS estimator is inefficient. However, we can have efficient estimates by estimating (1.14) using the fixed effects model. The fixed effects estimator is efficient under the following assumptions:

$$E(u_{it} \mid x_i, \eta_i) = 0$$

$$Var(u_{it} \mid x_i, \eta_i) = Var(u_{it}) = \sigma_u^2 \text{ for all t=1, …,T}$$

$$Cov(u_{it}, u_{is} \mid x_i, \eta_i) = 0 \text{, for all } t \neq s.$$ [11]

In the fixed effects model, we need not assume that the country specific effects η_i and the observed explanatory variables are uncorrelated since under correlation of the two we can still get consistent estimates. The fixed effects estimator is simply given by OLS regression applied to the demeaned variables. The procedure is as follows. First, average (1.14) over time to get:

$$\bar{y}_i = \beta_i \bar{x}_i + \eta_i + \bar{u}_i \;, \tag{1.15}$$

where $\bar{y}_i = \frac{1}{T}\sum_{t=1}^{T} y_{it}$, $\bar{x}_i = \frac{1}{T}\sum_{t=1}^{T} x_{it}$, $\bar{u}_i = \frac{1}{T}\sum_{t=1}^{T} u_{it}$.

Now, for each t, subtract (1.15) from (1.14) and get:

$$y_{it} - \bar{y} = \beta_i (x_{it} - \bar{x}) + u_{it} - \bar{u}_i \;. \tag{1.16}$$

As can be seen from (1.16), the individual (unobserved) country effect η_i is removed, and simple OLS can now be applied to this equation to get consistent estimates of β_i. The shortcoming of this demeaning procedure is that we cannot include variables such as country dummy or any other variable that is constant over time.

Random Effects Estimator (RE)

Unlike the fixed effects model, the random effects model assumes that the unobserved country specific effect is random across time and unit groups, and further

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[11] It can also be assumed that conditional on x_{it} and η_i, u_{it} is i.i.d and $N(0, \sigma_u^2)$. This is a strong assumption, but it is convenient to have an estimator that is normally distributed, and with exact t and F distributions for small samples. Otherwise, we have to rely on large N and small T (e.g., to rely on asymptotic approximation) to have an estimator with normal distribution.

assumes that the country specific effect is uncorrelated with the observed explanatory variables, which implies that the composite error term $v_{it} = \eta_i + u_{it}$ is uncorrelated with the right hand side variables. However, since η_i is in the composite error in each time period, the v_{it} are serially correlated across time, with

$$Cor(v_{it}, v_{is}) = \frac{\sigma_\eta^2}{(\sigma_\eta^2 + \sigma_u^2)}, \; t \neq s, \tag{1.17}$$

where $\sigma_\eta^2 = \text{var}(\eta_i)$ and $\sigma_u^2 = \text{var}(u_{it})$. Because of the presence of serial correlation of the composite errors, the random effects model uses the GLS technique to yield efficient estimators. The assumption of uncorrelated country specific effects and the right hand side variables allows us to include time constant variables. However, if the two are correlated, the random effects estimates of β_i are inconsistent. As in standard GLS estimator, the random effects estimator is given by:

$$\beta_i = \left(\sum_{i=1}^{N} X_i^{'} \hat{\Omega}^{-1} X_i \right) \left(\sum_{i=1}^{N} X_i^{'} \hat{\Omega}^{-1} y_i \right), \tag{1.18}$$

where $\hat{\Omega} \equiv E(v_{it} v_{it}^{'})$.

In our estimation, we compare the FE and RE estimates to check whether the FE estimate or the RE estimate is appropriate. This is done by using the Hausman (1978) specification test. The test procedure is simple: if there is evidence of the existence of correlation between η_i and x_{it}, then the RE is inappropriate. The null of the Hausman test is that there is no correlation between η_i and x_{it}. Under the null, both FE and RE are consistent; under the alternative only FE is consistent. Thus, a rejection of the null can be taken as the evidence that the RE is inappropriate. If the null is not rejected, however, it is more appropriate to use RE because it is more efficient than FE. The Hausman statistic H is given as follows:

$$H = (\beta_{FE} - \beta_{RE})'\left[A\,\mathrm{var}(\beta_{FE}) - A\,\mathrm{var}(\beta_{RE})\right]^{-1}(\beta_{FE} - \beta_{RE})\,. \qquad (1.19)$$

Under the null, H has a χ_K^2 distribution asymptotically, where K is the number of explanatory variables excluding the fixed effects, and Avar(.) denotes the asymptotic variance of the expression in the parenthesis.

IV Estimation (2SLS)

In the above discussions, the FE and RE models assume no correlation between u_{it} and x_{ti}; that is, the explanatory variables are strictly exogenous. Under the assumption of endogeneity of the explanatory variables, the FE and RE are no longer consistent. Endogeneity may spring from simultaneity or from measurement error in the right hand side variables. The problem of endogeneity, whatever its cause, can be dealt with by using appropriate instruments for the endogenous variables. In our case, we suspect that both of our variables of interest, the tax rate and enforcement strength measures are endogenous. This might be the case particularly when the tax rate measure is tax revenue per GDP. We expect that this variable is measured with error since the tax revenue is calculated with the presence of tax evasion. Moreover, this tax rate is not what taxpayers face when they contemplate to evade taxes. Similarly, the measure of corruption, quality of bureaucracy, or rule of law depends to a large extent on the presence of the opportunity for violations. Higher corruption or lower quality of bureaucracy in tax administration leads to higher tax evasion. It is also possible that higher opportunity of tax evasion also causes corruption to increase and bureaucratic quality to deteriorate.

We try to detect, and correct for the endogeneity problem using two approaches. The first approach is to employ the 2SLS estimator and detect the endogeneity problem using Hausman (1978) specification test. The second approach is to use the dynamic panel data model. The latter method is discussed in detail in the next section.

In the 2SLS method, the Hausman test is based on comparing two estimators. The comparison entails checking if estimates from an efficient estimator (such as OLS estimator) are statistically similar to estimates from a consistent estimator (such as IV estimator). If the two estimators are not similar, the efficient estimator is most likely inconsistent, which means there is endogeneity problem. Let β_E be an estimator that is consistent and asymptotically efficient when the null hypothesis H_0 is true, but inconsistent when the null is false; and let β_C be an estimator that is consistent under both H_0 and the alternative hypothesis. When H_0 is true, the asymptotic distribution is such that $Cov(\hat{\beta}_E, \hat{\beta}_C) = \mathrm{var}(\hat{\beta}_E)$. This implies the following:

$$Var(\beta_E - \beta_C) = Var(\beta_C) - Var(\beta_E) \,.^{12} \qquad (1.20)$$

We can use this relationship to test, for instance, if the estimates from least squares (β_E) and the estimates from IV model (β_C) are the same. In this case, H_0 is that the true residuals are uncorrelated with the regressors. All we need for this test are the point estimates and consistent estimates of the variance matrices. Testing one of the

[12]Note that $Var(\beta_E - \beta_C) = Var(\beta_E) + Var(\beta_C) - 2Cov(\beta_E, \beta_C) = Var(\beta_C) - Var(\beta_E)$.

coefficients can be done by a *t-test*, while testing all coefficients can be done using a χ^2 test. The χ^2 is based on the relationship that:

$$(\hat{\beta}_E - \hat{\beta}_C)' Var(\hat{\beta}_E - \hat{\beta}_C)^{-1} (\hat{\beta}_E - \hat{\beta}_C) \sim \chi_j^2 \quad (1.21)$$

where *j* equals the number of regressors that are potentially endogenous. An ideal instrument has the property that it is correlated with the endogenous variable it instruments and not correlated with the error term. Again, we use legal origin dummies, distance of the country from the equator, and indices of political rights and civil liberties as instruments.

Dynamic Panel Data Estimation

When there is persistence in the dependent variable and the explanatory variables are endogenous we need to use a dynamic panel data estimation method because under these conditions the FE, the RE, and also the 2SLS yield inconsistent estimates. The dynamic panel data method is useful in that it provides for internal instruments. This is particularly important in our case since the external instruments are found to be weakly correlated with the endogenous variables.

This method was developed by Anderson and Hsiao (1982), and later extended by Arellano and Bond (1991) and Blundell and Bond (1998). The method uses internal and external instruments to obtain consistent estimates of the currency equation in the presence of dynamic and endogenous regressors. The method has recently been used quite extensively in the economic growth literature and the discussion of the tenets of the model that follows is derived from that literature; see, for example, Bond, Hoeffler, and Temple (2003).

The approach first entails the introduction of dynamics to equation (1.14) as follows:

$$y_{it} = \alpha y_{i,t-1} + \beta_i x_{it} + \eta_i + u_{it} \quad \text{for i=1,…,N and t=2, …,T .} \qquad (1.22)$$

First differencing the dynamic equation to get rid of the individual specific effects generates the following equation:

$$y_{it} - y_{i,t-1} = \alpha(y_{i,t-1} - y_{i,t-2}) + (x_{it} - x_{i,t-1})'\beta + (u_{it} - u_{i,t-1}) . \qquad (1.23)$$

By construction, the difference lag of the currency ratio $(y_{i,t-1} - y_{i,t-2})$ in (1.23) is endogenous. By assumption x also contains endogenous variables such as the tax rate, and the measure of enforcement strength. Therefore, we need to introduce instruments in estimating the above equation to fix the effect of the endogeneity problem and hence to get consistent estimates. The approach instruments the differenced right-hand-side variables with their appropriately lagged levels. Under the assumption of serially uncorrelated errors ($Eu_{it}u_{i,t-1} = 0$), the following moment conditions give the appropriate instruments for the differenced lagged dependent variable and the endogenous regressors:

$$E\left(y_{it-s}\Delta u_{it}\right) = 0 \text{ for } t = 3, \ldots, T \text{ and } s \geq 2 \qquad (1.24)$$

$$E\left(\mathbf{x}_{it-s}\Delta u_{it}\right) = 0 \text{ for } t = 3, \ldots, T \text{ and } s \geq 2. \qquad (1.25)$$

When these two moment conditions hold, we can use the lagged levels of the variables as instruments for the first differenced variables. However, when the lagged levels are weakly correlated with subsequent first differences, the Arellano and Bond (1991) differenced GMM estimator has been subject to the problem of small sample bias (Blundell and Bond 1998). To deal with this problem, Arellano and Bover (1995) proposed an estimator that makes use of additional information in levels. This estimator, referred to as the system GMM estimator, combines two sets of equations into a system of equations. The two sets of equations consist of one in the first difference and another in the level. This introduces an additional T-2 moment conditions given by:

$$E[(\eta_i + u_{it})\Delta y_{it-1}] = 0 \tag{1.26}$$

$$E[(\eta_i + u_{it})\Delta \mathbf{x}_{it-1}] = 0 . \tag{1.27}$$

The Arellano and Bover (1995) system GMM estimator uses the moment conditions (1.24)-(1.27) to give consistent estimates of the coefficients of the currency equation. Valid instruments have the following properties: they should be correlated with the endogenous variables and at the same time be uncorrelated to the error term. The validity of the instrument is checked by conducting the Sargan (1958) test of over-identifying restrictions to test jointly the appropriateness of the instruments. The null for the test is that the instruments are valid in that they are orthogonal to the error term. Under the null, the test statistic is distributed $\chi^2_{(L-k)}$, where L is the number of instruments and k is the number of parameters in the model.

Recall that the GMM estimator yields consistent estimates only if the errors in the level equation are white noise. If they are serially correlated, the GMM estimator is not consistent. To test whether the errors in the level equation are white noise, we use the Arellano and Bond (1991) test for second-order autocorrelation in the difference equation. The null of this test is that there is no second-order autocorrelation in the difference equation.

Estimation of the Currency Equation

In this section, we present the estimation results of the currency demand equation as a first step to estimate the underground economy in the next section. As we specify the bench mark estimation, an explanation of how the interaction of the tax rate and enforcement strength brings about tax evasion is in order.

As pointed out previously, higher tax rates do not necessarily translate into higher tax evasion because with higher enforcement capabilities higher compliance can be achieved. It can be said, however, that higher tax rates with lower enforcing capabilities result in higher tax evasion. Therefore, we include the interaction of the tax rate and the measure of enforcement strength, in addition to including the separate effect of each of these variables. The basic equation estimated is:

$$\begin{aligned} \ln(C/M2)_{it} = {} & \alpha_0 \ln(1+\tau_{it}) + \alpha_1 \ln(1+Enf_{it}) + \alpha_2 \ln y_{it} \\ & + \alpha_3 \ln r_{it} + \alpha_4 \ln \pi_{it} + \alpha_5 \ln Ed_{it} + \alpha_6 \ln Ub_{it} \\ & + \alpha_7 \ln Er_{it} + \eta_i + u_{it}, \end{aligned} \tag{1.28}$$

where $\ln$ is the natural logarithm, u_{it} is the error term assumed to be $i.i.d.$, η_i is the unobserved group heterogeneity which can be random or fixed effects, i indexes countries in our sample, and t indexes time.

Based on the theoretical model, the expected sign of the coefficient estimate of each explanatory variable is as follows. The sign on the estimates of the tax rate and enforcement measures are expected to be positive. The sign on the coefficient estimate of income is ambiguous. The interest rate as a measure of the cost of holding cash money is expected to have a negative coefficient estimate. The coefficient on inflation cannot be signed a priori because there are two opposing effects of inflation on the currency ratio.

Inflation as a cost of holding currency is negatively related to the currency ratio; however, when the tax system is not indexed, higher inflation creates tax bracket creep, which increases the tax liabilities of individuals even though their real income is unchanged and which results in higher tax evasion and thus a higher currency demand. The effect of these two opposing forces renders the sign of the coefficient of inflation ambiguous. The coefficient estimate on exchange rate depreciation is also ambiguous. Finally, the expected signs on the coefficient of schooling and of urbanization are expected to be negative.

Table 1.2 gives the descriptive statistics for the variables; see the Appendix for all tables. The estimation technique employs panel data methods that pool non-OECD countries for the period 1982-2003. The time period of the study is restricted by the availability of data. The variables are averaged over a three year interval to reduce the noise in the data.

Table 1.3 presents the correlation matrix for the variables. The correlation matrix shows that there is not much multicollinearity between the explanatory variables except between the inflation, the interest rate and exchange rate depreciation. Table 1.3 also gives the correlation between the currency ratio and the explanatory variables. The simple correlation shows that the direct tax rate and the total tax rate are negatively related to the currency ratio. However, the correlation is positive when the top bracket statutory income tax rate is used as the tax rate. Further the enforcement strength measures are positively related to the currency ratio. A simple correlation coefficient between variables indicates the linear relationship between two variables without controlling for the effect of other potential explanatory variables. Because of this, we further investigate the relationship between the explanatory variables and the currency ratio using regression analysis.

Turning to our regressions, we present various results using different estimation methods. The methods are the fixed effects (FE), the random effects (RE), the two-stage least Squares (2SLS) and the dynamic panel data models (DPD). Since we expect persistence in the dependent variable and endogeneity of explanatory variables, our preferred method is the dynamic panel data model, and hence a detailed explanation of the results of our estimation of the currency equation and of the underground economy is based on this model. However, we also present the results of the other estimation models.

For each estimation technique, we report various set of regressions by varying the measures of the tax rate used. These measures are the direct tax rate, total effective tax rate, and statutory tax rate. The enforcement strength is proxied by a composite index constructed by averaging the indices of corruption, the quality of bureaucracy, and the rule of law.

Fixed and Random Effects Estimation Results

We look into the results of using the two traditional methods of panel data estimation: fixed effects and random effects models. Tables 1.4 to 1.9 give these results for the currency equation with standard errors of the estimates in parenthesis. The results of both models are qualitatively similar, so we discuss only one of the estimators. The F-statistics for these estimations (which are not reported here) show that the joint explanatory power of the regressors is highly significant.[13] Table 1.4 reports the estimates when the direct tax rate is used as the tax burden measure. As can be seen from these results, the tax rate is either not significant or not of the expected sign when it is significant. The interaction term of the tax rate and enforcement parameter is significant and positive as expected in specifications (2)-(4), although this result is derived when the separate effect of the tax rate is negative. Specifications (5)-(7) which do not include the separate effect of the tax rate and the enforcement variable yield negative coefficient estimates for the interaction term. Table 1.5 reports FE results when the total tax rate is used as tax burden measure. The results are qualitatively similar to the results of Table 1.4.

The above tax rates are not the tax rates that taxpayers face since they are simultaneously determined with tax evasion. Given this, the statutory tax rates are able to gauge the tax burden that the taxpayers face. Therefore, we estimate similar equations using the statutory tax rates as the measure of tax burden. The particular statutory tax rate we use is the *top bracket marginal income tax rates*. The use of this tax rate obviously has its weaknesses in that few taxpayers fall into this tax bracket. However, it captures the general burden and the stance of tax rate policy of a country.

The results of using this tax rate are reported in Table 1.6 and Table 1.9 of the fixed and random effects estimations, respectively. The estimates on the tax rate are negative except in one specification in which the estimate on the interaction term is negative i.e., when the tax rate is significant, the interaction term is negative; or when the interaction term is significant and of the expected sign, the separate effect of the tax rate

[13] The F-statistics are also highly significant for the 2SLS and dynamic panel data models that we discuss later.

is not of the expected sign. However, in the specifications in which only the interaction term is used as the tax evasion factor, its estimate is highly significant and positive.

Turning the results on other variables' estimates, Table 1.6 and Table 1.9 show that the estimate on income is negative and highly significant in all these regressions. The estimate on the rate of interest is negative as expected and significant in a majority of specifications. The estimate on the inflation rate is consistently negative, but is not significant in some specifications. The degree of urbanization is of the expected sign and is highly significant in the FE estimations, while it is insignificant in the majority of specifications in the RE estimations. Education is significant and its estimate has the expected sign in the majority of specifications of the RE model, but it is not significant in the FE estimations.

Our estimation also reports the use of regional and financial crisis dummies. Recall that the currency ratio can be affected by the stability of the financial sector. The more unstable the financial system, the less demand for domestic currency and the more demand for foreign assets. This results in the decline of the demand for domestic currencies in the form of cash and M2. The overall effect on the currency to M2 ratio is therefore ambiguous.[14]

We use a dummy constructed from the threshold of the inflation or the exchange rate depreciation variables as the measure of the financial instability.[15] We have already included the inflation rate and the exchange rate depreciation in the above regressions.

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[14]To examine this ambiguity we use the currency to GDP ratio as an alternative dependent variable. During a financial crisis, GDP may also decline but only with a lag. Hence, for the relationship we are examining, the currency to GDP ratio is a better regressand than the currency to M2 ratio. When the currency to GDP ratio is used, the expected sign on the financial crisis measure is negative. However, the regression results (which are not reported here) do not corroborate this expectation and the overall results on the other variables are also poor in terms of model fit.

[15]We follow Bubula and Otker-Robe (2003) in defining crisis episodes of countries.

These can gauge the instability in the financial sector. However, the relationship between inflation (or exchange rate depreciation) versus the degree of financial instability may not be linear i.e., the instability may occur only beyond some threshold. Thus we use a dummy variable constructed from the inflation rate or the exchange rate depreciation rate threshold rather than using these variables in their continuous form.

The dummy of inflation crisis has a value of 1 if the inflation rate for a given period is greater than some threshold and 0 otherwise. The threshold is taken to be an inflation rate one standard deviation from the mean i.e., 593 percent. The regression result with the inclusion of this dummy is reported in Columns (6) and (7) of Tables 1.4 to 1.9 of the FE and RE models. The results show a positive and significant estimate on this dummy variable.[16] These tables also show the results when a crisis dummy is constructed from exchange rate depreciation threshold. The threshold for depreciation rate is taken also to be the depreciation rate 1 standard deviation from the mean i.e., 460 percent. Thus, the dummy has a value of 1 for depreciation rate greater than this threshold and 0 otherwise. The result of using this financial crisis dummy is also similar to the inflation crisis dummy: the estimate is positive and significant.

The other dummy variable included is a measure of regional differences between countries. Here we include a dummy variable for African and Asian countries. For the African dummy, the value is 1 when the country is an African country and 0 otherwise. Being time constant, the regional dummies are not included in the FE model. The regression results show that the African dummy is negative but is significant only in some of the regressions. The Asian dummy, however, is negative and significant in all specifications of the RE model. The negative coefficients imply that the currency ratio is

[16]This result is unchanged when currency to GDP ratio is used as the dependent variable.

lower for countries in Africa and Asia than for countries in other regions. The currency ratio is also much lower in Asian than in African countries.

Finally, we include a dummy variable measuring the degree of mining production in the country. The rationale for including this dummy variable is that, in developing countries where the mining sector is bigger relative to other activities, the dependence of the government on this sector for revenue is higher. Since this sector is more organized than other sectors in these countries, it is easier for the government to collect taxes implying that compliance will be higher. However, data on mining production per GDP that is ideal for the purpose at hand are not available. We find a measure that proxies some aspect of mining. The variable is ore exports as a percentage of total merchandize export. The data are drawn from the World Bank's *World Development Indicators* CD-*ROM (2006)*. We define a dummy based on this variable. This dummy has a value of 1 when the ratio of ore exports to total merchandize export is greater than a threshold and 0 otherwise. The threshold is 20 percent, which is one standard deviation from the mean. The regression result that includes the mining dummy is given in Columns 6 of Table 1.4 to 1.19, and the coefficient estimate is insignificant.

Having shown the results of the two traditional panel data estimators, we test whether the FE or the RE estimator is appropriate for the data at hand. As discussed before, if the unobserved country specific effect is correlated with the observed explanatory variables, the RE model yields inconsistent estimates while the FE estimator still yields consistent estimates.

To check whether the FE or the RE is appropriate, the Hausman (1978) specification test is undertaken. The task here is to check whether there is statistically significant difference between the FE and RE coefficients. If there is, then FE is taken to be more appropriate since it is consistent under the null (i.e., no correlation between the country specific effects and the explanatory variables) and also under the alternative hypothesis. But if the null of the Hausman-test is not rejected, then RE method should be used because it is more efficient than the FE estimator.

Table 1.10 reports the results of the Hausman test for the corresponding FE and RE models when the statutory tax rate is used. As the *p-value* of the test statistic shows, except in one specification, the null hypothesis that there is no systematic difference between the FE and RE estimators is rejected at 5 percent significance level. Rejecting the null implies that the FE is more appropriate than RE.

<u>IV (2SLS) Estimation Results</u>

In trying to understand economic relationships, one should realize that many economic variables evolve together and few economic variables are endogenous. The problem of endogeneity is likely to be present in our estimation for several reasons. Some of our measures of the tax rate are different from what consumers actually face. The two tax rates used in the estimation are calculated as the ratio of actual revenue from a given tax base to GDP. That is, there appear to be errors in variables that possibly create the problem of endogeneity due to measurement error. The effect of this type of endogeneity can be corrected by using instrumental variable estimation or by finding a more appropriate tax rate measure such as statutory marginal tax rates. Second, the tax rate measures (including statutory marginal income tax rates) can be endogenous because of simultaneity with the tax evasion. Countries with higher tax evasion may set their tax rates low to encourage compliance because lower tax rates might be optimal with lax tax administration. This is the endogeneity problem due to simultaneity between the dependent variable and the explanatory variables. Finally, endogneity may be present because other omitted may determine the tax rate or the enforcement variable.

We correct for the effects of the endogeneity problem using instrumental variable (IV) estimation methods. A good instrument has the property that it is highly correlated (but not perfectly) with the endogenous variable it instruments but uncorrelated with the error term. No one has addressed the problem of endogeneity problem in currency equation studies. We follow other work in selecting the potential instruments for the tax rate and enforcement variables. These instruments are legal origin, distance from the equator, and indices of political rights and civil liberties. The first stage regressions (not reported here) show that the instruments have joint explanatory power on the endogenous variables; however, on an individual basis, the instruments are not robustly correlated with the endogenous variables.

The results of 2SLS estimation when these instruments are used are presented in Tables 1.11 to 1.13 for the different tax rate measures. The results are similar to the FE and RE estimations, but the sizes of the estimates (particularly for the tax evasion variables) are now larger. For the other variables, we have mixed results; while income retains the sign of its earlier estimate, the significance of the estimate is not robust. The inflation rate is not significant, and urbanization is also insignificant.

Dynamic Panel Data Estimation Results

When there is persistence in the dependent variable and explanatory variables are endogenous, neither the two traditional panel data methods (FE and RE models) nor the 2SLS yield consistent estimates. It is imperative that we look for an estimator that deals with the problem of persistence and endogeneity of the variables at the same time. The dynamic panel data estimation technique corrects for the effects of both of these econometric problems.

The attractiveness of this method over the other estimation methods is that it does not require external instruments to deal with the problem of endogeneity, but rather it uses internal instruments. These internal instruments are the appropriate lags of the explanatory variables. The tenets of this method are explained in the methodology part of this essay.

Tables 1.14 to 1.16 report the results of dynamic panel data estimation. Table 1.14 gives the results when the direct tax rate is used as the measure of tax burden while Tables 1.15 and 1.16 give the results when the total tax rate and statutory tax rates are used. Before we discuss the individual estimates, it is appropriate to check whether the assumptions necessary for using the dynamic panel data model are met. Recall that the use of dynamic panel model requires that the error term of the dynamic equation in levels form must be white noise which implies that the errors of its first difference are AR(1) by construction and that higher order autocorrelation are absent. Our results corroborate this expectation in that the Arellano-Bond test for AR(1) in first difference shows the presence of autocorrelation of errors of first order and the absence of second order autocorrelation.

The other test statistic that must be checked is the validity of the instruments used. The endogenous variables are the lagged value of the dependent variable and the tax evasion variables. We use the Hansen test of over-identification restrictions. The majority of specifications show a small Hansen test static and hence the *p-value* of the Hansen test statistic is statistically insignificant, which implies that the null that "instruments are valid" is not rejected. Therefore, we conclude that the use of the lagged values of the explanatory variables as instruments is valid.

Turning to the individual estimates, the lagged values of the currency ratio is highly significant which shows that the currency ratio is affected by its past values. The significance of the estimates on the tax evasion factors greatly differs when the different tax rates are used. When the direct tax rate is used as a measure of tax burden, the tax rate is either statistically insignificant or of the unexpected sign. In Table 1.14, we have only one specification when the separate effect of the tax rate is significant and negative. Similarly, the interaction term is significant and its estimate positive as expected in only one regression of Table 1.14. Similar qualitative results are reported in Table 1.15, where the total tax rate is used as the measure of tax burden.

Better estimates are reported in Table 1.16 where the statutory tax rate is used. In particular, in column (6) where the interaction term is used as the only tax evasion factor, the estimate of this variable is consistently significant and positive as expected, except in one regression. The same table also gives the estimates for the coefficients of the other determinants of the currency demand equation. Based on our preferred specification, Column 6 of Table 1.16, we discuss the estimates of the other variables. The coefficient on income is significant and negative. This supports either of two notions: as people get richer they evade less, or as a country develops the use of currency relative to other means of payments declines due to increased financial sophistication.

Turning to the estimate on the rate of inflation, inflation is a cost of holding currency or non-interest bearing assets in general. In this sense, the expected sign of the coefficient is negative. However, a higher inflation rate increases an individual's nominal income, and, since most tax systems are not indexed, this creates tax bracket creep. This in turn increases the tax liability of the taxpayer even though the real income of the taxpayer is kept constant through a cost of living adjustment. This increases the tax burden of taxpayers, and tax evasion is expected to increase, which implies a positive relationship between the currency ratio and inflation. The coefficient estimate on the inflation is insignificant. This may be due to the two effects of inflation canceling each other out.

The rate of interest as a measure of the opportunity cost of holding money is expected to have a negative effect on ratio of currency to M2. In Table 1.16, this expectation is corroborated in few of the specifications. Exchange rate depreciation is insignificant except in one specification where it comes with a negative coefficient. The use of checks is more likely in urban areas than in rural areas. Thus, more urbanization will tend to lower the currency ratio. However, the coefficient estimate on urbanization is significant and positive.

Estimation of Underground Economy

To estimate the underground economy attributed to tax evasion, we must have a positive relationship between the tax evasion factors and currency ratio. Once such relationship is vindicated, it is straightforward to calculate the underground economy for the countries in our sample using a preferred specification.

In selecting the preferred specification, we made a choice first between the estimation methods. Since we believe that there are the econometric problems of persistence in the dependent variable and endogeneity in the relationships in the currency demand equation, we preferred the dynamic panel data estimators to the traditional panel data ones. Our selection of a specific specification from the dynamic panel data regressions is based on the sign and significance of our variable of interest- the tax evasion factor- and the performance of other test statistics reported in the estimation.

As can be seen from Table 1.16, all the dynamic panel data specifications have similar results on the significance of the test statistics for autocorrelation and Hansen's over-identification restriction tests. The tests show that there is first order autocorrelation but not higher order ones, and the Hansen's test statistic for all specifications shows that the instruments used are exogenous and confirm that they are valid instruments for the endogenous variables.

Based on the sign and significance of the estimated coefficients of the explanatory variables and particularly of the tax evasion variables, we select equation (6) of Table

1.16 as the preferred specification for calculating the underground. For this specification, the short-run estimate on the tax evasion factor is about 0.22 and its long-run value is 1.10.

Using long-run coefficient values of the estimates of the preferred equation and following the Tanzi (1980) procedure, the underground economy is estimated as follows. First the predicted value of currency ratio with the presence of tax evasion (denoted by Z_{it}^{*}) is computed. This is compared with the predicted value of the currency ratio when the tax evasion factors are assigned the value of zero (denoted, Z_{0}^{*}).

Now, since $Z_{it}^{*} = \ln(C_{it} / M2_{it})^{*}$, this can be rewritten as $C_{it} = \exp(Z_{it}^{*} + \ln M2_{it})$ $= M2_{it}\exp(Z_{it}^{*})$. Thus, with a given level of M2, it is possible to calculate the total amount of currency explained by all factors of currency ratio (including the tax evasion factor). Similarly, $C_{0} = \exp(Z_{0}^{*} + \ln M2_{it}) = M2_{it}\exp(Z_{0}^{*})$, which is the predicted amount of currency excluding the effect of tax evasion factors. Thus, the difference $C_{it} - C_{0} = M2_{it}\left\{\exp[Z_{it}^{*}] - \exp[Z_{0}^{*}]\right\}$ is the stock of currency attributed to tax evasion ("illegal" stock of currency).

The last step is to calculate the amount of income (transactions) supported by this stock of illegal currency. This is calculated by multiplying the illegal stock of currency by the income velocity of money. Here it must be assumed that the velocities of money in the underground and official economy are the same. The velocity of money in the official economy is calculated as a ratio of nominal official income to legal $M1$, legal $M1$ being the difference between total $M1$ and the stock of illegal currency C_{0}.

One of the weaknesses of the use of currency equation to calculate the underground economy is that large yearly variations in M2 result in wide variation of the underground economy. To lessen such swings in the underground economy, variables are averaged over the three panel periods. The result of this exercise is reported in Table 1.17 for 56 countries of our sample. The table shows substantial underground economy and a wide variation across the countries. The mean underground economy for the sample is 16 percent and the standard deviation is 14 percent. The lowest figure of underground economy as a percent of the official economy in our sample is for Latvia at about 2 percent, and the highest one is for Tanzania at about 67 percent of the official economy.

Next we compare our result to other similar studies. Koyame (1996) estimates the underground economy of eight Sub-Saharan African countries. Our study is closely related to her study in that she uses panel data methods in his estimation and more importantly she uses the same method of estimating underground economy i.e., the currency demand method. Her estimates of underground economy percentage of GNP from his Table 6.3 are replicated in Table 1.18 along with our estimates. As can be seen from the table, her estimates are very small.

We also compare our estimates with the estimates of Schneider (2004), who estimated shadow (underground) economies of 145 countries for the period 1999-2003 using the MIMIC method. Table 1.19 reports his estimates for those countries that are in our sample. His estimates generally show higher underground economy as percentage of GDP than ours. Table 1.20 gives a descriptive statistics of his estimates and of ours. The mean of underground economy of his estimates is about 39 percent of GDP compared to ours of about 17 percent (when our sample is restricted to those that are included in his sample). The standard deviation of Schneider's estimates is about 13 percent compared to ours at about 15 percent.

The comparison of the estimates is also presented in Figures 1.1 and 1.2. Fig 1.1 shows a simple relationship between our estimates and Schneider's. As is depicted in the figure, few countries lie in the 45^0 line, implying that the absolute estimates of the two studies diverge for many countries. However, we find that the two estimates are comparable in terms of their correlation i.e., a country that has a lower (higher) underground economy estimate in Schneider's study has also a lower (higher) estimate in our study. This can be seen from the upward slopping fitted line in the scatter plot of the fitted line. The fit is even better when outliers are removed using the Hadi (1994) method of removing outliers. Figure 1.2 gives the scatter plot when outliers that are at the 10 percent level of the tail of distribution are removed. The result now shows that the correlation between the two estimates of the underground economies is 0.9. Note that only 29 countries are in the sample.

As shown above, there is a wide difference in the mean of the underground economy between our estimates and that of Schneider's. The difference emanates from the difference in the method of estimating of the underground economy. Schneider uses the MIMIC model while our study uses the currency demand method. The difference has also to do with what part of underground each study is trying to measure. We measure the underground economy only due to tax evasion activity while Schneider's study calculates the underground economy due to tax evasion, government regulation, and provision of public services by the government.

These differences do not mean that his estimates are more reliable than ours. First, in the MIMIC method adding additional variables as causes of the underground economy always increases the size of the underground economy since the latter is a direct transformation of the causal variables. The other weakness of his study is that he does not control for enforcement strength of the tax authorities.

Conclusion

This essay is concerned with estimating the underground economy in developing countries using the currency demand method. We first estimate the currency demand equation in a cross-section of non-OECD countries as a first step to estimate the size of tax evasion in these countries. Unlike past studies, we add measures of tax enforcement strength to the tax rate as tax evasion factor to have at an estimation that is consistent with the theory of tax evasion.

Our empirical investigation finds that the currency to M2 ratio tends to be higher the higher the economic return from underreporting and the weaker the enforcement strength of the tax authorities, after controlling for other determinants of currency demand. The control variables are per capita income, the interest rate, inflation, degree of urbanization, level of education, and exchange rate changes. We proxy the enforcement strength by measures of corruption, quality of bureaucracy, and rule of law. We employ different panel data estimation techniques to estimate the currency demand equation. Of special significance is the use of dynamic panel data technique to deal with the endogeneity problem in the estimation; this method also accounts for the dynamics in currency demand equation.

After estimating the relationships in the currency equation, we estimate the underground economy of the countries in the sample. We use the Tanzi (1980) approach in separating the legal and illegal stock of currency and converting the latter into the value of illegal economic activity. The results of our calculation show that the underground economy shows wide variation among the countries in the sample, and in many of these countries the size of the underground economy is substantial.

ESSAY II: EVOLUTION OF THE UNDERGROUND ECONOMY IN SOUTH AFRICA: A TIME SERIES ANALYSIS

Introduction

Tax evasion is a growing public concern in many countries. In addition to the direct loss of revenue to the government, tax evasion causes an underground economy, which in turn may hamper the growth of the official economy. This problem is more severe in developing countries where tax administration is more important than tax rate policy (Casanegra de Jantscher 1990). Thus, reducing the underground economy is a timely policy issues in many of these countries.

Policy makers aiming at reducing the underground economy need an estimate of its size and also its main causes. There are many studies that estimate the underground economy for many countries. A notable feature of these studies, however, is that they focus on developed countries despite the issue's enormous significance for developing countries.

Reducing tax evasion is one of the main policy goals in South Africa. In 1994, the country embarked on a series of economic reforms aimed at rapid economic growth, increased employment, and an equitable distribution of income. A number of policies have been formulated on fiscal, monetary and exchange rate policies to realize these objectives. Of particular interest is the comprehensive fiscal reforms undertake by Katz Commission. One of the objectives of this tax reform is to formulate tax policy so as "to avoid permanent increase in the tax burden" (South African Ministry of Finance 1996).

To reduce tax evasion policy makers need a reliable estimate of the extent of tax evasion. There are some estimates of underground economy for the South African economy (Kirsten 1988; Abedian and Desmidt 1990; Kantor 1989; Saunders and Loots 2005). In particular, Saunders and Loots (2005) report a yearly estimate of the underground economy for an extended period using the currency demand method of measuring underground economy.

However, the estimates of Saunders and Loots (2005) have some limitations that make further investigation of the issue necessary. Saunders and Loots (2005) use Tanzi's (1980) currency demand method but with two causes of the underground economy: the tax rate and a measure of the degree of government regulation. Having found a negative coefficient on the tax rate, the study attributes the underground economy in South Africa to government's regulatory activity. Moreover, this study shows that the South African underground economy is declining or remaining constant at lower level. The policy implication of having a negative coefficient on the tax rate is that government cannot gain increased compliance by reducing the tax rate. This result is against some evidence done on other countries (Clotfelter 1983) and peoples' intuition regarding the relationship between the tax rate and tax evasion. The other weakness of the study is that it uses a simple OLS regression corrected for autocorrelation of errors while there is a unit-root in the variables. The OLS regression is an inappropriate estimation procedure in the presence of a unit root in the variables.

Therefore, in this study we provide a time series estimate of the underground economy in South Africa by giving attention to the complications that might arise due to unit root problem in the variables. In particular, we use the cointegration method to estimate the currency equation. We also check whether the tax reform of 1994 has brought about the desired result of reducing tax evasion in South Africa after its implementation.

The rest of the essay is organized as follows. Section II briefly reviews the literature focusing on those studies of underground economy of South Africa. Then we estimate the currency equation in section III and also report the estimates of the underground economy in South Africa. Section IV concludes.

Literature Review

Essay I extensively reviews the literature on tax evasion and currency demand method. The review here focuses on those studies of tax evasion and underground economy in the Republic of South Africa.

Like in most developing countries, there are not many studies that estimate the extent of underground economy in South Africa. Kirsten (1988) is the earliest attempt to provide an estimate of the underground economy of South Africa. Using the labor market approach, the study puts the estimate of the underground economy at 6.5 percent of GDP. This estimate differs substantially from the estimate of Kantor (1989) who puts the underground economy at 40 percent using the Feige (1979) transaction demand approach. Abedian and Desmidt (1990) present a time series estimate of the informal economy using the labor market approach and estimate the size of the informal economy in the range of 6 to 12 percent for the period 1970 to 1988. Finally, Saunders and Loots (2005) using the currency demand method of the Tanzi (1980) report a time series estimate of the informal economy for the period 1967-2002. They use least squares autoregressive estimation and estimate the underground economy in the range of 7.2 to 12.5 for the period, with a declining trend over time.

The currency demand method of estimating the size of tax evasion or the underground economy has been applied for various countries but mainly for developed ones. The dearth of estimates of the underground economy for developing countries is partly because of data inadequacies. Data for an extended period of time that enables one to undertake valid time series tests are usually unavailable in these countries. However, this limitation on data is being relaxed. The development and wide application of some improved time series estimation methods have also made it possible to remedy some of the econometric problems that plague the currency demand approach. A recent example is the study by Giles (1999), who has addressed the criticism of assuming the same velocity of money in the underground and official economy.

Another objection to the time series application of currency demand approach is that a country's currency may be held outside its borders. This is common for hard currencies such as, among others, the U.S. dollar and the Euro. For such currencies, changes in currency outside banks are not necessarily related to tax evasion activities or the usual factors affecting domestic demand for the currency; hence the currency demand equation can be misspecified. This objection can be addressed using some countries whose currency is hardly used outside their borders. Good candidates for this are developing countries such as South Africa.

Therefore, this essay plans to make a contribution to our understanding of the evolution of the size of tax evasion in developing countries focusing on South Africa. A similar study has been done by Saunders and Loots (2005). However, the study's estimation of currency equation is faulty in that it uses simple OLS corrected for autoregressive errors which does not consider the complications that arise in the presence of a unit root in the variables. Thus, we improve on this study by studying the unit root properties of the variables and by employing cointegration estimation. Moreover, in studying the evolution of the underground economy of South Africa, we access the effect of the post-apartheid tax reform geared towards reducing tax evasion.

Data, Methodology and Results

Data

The currency demand equation used to estimate the underground economy relates the currency ratio (C/M2) to tax evasion factors such as the tax rate and enforcement parameters and other controls variables. In this study we use per capita income, household consumption per GDP, the interest rate, the inflation rate, and the government employment index as the controls.[17]

The sources of the data of this study are as follows. We have two dependent variables- the currency to M2 ratio and the real per capita currency. Currency is the coins and notes outside banks. M2 includes currency, demand deposits, and time deposits. That tax rate measure is the effective tax rate on household income and wealth calculated as current taxes from income and wealth of households divided by the GDP. The income measures is the GDP per capita and inflation is calculated as the ratio of current year to last year consumer price index. The interest rate measure used is the predominant rate on new mortgage loans. The data for the currency, the M2, the GDP per capita, household consumption, the interest rate, consumer index, and government employment are drawn from online version of *South African Reserve Bank (SARB).*[18]

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[17] See Essay I for details on how each variable affects the currency ratio.
[18] See http://www.reservebank.co.za/ accessed August 2006

Methodology

It is well known that, in trying to estimate the relationship using time series analysis, a meaningful regression can be done only among those variables that are integrated of the same order. Therefore, our statistical procedure starts by performing Augmented Dickey-Fuller (ADF) tests; see Appendix II for all tables of this essay. The test studies the univariate stationarity properties of each variable to determine the order of integration of a given variable.

The next step in the analysis is to test whether there is a linear relationship between the variables of the same order of integration. This is done by cointegration tests (Granger and Newbold 1974). The cointegration procedure entails the identification of stationary error processes on linear combination of the variables under study i.e.,

$$y - a - \boldsymbol{\beta}\mathbf{X} \equiv \varepsilon \sim I(0), \qquad (2.1)$$

where y is the variable being explained, a is a constant, $\mathbf{X}$ is a vector of potential explanatory variables, $\boldsymbol{\beta}$ is vector of the corresponding coefficients for $\mathbf{X}$, and ε is stationary random disturbances.

Results

In presenting the result of estimating the currency equation, we use different specifications of the relationship between the currency demand and tax evasion factors and other control variables, and report their corresponding estimates of the underground economy for the Republic of South Africa.

Table 2.1 gives the summary statistics of the variables used in the regression. The per capita real currency holding has grown at the rate of 1.42 percent per year. The currency to M2 ratio and currency to GDP ratio have declined over the period at an average annual rate of 1.6 and 0.58 percent, respectively. The tax rate as measured by current taxes on income and wealth of household per GDP grew at an average rate of 1.69 percent. The average rate of inflation for the period was 9 percent, and ranges from a low of 1 percent to a high of 19 percent. Government employment has increased at the average rate of 2.6 percent. This variable has been used in other studies to gauge for the degree of government's regulation in the economy, and is expected to increase the underground economy. The share of household consumption in GDP has declined by 0.4 percent during the period.

The Tanzi (1980) method of estimation of underground economy has been presented in Essay I of this dissertation. The method is used first to investigate the relationship between currency demand and tax evasion factors. After finding statistically significant and positive relationship between the two variables, the estimated equation is used to calculate the underground economy. As a bench mark, we employ a currency demand equation similar to the one in Essay I, but now in time series data context:

$$\begin{aligned} \ln(C/M2) = \beta_0 + \beta_1 \ln(1+\tau_t) + \beta_2 \ln(Gei) + \beta_3 \ln(y_t) + \beta_4 \ln(WS) \\ + \beta_5 \ln(r_t) + \beta_6 \ln(\pi_t) + u_t \end{aligned} \tag{2.2}$$

where $\ln$ is the natural logarithm and t indexes time. The dependent variable is the ratio of currency to M2, τ is the tax rate, Gei is an index of government employment, y is the per capita income, WS is household consumption expenditure per GDP, r is the interest rate, and π is the rate of inflation. The currency equation does not include a variable gauging the enforcement strength of the tax authorities. The corruption, quality of bureaucracy, or rule of law indices used to proxy enforcement parameters for South Africa in Essay I are not adequate for time series analysis, and hence are not included here.

We first check the degree of integration of the variables by undertaking unit root test for each variable. Table 2.2 reports the results of this test, and demonstrates that all the variables can be considered I(1) at the 1 percent significance level. Since the included variables are I(1), equation (2.2) can be estimated in first difference but such estimation captures only the short-run relationship among the variables, and ignores their long-run relationships. Hence, we need an estimation method that captures the short-run as well as long-run relationship of the variables. The Error Correction Method (ECM) is an attractive option. As in Bajada (1999), the general form of the ECM model we employ to estimate equation (2.2) is the following:

$$\Delta Z_t = \beta_0 + \sum_{i=1}^{p} \beta_i \Delta X_{i,t} + \sum_{j=1}^{p} \beta_j X_{i,t-1} + u_t \tag{2.1}$$

where ΔZ_t is the first difference of the currency ratio and $X_{i,t}$ is a vector of variables determining the currency ratio.

The results of the estimation for this specification (which are not reported here) yield negative coefficient estimates for the tax variables. In that case, we can not proceed to the estimation of underground economy. So we resort to other specifications.

One of the criticisms of the currency demand approach of the Tanzi (1980) is that, when M2 grows faster than currency holdings, the currency to M2 ratio dramatically declines even when tax evasion is increasing. In such cases, the currency to M2 ratio is bad indicator of the level of tax evasion.

In South Africa, M2 has grown substantially and the unexpected negative coefficient estimate on the tax rate earlier is possibly due to currency to M2 ratio being a bad indicator of the level of tax evasion. To avoid this problem, we use real currency per capita as alternative indicator to currency to M2 ratio as the dependent variable as in Bajada (1999).

The results of the estimation when real currency per capita is used are given in Table 2.3. The F-statistics of this regression is 3.72. Since the degrees of freedom for the numerator is 11 and for the denominator is 32, the joint explanatory power of the regressors is statistically significant at 5 percent.

Turning to individual coefficient estimates, the lagged tax rate is positive and significant as expected. The first difference of the tax rate is also positive and marginally significant. This supports the hypothesis that the higher tax burden, the higher tax evasion and the higher currency demand, other things being equal. The rate of interest, the opportunity cost of holding currency is negative and significant as expected. Per capita income is positive as expected but statistically insignificant in both the level and its first difference.

The first lag of index of government employment is negative and marginally significant, but the first difference of the same variable is not significant. This variable is meant to gauge the degree of government regulation in the economy and is expected to have a positive effect on the underground economy and hence on currency holdings. However, the government employment index is not a good proxy for the extent of government regulation in the economy. In fact, it might measure the efficiency of the government in its various undertaking of which tax administration is one. An increase of the size of an efficient civil service can indicate an increased enforcement capability of the government; hence, this may result in higher compliance and thus lower tax evasion. If this is the case, then a negative estimate on sign on the government employment index is in line with the theory of tax evasion.

Having established a positive relationship between the tax rate and currency demand, we can now estimate the underground economy. First, restate the estimated equation as follows (the time index suppressed):

$$\Delta \ln(c) = \boldsymbol{\tau\alpha} + \mathbf{XB} + u ,$$

where c is the real per capital currency holdings. $\boldsymbol{\tau}$ is a vector of tax variables (namely $\ln(\tau_{t-1})$ and $\Delta \ln(\tau_t)$), $\mathbf{X}$ is a vector of variables other than the tax variables (namely the intercept, $\ln(WS_{t-1})$, $\Delta \ln(WS_t)$, $\ln(r_{t-1})$, $\Delta \ln(r_t)$, $\ln(Yd_{t-1})$, $\Delta \ln(Yd_t)$, $\ln(Gei_{t-1})$, $\Delta \ln(Gei_t)$, and $\ln(c_{t-1})$), $\boldsymbol{\alpha}$ is a vector of coefficients for the tax variables, and $\mathbf{B}$ is a vector of coefficient for all other variables of the model.

Second, the estimated nominal currency holding for time t is given by $\hat{C}_t = \exp(\boldsymbol{\tau\alpha} + \mathbf{XB} + \hat{C}_{t-1} + \Delta \ln(P_t) + \Delta \ln(N_t))$, where P_t is the consumer price index, N_t is the population, and $\hat{C}$ = estimated nominal currency holdings of the public.

Third, currency holdings due to the other motives, other than the tax evasion purpose, are estimated by setting taxes to zero as follows:

$$\hat{C}_t^W = \exp(\mathbf{XB} + \hat{C}_{t-1} + \Delta \ln(P_t) + \Delta \ln(N_t)).$$

This is the “legal currency holdings” or the amount of currency used in legitimate transactions. Thus, the following expression gives the stock of illegal (i.e., tax evasion activities) currency holdings:

$$CI = \hat{C}_t - \hat{C}_t^W . \quad (2.4)$$

Finally, to calculate the income that is supported by this stock of illegal currency, we multiply the latter by the velocity of money. The velocity of money is calculated as income in the official economy divided by the legal stock of money.[19] The legal stock of money in turn is the difference between M1 and illegal currency holdings.

The estimate of the underground economy as a percentage of GDP is given in Table 2.4, and the plot of the same is given in Figure 2.1. The estimate is between 10 and 27 percent of the official economy. As can be seen from Figure 2.1, the underground economy in South Africa first grew from the 1960s to the last half of the 1970s. After this period, the underground economy has declined but not steadily. One notable feature of the underground economy in South Africa in recent years is that it has shown a steady decline particularly since the tax reform year of 1994. The tax reform seems to achieve the desired result of increased tax compliance.

[19] This is an estimate of the velocity of currency in the underground economy. With income in this economy unknown, it is not possible to know the exact velocity of money in the underground economy. Therefore, as in the literature, we must assume that the velocity of money in the underground economy is equal to that of the official economy.

Conclusion

This essay deals with time series estimation of the underground economy of South Africa for the period 1960-2002. The study uses the currency demand method to estimate the underground economy, and makes use of cointegration techniques to account for the presence of unit root in the variables of the currency demand equation.

The study also uses two versions of the currency demand method. Usually, currency to M2 ratio is used as the indicator of tax evasion or underground economy. However, sometimes the ratio is not a good indictor of the level of tax evasion. When M2 grows faster than the currency, currency to M2 ratio declines even though tax evasion is growing. To avoid this problem, we use real currency per capita as the dependent variable. The explanatory variables included are the tax rate, the per capita income, inflation, the interest rate, household consumption per GDP, and index of government employment.

Our results show that real currency per capita is explained well by these explanatory variables. We then calculate the estimate of underground economy for the South Africa for the period 1960-2002. The estimates show that the underground economy for the period was about 10-27 percent of GDP. The estimates also show that the trend of the underground economy as percentage of GDP has also shown a declining trend, though the decline is not steady.

An underground economy of 10 percent is nontrivial. Moreover, these figures of the underground economy for South Africa are those associated only with tax evasion. These estimates do not include underground activity due to other factors such as such as government regulation. Importantly, the underground economy associated with tax evasion has shown a declining trend especially after the tax reform of 1994.

ESSAY III: APARTHEID, COUNTRY SHOCKS, AND GOVERNMENT SPENDING IN SOUTH AFRICA

Introduction

A notable feature of the economies of the developing countries is that the government plays a major role in the economy. The economy of South Africa is not an exception. In 1960 real per capita government spending in the Republic of South Africa was about R16 at 2000 prices.[20] By 2002 this had more than tripled to R55. During the same period real per capita gross domestic product (GDP) increased from R15690 to R21900, less than doubled (See also Figures 1, 2, and 3.) What caused real per capita government spending to increase more than proportionately to that of GDP?

Such "excessive" size of government spending is alleged to be the cause of many macroeconomic ills in developing countries. High government spending with slower growth of tax revenue is the main cause of large government deficits. Budget deficits in addition to creating internal and external imbalances reduce the perceived price of government services which further increases demand for government spending. In most cases, such an increase in spending is sub-optimal since taxpayers discount the actual cost of the service they get from the government, a form of fiscal illusion (Gemmell, Morrissey, and Pinar 1999).

The latter half of the 20th century was an especially turbulent time for South Africa. In addition to external shocks such as those generated by the various oil crises of this period, the country went through the difficulties of dealing with its own transition from apartheid, as well as those stemming from the normal political transitions of one

[20] The base year is 2000 for all indices.

administration to another. A natural question to ask is whether these external and internal shocks affected in a systematic way the pattern of government expenditures.

In this essay we examine the impact of these and other factors on real per capita government spending in South Africa over the 1960 to 2002 period, using an extended median voter model of government expenditures. An important part of our estimation strategy is the correction for unit root problems that are common to time series data. Our estimation results indicate that government expenditures clearly declined after the abolition of apartheid; that is, there appears to be an "apartheid dividend" from its elimination. However, external shocks and regime changes typically did not affect government spending. We also find across a wide range of alternative specifications those income and tax prices are strongly significant determinants of government spending.

The next section reviews some of the theories of growth of government spending. Section 3 details our theoretical and empirical framework, including some econometric issues in the analysis of time series data. Our estimation results are presented in section 4, and we summarize our results in section 5.

Literature Review on Government Spending

There are many theories of government spending growth, and many begin with some variant of the median voter hypothesis. The median voter hypothesis states that (under some conditions) government officials choose the level of government spending selected by the median voter. The outcome of such choice is a demand for public services by the median voter that depends upon such things as the median voter's income and tax price, where this price depends in turn on the voter's tax share and the relative unit cost of the public good as given by the technology of public provision.[21]

Borcherding and Deacon (1972) and Bergstrom and Goodman (1973) were among the first to develop formally and test empirically the median voter model, focusing on the expenditures of local governments in the United States. Niskanen (1978) extended empirical tests to the spending behavior of the federal government of U.S and its aggregate money market behavior. Recent use of the median voter model in explaining the time series behavior of government spending at a national level include Gemmell, Morrissey, and Pinar (1999) for the U.K., Hondroyiannis and Papapetrou (2001) for Greece, and Christopoulos and Efthymios (2003) for a panel of European OECD countries.

There are of course other theories of government expenditure determinants and, especially, of the growth of government spending. "Wagner's Law" argues that government spending increases more than proportionately with income; that is, the income elasticity of demand for government services is positive and greater than unity.

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[21] Baumol (1967) showed that the relative price of public services was likely to increase over time because productivity growth in service sectors is slower than in other sectors and government provision tends to focus on the provision of services. This increase in the relative price of government services is often termed the "cost disease" of the public sector.

Empirical tests of this hypothesis give mixed results across country studies. Ansari, Gordon, and Akuamoah (1997) find no support for a long-run relationship between government spending and income for South Africa. Another theory is associated with Peacock and Wiseman (1961), the so-called "displacement effect." They argue that the shocks to public spending during such events as war and economic crises that necessitate higher spending during the shock period have a permanent effect on subsequent post-shock spending, even after the shock is not present. This displacement effect occurs because taxpayers develop tolerance to higher taxes during the shock, and thus the higher level of government spending becomes permanent. Other things equal, it is therefore expected that a higher level of spending emerges following a shock.

Demographic and taste factors are other determinants of public spending. The median voter hypothesis includes population as an explanatory variable. Other aspects of demography can also affect government spending. For example, as the population grows the density of population is likely to increase as the population becomes concentrated in more urban areas. Because of urbanization and its associated externalities, market solutions may no longer be efficient, so that government intervention and higher levels of government spending become necessary (Borcherding 1977).

All of the above theories of government spending growth can be considered extensions of the median voter model in its empirical investigation. A strict application of the median voter model for democratic developing countries may not be appropriate because macroeconomic factors can be important, especially in developing countries in which internal and external disturbances are frequent. Rodrik (1998) argues that a more open economy tends to be associated with a larger government sector because the latter reduces risk when the economy is more exposed to external negative shocks. His empirical work finds that there is a positive relationship between openness (as measured by the ratio of imports and exports to GDP) and government spending, and this relationship is strongest when the terms of trade risk is highest.

Empirical Specification, Data and Econometric Issues

Empirical Specification

We follow Niskanen (1978) and Borcherding (1985) in specifying our empirical model. The median voter's demand function is assumed to have the following form:

$$Q = As^{\eta} y^{\delta} m^{\phi}, \tag{3.1}$$

where

Q = quantity of the public good demanded by the median voter

s = the perceived tax price of the median voter

y = the median voter's income

m = other exogenous preference or shift variables,

and where (η , δ , φ) are parameters of the demand function with $\eta < 0$ and $\delta > 0$.

Since Q and s are unobserved, we must replace them with observable variables before we can estimate the demand function. Assume that the cost of Q is priced by the government at a unit marginal cost equal to c, and let t be the average taxpayer's perceived tax share of the unit cost of public services. Then the per unit perceived tax price s is given by

$$s = t \times c . \tag{3.2}$$

Note also that cQ is the government spending per average taxpayer. Making use of this and combining (1) and (2) we have:

$$cQ = At^{\eta} c^{1+\eta} y^{\delta} m^{\phi} . \tag{3.3}$$

The variable t is assumed to be a function of the fraction of government spending financed by tax revenues and the total number of taxpayers, or

$$t = (\frac{T}{E})(\frac{1}{N}) \tag{3.4}$$

where *T* is total government tax revenues, *E* is total government spending, and *N* is the number of taxpayers. Note that E is equal to cQN. Finally, it is assumed that the marginal cost *c* is a function both of the wage rate in the private sector *W* and of the numbers of voter-taxpayers *N*, or

$$c = BW^{\gamma} N^{\lambda} \tag{3.5}$$

where *B* is a scale parameter, $\gamma (0 \leq \gamma \leq 1)$ measures the “cost disease” of government services and $\lambda (0 \leq \lambda)$ measures the degree of publicness of government services.

Combining these equations, we have:

$$cQ = A\left(\frac{T}{E}\frac{1}{N}\right)^{\eta} \left(BW^{\gamma} N^{\lambda}\right)^{1+\eta} y^{\delta} m^{\phi} = k(T/E)^{\eta} W^{\gamma(1+\eta)} N^{\lambda(1+\eta)-\eta} y^{\delta} m^{\phi} \tag{3.6}$$

where $k = AB^{1+\eta}$. All variables are now observable. Taking logs, we get

$$\ln(G) = \beta_0 + \beta_1 \ln(y) + \beta_2 \ln(\tau) + \beta_3 \ln(N) + \beta_4 \ln(W) + \beta_5 \ln(m) \tag{3.7}$$

where $G = cQ,\ \tau = T/E,\ \beta_0 = \log k,\ \beta_1 = \delta,\ \beta_2 = \eta,\ \beta_3 = \lambda(1+\eta) - \eta,$

$\beta_3 = \lambda(1+\eta) - \eta,\ \beta_4 = \gamma(1+\eta),$ and $\beta_6 = \phi.$ Equation (3.7) forms the basis for our estimation. The expected sign of the estimate on the coefficient of income is positive, and that of the tax share negative. Ignoring the extreme case $\lambda = 0$, if demand for government services is price inelastic i.e., $|\eta| < 1$, then the expected sign of the coefficient estimate on population is positive; if they are price elastic, then any sign on the estimate is consistent with the theory; and the expected sign on the coefficient estimate of the wage rate can be positive, negative or zero depending on the magnitude of the price elasticity of government services as given by estimate of η.

Data

We estimate equation (3.7) with annual South African data for the period 1960 to 2002. The dependent variable is total government expenditures per capita in constant prices. In addition, we use disaggregated government spending as alternative dependent variables. We use Income is measured by GDP per capita. The wage rate in the private sector is proxied by total compensation of employees in the economy divided by employment in mining and quarrying, manufacturing, and construction.[22] The terms of trade is calculated as the ratio of unit price of exports to imports. The degree of openness of the economy is measured as the ratio of the value of imports and exports to GDP. All nominal variables are deflated by the consumer price index to get their corresponding quantities in real terms. Data for GDP, government receipts and expenditures, compensation of employees, and population are drawn from the *South African Reserve Bank (SARB)* online version[23]. See Table 3.1 of Appendix C for the source and descriptions of the other variables.

Table 3.2 presents summary statistics for some of the variables. Real per capita government spending grew at an annual average rate of 3.1 percent over the period 1960 to 2002. GDP per capita increased at an annual average rate of 0.83 percent, population grew at a rate of 2.42 percent, and the growth rate of our proxy for the real wage rates was 3.1 percent. Figures 3.1, 3.2, and 3.3 also depict the trends of real government expenditure, per capita government expenditure, and government expenditure relative to GDP.

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[22]Tridimas (1985) uses a similar measure of the wage rate in his study of South African government spending.

[23] See http://www.reservebank.co.za/ accessed August 2006

Of perhaps most interest in our estimation are various dummy variables meant to capture internal and external shocks. We include a dummy variable for the post-apartheid period (1990 to 2002), equal to 1 following the abolition of apartheid for years following 1990 and 0 otherwise. As discussed in more detail later, we also include a separate dummy variable for the post-1994 period, equal to 1 for the years 1994 and beyond and 0 otherwise to account for the effect of all inclusive election. We include a dummy variable ("Oil Shock") for the oil shocks after 1973, equal to 1 for the period after 1973 and 1 otherwise. We include a "War" dummy variable for the years 1975 to 1987 to account for the period when South Africa was indirectly involved in a proxy war with Mozambique and Angola in an attempt to contain the spread of communism in the region. This dummy has value of 1 for the period after 1975 and 1 otherwise. All these variables are included in our estimation to test the displacement hypothesis of Peacock and Wiseman (1961). Finally, we include various regime dummy variables that embrace the years of administration of a given head of state in South Africa; these periods include the regimes of Vorster (1967 to 1977), Botha (1978 to 1988), De Klerk (1989 to 1993), Mandela (1994 to 1998), and Mbekie (1999 to 2001). In all cases these regime dummies are equal to 1 in the years of the specific regime and 0 otherwise.

Econometric Issues: Stationarity Tests

As with all time series data, the potential existence of unit roots in the variables complicates the estimation of equation (3.7). It is well known that estimating equation (3.7) via ordinary least squares OLS in the presence of unit root may yield spurious estimates (Harvey (1991)). The appropriate way of dealing with such problems is to identify first if each variable has the same order of integration and then to test if there is a cointegrating relationship on those variables with the same integration order.[24] Thus, our estimation procedure starts with performing the Augmented Dickey-Fuller (ADF) test, which determines the univariate stationarity properties of the variables. Table 3.3 gives the results of stationarity tests both in levels and first differences of the variables. The null hypothesis is that there is a unit root for a given series. If the null is rejected, then the series is stationary; if it is not rejected, then the series is non-stationary.

The results indicate that our measure of government expenditure, median income, population, and wage rate variables are I(1) at the 5 percent significance level.[25] The different tax share measures give mixed results. Tax share as measured by total revenue per spending is I(0); hence it cannot be cointegrated with I(1) variables. Tax share calculated from total tax revenue, income tax, and indirect tax are all I(1) and are therefore included in the cointegration analysis. The existence of a long run equilibrium relationship is detected by running cointegration tests (Granger and Newbold (1974)), which for I(1) variables entails the identification of stationary error processes on linear combination of the variables in levels:

$$G_t - a - \alpha X_t \equiv \varepsilon_t \sim I(0)\,, \qquad (3.8)$$

where G_t is our explained variable , a is a constant, X_t is a vector of potential explanatory variables, α is a vector of associated coefficients, and ε_t is stationary

[24] If all the variables are integrated of the same order and they are not cointegrated (implying that there is no support for long run relationship between the variables), then one can estimate them in first difference form for assessing the short run relationship. Otherwise, estimating cointegrated variables just in first difference form removes the long run relationship between the variables. "After all, if the linear relationship is already stationary, differencing the relationship entails a misspecification error" (Enders 2004, 358).

[25] Unless stated, we have taken the 5 percent significance level for including or excluding a variable in the cointegration analysis.

random disturbances. If a cointegrated system is established, the short-run behavior of the variables can be assessed using an error-correction method (ECM) of Engle and Granger (1987).

Results

Long Run Relationship

In this section, we focus on testing the potential long run relationship between government spending, the median income, the tax share, the population, and the wage rate i.e., we test if these variables are cointegrated. The test we use for cointegration is the Engle-Granger (1987) procedure.

In all regressions, we include a basic set of regressors typically included in median voter models: median income, the tax share, the wage rate, and population. These form our "parsimonious", or basic specification. Then we include measure of openness and terms of trade as additional variables, as well as various dummy variables.

We expect the income elasticity of demand for public spending to be positive, while the price elasticity to be negative. The estimate for the coefficient on the wage rate will be positive if the tax share estimate is inelastic, and it will be negative otherwise. The sign for the coefficient of population can also be either positive or negative. We expect it to be positive if the estimate for the tax share is inelastic; however, if the tax share coefficient is elastic, then any sign can be consistent with the model, although some magnitudes of the estimate are ruled out.

Table 3.4 presents the results of various specifications when real GDP per capita is used as a proxy for the income of the median voter. Specifications 3 and 8 show that the variables are cointegrated.[26] In those specifications, the estimates for the income, the tax share, population are significant at higher levels and also the sign and magnitudes of

[26] The critical values for testing for cointegration are from MacKinnon (1991). For our sample of T=43 and 4 endogenous variables, the 1, 5, and 10 percent critical values are approximately -5.02, -4.32, -3.98, respectively; for 5 variables, they are -5.42, -4.70, and -4.43; and for 6 variables, they are -5.78, -5.05 and -4.69.

the estimates are as stipulated by the median voter hypothesis. The coefficient estimate for the wage rate is negative, although it is not always significant. Specifications 2, 3, and 4 add measures of openness, the terms of trade, and their interaction to the parsimonious model; and the results show that these variables are significant.

Of most interest are the various dummy variables for internal and external shocks. The table reports two dummy variables related to apartheid. 1 is the dummy covering the period after 1990, the year apartheid was abolished. The other is for the period after 1994, the year when the first all inclusive election was undertaken. They are both significant and their estimates have negative signs. However, these results are derived in a regression that is stationary only at higher significance level. The coefficient on the oil shock dummy is significant and its estimate is positive. This supports the notion that there was a permanent increase in expenditures following the oil shock of 1973.

The median voter model specifies that the income variable should equal the income of the median voter. Before the election of 1994, only the white population of South Africa could vote; after this year all segments of the population could vote, so that the median voter most likely have changed after 1994. We address this issue by using personal income per capita of the white population for the period 1960-94, and personal per capita income of the total population after this year.[27] The estimation results using this proxy for median income are reported in Table 3.5.

The stationarity test of all the regressions show that the null of no cointegration can be rejected only at more than 10 percent level of significance. Given the results, it seems that the proxy is a bad measure of median income.

[27] The data on personal income of the white population are from Burea of Market Research (2004) and are kindly provided to us by . The data are annual from 1990-2000 and for every 5 years for the years 1960-90 (i.e., data are available for 1960, 65, 70, 75, 80 and 85); hence we interpolate for the years in between.

The above two sets of regressions have been repeated by disaggregating government expenditure into functional classifications: *expenditures on general services*, *defense*, *public order and safety*, *community and social services*, and *economic services*. Unfortunately, data for such expenditures are available only for short period span (1983-2002) which reduces the degrees of freedom. Hence, we limit our regressions here to the variables of the parsimonious specification and the apartheid dummies so as to investigate the political transition further with the disaggregated expenditure data. Since the explanatory variables are all I(1), we need also to test which of the expenditure classifications are I(1). Our tests show that expenditures on *public order and safety*, and *community and social services* are I(1). *Expenditure on general services* and *economic services* is I(0) while *expenditure on defense* is I(2). Thus, only *expenditure on public order and safety*, and *community and social services* may be cointegrated with the independent variables. We therefore run the test only for these two types of expenditures.

Table 3.6 reports the results for these two types of expenditures when real GDP per capita is used as a proxy for median income. The results show that cointegration relationship is indicated for expenditures on *public order and safety*. However, the point estimates are statistically significant only for the population variable and in some cases for the wage rate. The estimate of post94 is negative while for that of post90 is positive.

Table 3.7 presents similar regressions when personal income per capita of the white population before 1994 is used as a proxy for the median income. There is a cointegration relationship indicated in all the regressions except in one case (i.e., specification 4). However, only the estimate for population is robustly significant. The post 1994 and post 1990 period dummies are significant and negative in the regression with spending on *public order and safety*, but they are not significant when the dependent variable is expenditure on community and social services.

We are limited by the time span of the data to appropriately examine the effect of political transition on the behavior of disaggregated government expenditure. If a strict form of the median voter model holds, then median income that takes the white per capita income before 1994 would better explain government spending than GDP per capita of the total population of South Africa. Moreover, given that there is a huge decline in the median income after abolishment of apartheid, government spending should have declined substantially. What we might also expect is something similar to the "displacement effect" in which government spending is rigid downward. In such cases, the median voter does not reduce the total demand for government spending, but rather changes the composition of the government spending. To see if this is working for the case of South Africa, it is worthwhile to look at the evolution of the various disaggregated categories of government spending.

Figure 3.4 gives the plots of per capita disaggregated government expenditures. As can be seen from the graphs, there is a clear increasing trend on *community and social services*, and a clear declining trend on *defense* spending especially after 1994. The other classifications of government spending, however, fluctuated within a narrow band even before this period and then leveled off after this year.

Because of the limitation of observations of the above data, we use other disaggregations of government expenditure for which data are available for the 1960-2002. These are government consumption expenditures, government investment expenditures, total government spending less interest payments, and expenditures on transfers (both to households and businesses). The cointegration tests using these types of government expenditures are given in Table 3.8. In this table, we use the parsimonious specification and the dummy variables for post90 and post94 period. Only transfers to households and subsidies to business are cointegrated with the median voter variables. In these regressions, we also see that the post90 and post94 dummies are significant and negative.

Finally, we run the cointegration test by using different measures of the tax share: total tax share, total income and wealth tax share, individual income and wealth tax share, corporate income tax share, VAT tax share and production and imports tax share. The aim of using the different tax measures is to test whether the taxpayer is more sensitive to a particular type of tax revenue sources than others. Recall that the median voter model shows that the taxpayer calculates the cost of provision of government services by looking at the tax share. It is unlikely that the taxpayer's perception of his burden of different source of revenue will be the same. For some tax revenue sources, the taxpayer may be more responsive (e.g., for "visible taxes" such as income or other direct taxes) and less responsive for others (e.g., for "less visible taxes" such as sales taxes or other indirect taxes). In such cases, disaggregating the tax revenues and calculating different types of tax shares may improve the fit of the regressions.

The cointegration test in Table 3.9 is aimed at this. Column 1 of this table, which is a replication of Column 1 in Table 3.4, uses total tax share, the tax share we have used so far. This is, therefore, our "gross" measure of tax share. The regression does not lend support for cointegration relationship. Once we run the cointegration on the disaggregated tax share, we find some cointegration relationships. Comparing the specifications that include the individual income tax share, the corporate tax share and the VAT tax share (Column 3, 4, and 5), we see that the individual income tax share is more responsive than the corporate income tax share, and the latter is more responsive than the VAT tax share. This apparently lends support to the notion that how expenditures are financed matters for the size of government spending.

Short Run Relationship

Next we assess the short-run relationship between government expenditure and its potential determinants. To do this, we run the error correction method of estimation on the specification that lends support to the existence of long run relationship. Recall that there are two specifications that rejected the null of no cointegration at conventional levels of significance, specification 3 and 8 in Table 3.4. We experimented with both specifications, and we find that the former fits the data better in estimating the error correction model (ECM). By using this specification as the first stage regression, the ECM regression results is (p-values in parenthesis):

$$\begin{aligned}\Delta\ln(G) = {} & 0.08(.34) - 0.53(0.08)\varepsilon_{-1} + 0.58(0.18)\Delta\ln(y) + 0.23(0.11)\Delta\ln(\tau) \\ & -1.88(0.58)\Delta\ln(N) - 0.10(0.82)\Delta\ln(W) + 0.08(0.07)Post94,\end{aligned} \tag{3.9}$$

where ε_{t-1} is the error term from the first stage regression. The $R^2 = 0.28$, and the $\text{Prob.} > F = 0.11$. The estimation indicates that the error correction estimate is negative and significant at 10 percent, and the magnitude of the corresponding coefficient shows that almost 50 percent of any disequilibrium in the long run relationship between the variable is corrected within one year. The estimation also shows that the variables of the median voter jointly explain the short-run behavior of government spending as the F-statistics is marginally significant. The estimation, however, does not demonstrate that there is a short run relationship between expenditure, median income, tax share, population and the wage rate, as can be seen from the high p-values of the estimates on the differenced right hand side variables.

Conclusion: Accounting for the Growth of Government Spending in South Africa

What are the major reasons for the growth of government spending in South Africa in the last half of the 20^{th} century? We can use our estimation results to decompose the causes of government spending over the period 1960 to 2002. We use the results from the regression in Table 3.4, specification 3:

$$\begin{aligned}\ln(G) = -14.96 + 1.208\ln(y) - 0.731\ln(\tau) + 0.964\ln(N) \\ - 0.027\ln(W) + 0.44\ln(TOT)\end{aligned} \qquad (3.10)$$

This specification is preferred because the residual from this relationship is found to be stationary and all the estimates are in accord with the median voter model. Using these results, we can directly calculate the price and income elasticities of demand and indirectly the elasticities associated with the cost disease and the degree of publicness. The price elasticity of demand for government spending is about -0.73 and the income elasticity is about 1.21. Since the coefficient estimate for the wage variable is not different from zero and given that the price elasticity is statistically significant, it can be inferred that the measure of the degree of cost disease is nil; and finally, the measure of degree of publicness is 0.87, which shows that there is some degree of publicness.

We can then decompose the contribution of each explanatory variable to the growth of government spending along the methodology adopted by Holsey and Borcherding (1997) and Borcherding (1985). From equation (3.10) above, the relationship between government spending per capita and the explanatory variables of the basic model, expressed in growth form, is given by:

$$gr(G) = 1.208gr(y) - 0.731\mathrm{gr}(t) + .964gr(N) - .027\mathrm{gr}(W) + .440gr(TOT) \quad (3.11)$$

where gr(.) is the growth of a variable. Recall that real government spending per capita grew by 3.1 percent, real GDP per capita by 0.83 percent, the tax share of the average taxpayer by 0.43 percent, the measure of the wage rate in the private sector by 3.02 percent, and population by 2.3 percent (See Table 3.1 for these figures). Since the estimate for the coefficient of the wage rate is found to be not different from zero, we exclude it in the calculation of contribution of government spending growth. Using equation 3.11, the contribution of per capita income growth to government spending growth is therefore about 1 percent (or 1.21 × .83 percent). Similarly, the contribution of the tax share growth and the population growth to government spending are -0.31 percent (-0.73 × 0.43 percent), and 2.2 percent (0.964×2.3 percent), respectively. In total, the explanatory variables of the median voter model explain 2.89 percent of the actual government spending growth of 3.1 percent which is about 93 percent of the variation in government spending. The remaining factors responsible for change in government spending are mainly internal and external shocks, especially the abolition of apartheid and the terms of trade shocks.

APPENDICES

Appendix A. Appendix to Essay I

Table 1.1. Variable Description and Data Source

Variable	*Description*	*Data Source*
C/M2	Ratio of Currency to M2. Currency is coins and notes outside banks, M2 is the some of money (M1) and quasi money which include time deposits	Currency and M2 are from International Monetary Fund's International Financial Statistics (IFS) (2006). Currency is item line 14, and M2 is sum of IFS item line 35 and 35b
Taxrate1	Direct tax rate calculate as total nominal tax revenue from income and profits divided by nominal GDP	World Development Indicators (WDI) CD-ROM (2006)
Taxrate2	Effective tax rate calculated as total nominal tax revenues divided by nominal GDP	WDI CD-ROM (2006)
Taxrate3	Top bracket statutory marginal individual income tax rates	Price Waterhouse (1983-1997) and WDI (2007)
Income	A measure of the income of the representative taxpayer calculated as GDP per capita at constant U.S. dollars divided by population.	WDI CD-ROM (2006)
Inflation	Percentage change in Consumer Price Index	WDI CD-ROM (2006)
Intrate	The interest rate measuring the opportunity cost of holding currency; it is given by the bank deposit rate.	IFS CD-ROM (2006)

Table 1.1. –continued.

Variable	*Description*	*Data Source*
Corruption	An index on a scale of 0 to 6 that measures perceptions of corruption in this context is defined as the exercise of public power for private gain. A higher score indicates lower expectations of corruption	International Country Risk Guide (ICRG) (2007) published by the Political Risk Group
Bureaucratic quality	An index on a scale of 0 to 6 that measures bureaucratic delay and the general effectiveness of the government bureaucracy. A higher score indicates a more effective bureaucracy	ICRG
Rule of law	An index on a scale of 0 to 6 that measures perception of crime, the effectiveness, independence, and impartiality of the judiciary. In general, it measures the extent to which economic agents respects the rules that govern their interactions. The higher the score, the better the performance of the respective country.	ICRG
Enf	A measure of enforcement strength of the tax authorities constructed as average of the indices of corruption, Bureaucratic quality and Rule of Law.	Author's construction
Political rights	A country rating on a scale of 1 to 7 that indicates the degree of political rights in regard to existence of free and fair elections, competitive parties or other political groupings, an opposition that play a significant role in political decision-making., and the rights of minority groups to self government. A rating of 1 indicates highest level of political rights (closest o the ideals) suggested in the survey.	Freedom House

Table 1.1. –continued.

Variable	*Description*	*Data Source*
Civil liberties	A country rating on a scale of 1 to 7 that indicates that degree of civil liberties in regard to aspects such as the degree of freedom of expression, assembly, association, education, religion, and an equitable system of rule of law. A rating of 1 indicates the highest level of civil liberties.	Freedom House
Schooling	A measure of education attainment in terms of the average years of schooling for the total population over the age of 15 years	Barro and Lee (2000)
Urban	Urbanization, the share of the total population living in areas defined as urban in each country.	WDI CD-ROM (2006)
Excdep	Annual percentage change of the exchange rate	IFS CD-ROM (2006)
Minshare	Share of ore exports in total Merchandise exports	WDI CD-ROM (2006)

Table 1.2. Summary Statistics

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Currency/M2	4171	.26	.16	.004	.91
Currency/GDP	3510	.08	.07	.001	.63
Taxrate1	2017	.05	.04	.005	.30
Taxrate2	2017	.18	.08	.025	.81
Taxrate3	1169	.42	.13	.04	.90
Corruption	1815	2.81	1.17	0	6
Quality of bureaucracy	1815	2.64	1.54	0	6
Rule of law	1815	3.12	1.35	0	6
Income per capita	2846	4186.4	3826.7	419	26684.4
Inflation	3417	43.3	337.9	-100	10205
Intrate	2531	69.3	2150.1	.07	107379
Urban	6086	40.8	22.8	1.8	100
Schooling	2846	.72	.68	.01	3.95
Excdep	5399	3.8	178.9	0	13143
Minshare	2843	.1	.19	0	.99

Table 1.3. Correlation Matrix

Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*
(1)	1												
(2)	.37	1											
(3)	-.20	.00	1										
(4)	-.15	.26	.45	1									
(5)	.20	.18	.20	.09	1								
(6)	.33	-.15	-.14	-.55	-.10	1							
(7)	-.29	.13	-.05	.26	-.12	-.48	1						
(8)	.12	-.22	-.21	-.12	-.06	.08	.11	1					
(9)	-.08	-.43	-.19	-.14	-.17	.03	.18	.78	1				
(10)	-.06	-.02	-.20	.08	-.22	-.16	.72	.23	.29	1			
(11)	-.25	.13	-.12	.10	-.31	-.26	.72	.05	.10	.74	1		
(12)	.10	-.22	-.20	-.13	-.04	.09	.10	.97	.79	.21	.04	1	
(13)	-.23	-.27	-.05	.00	-.02	.12	-.09	.13	.17	.02	-.07	.13	1

Notes:
(1) Currency/M2
(2) Currency/GDP
(3) Taxrate1
(4) Taxrate2
(5) Taxrate3
(6) Enforcement
(7) Income per capita
(8) Inflation
(9) Intrate
(10) Urban
(11) Schooling
(12) Excdep
(13) Minshare

Table 1.4. FE Estimates with Direct Tax Revenue per GDP (Dependent Variable-Currency/M2)

Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Taxrat1	4.117	-11.03**	-12.63**	-12.48**			
	(7.521)	(5.141)	(5.216)	(4.824)			
Enf	.375***						
	(.138)						
Taxrat1*Enf	-1.481	2.120*	2.518*	2.383**	-.626***	-.409	-.421
	(1.813)	(1.260)	(1.278)	(1.184)	(.226)	(.322)	(.322)
Income	-.50***	-.573***	-.521***	-.570***	-.607***	-.499***	-.517***
	(.101)	(.100)	(.100)	(.091)	(.091)	(.120)	(.120)
Inflation	.110	.116	.259***	.115*	.110*		
	(.069)	(.070)	(.049)	(.064)	(.065)		
Intrate	-.077**	-.086***	-.045	-.112***	-.123***	.012	.005
	(.031)	(.032)	(.029)	(.028)	(.028)	(.025)	(.027)
Urban	-.86***	-.925***	-.946***	-.883***	-.932***	-1.25***	-1.29***
	(.250)	(.254)	(.259)	(.149)	(.150)	(.205)	(.204)
Schooling	.006	.023	.003				
	(.102)	(.104)	(.106)				
Excdep	.200**	.222***		.247***	.267***		
	(.078)	(.080)		(.070)	(.071)		
Minshare						-.179	-.227
						(.542)	(.542)
Dum_Inf						.281***	
						(.099)	
Dum_Exr							.317***
							(.112)
Constant	3.650**	5.980***	4.880***	5.922***	6.426***	7.000***	7.334***
	(1.527)	(1.287)	(1.251)	(.855)	(.845)	(1.035)	(1.041)
Obs.	212	212	212	269	269	230	230
Countries	44	44	44	67	67	63	63
R-squared	.55	.52	.50	.52	.50	.43	.43

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.5. FE Estimates with Total Taxes per GDP (Dependent Variable-Currency/M2)

Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Taxrat2	1.652	-1.905	-2.336	-2.351*			
	(1.679)	(1.427)	(1.459)	(1.341)			
Enf	.418***						
	(.112)						
Taxrat2*Enf	-.479	.386	.541	.437	-.129	-.120	-.112
	(.418)	(.359)	(.366)	(.334)	(.085)	(.103)	(.102)
Income	-.552***	-.639***	-.575***	-.641***	-.671***	-.545***	-.567***
	(.101)	(.101)	(.102)	(.094)	(.093)	(.118)	(.118)
Inflation	.087	.083	.245***	.077	.079		
	(.067)	(.070)	(.050)	(.064)	(.064)		
Intrate	-.077**	-.090***	-.040	-.112***	-.119***	.016	.004
	(.031)	(.032)	(.029)	(.029)	(.029)	(.026)	(.027)
Urban	-.922***	-1.07***	-1.08***	-.932***	-.940***	-1.30***	-1.34***
	(.243)	(.249)	(.255)	(.144)	(.145)	(.194)	(.191)
Schooling	.061	.078	.053				
	(.100)	(.104)	(.106)				
Excdep	.222***	.257***		.274***	.286***		
	(.076)	(.078)		(.070)	(.070)		
Minshare						-.257	-.307
						(.539)	(.536)
Dum_Inf						.236**	
						(.097)	
Dum_Exr							.313***
							(.112)
Constant	4.135***	7.129***	5.771***	6.786***	7.043***	7.537***	7.916***
	(1.462)	(1.262)	(1.225)	(.856)	(.847)	(.993)	(.996)
Obs.	233	233	233	295	295	253	253
Countries	44	44	44	68	68	64	64
R-squared	.54	.50	.47	.49	.49	.44	.44

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.6. FE Estimates with Top Bracket Statutory Individual Income Tax Rate (Dependent Variable-Currency/M2)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Taxrat3	7.461*	-.970	-1.006	-1.375			
	(4.140)	(1.281)	(1.279)	(1.022)			
Enf	.822**						
	(.384)						
Taxrat3*Enf	-1.526	.547*	.566*	.524**	.219***	.303***	.256***
	(1.012)	(.293)	(.291)	(.234)	(.059)	(.068)	(.068)
Income	-.346**	-.436***	-.418***	-.549***	-.552***	-.402***	-.452***
	(.139)	(.134)	(.131)	(.110)	(.110)	(.114)	(.115)
Inflation	.095	.085	.129**	.101	.107		
	(.086)	(.087)	(.059)	(.075)	(.075)		
Intrate	-.002	-.003	.008	-.050	-.059*	.024	-.012
	(.040)	(.041)	(.038)	(.031)	(.031)	(.030)	(.035)
Urban	-.767***	-.756***	-.756***	-.599***	-.561***	-.622***	-.633***
	(.258)	(.261)	(.260)	(.179)	(.177)	(.205)	(.202)
Schooling	.082	.065	.066				
	(.106)	(.107)	(.106)				
Excdep	.066	.071		.112	.114		.283***
	(.102)	(.103)		(.085)	(.085)		(.102)
Minshare						.305	.223
						(.556)	(.550)
Dum_Inf						.186*	
						(.107)	
Dum_Exr							-.279
							(.190)
Constant	-.451	3.625**	3.243**	4.246***	4.055***	3.273***	3.846***
	(2.385)	(1.448)	(1.335)	(1.072)	(1.064)	(1.103)	(1.116)
Obs.	232	232	232	322	322	283	283
Countries	41	41	41	57	57	56	56
R-squared	.46	.45	.45	.40	.40	.42	.43

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.7. RE Estimates with Direct Tax Revenue per GDP (Dependent Variable-Currency/M2)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Taxrat1	4.427	-14.96***	-16.44***	-18.29***			
	(7.72)	(5.28)	(5.33)	(5.05)			
Enf	.471***						
	(.141)						
Taxrat1*Enf	-1.373	3.277**	3.641***	3.938***	-.472**	-.238	-.225
	(1.868)	(1.291)	(1.304)	(1.236)	(.221)	(.283)	(.286)
Income	-.308***	-.368***	-.340***	-.362***	-.410***	-.326***	-.333***
	(.082)	(.081)	(.082)	(.069)	(.070)	(.094)	(.095)
Inflation	.114	.123*	.265***	.134*	.129*		
	(.072)	(.075)	(.052)	(.069)	(.071)		
Intrate	-.074**	-.084**	-.045	-.110***	-.127***	-.000	-.003
	(.032)	(.033)	(.030)	(.030)	(.030)	(.027)	(.029)
Urban	-.035	-.021	-.038	-.186*	-.193*	-.361**	-.416***
	(.158)	(.159)	(.161)	(.112)	(.114)	(.156)	(.157)
Schooling	-.181**	-.184**	-.198**				
	(.080)	(.081)	(.082)				
Excdep	.192**	.217***		.244***	.274***		
	(.081)	(.083)		(.075)	(.077)		
Minshare						.164	.288
						(.380)	(.383)
Dum_Inf						.338***	
						(.105)	
Dum_Exr							.344***
							(.124)
Dum_Afr						-.152	-.198
						(.182)	(.186)
Dum_Asia						-.647***	-.687***
						(.211)	(.216)
Constant	-1.524	.820	-.078	1.588***	2.021***	2.376***	2.665***
	(1.090)	(.824)	(.760)	(.563)	(.562)	(.741)	(.757)
Obs.	212	212	212	269	269	220	220
Countries	44	44	44	67	67	57	57

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.8. RE Estimates with Total Taxes per GDP (Dependent Variable-Currency/M2)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Taxrat2	2.241	-2.820*	-3.179**	-3.386**			
	(1.761)	(1.506)	(1.531)	(1.454)			
Enf	.558***						
	(.114)						
Taxrat2*Enf	-.597	.625*	.751*	.740**	-.083	-.119	-.102
	(.438)	(.380)	(.385)	(.364)	(.090)	(.105)	(.104)
Income	-.321***	-.392***	-.363***	-.390***	-.431***	-.332***	-.339***
	(.080)	(.082)	(.082)	(.071)	(.070)	(.091)	(.092)
Inflation	.111	.108	.255***	.116	.118*		
	(.071)	(.075)	(.054)	(.071)	(.071)		
Intrate	-.066**	-.083**	-.042	-.108***	-.116***	.004	.002
	(.032)	(.034)	(.031)	(.031)	(.031)	(.028)	(.030)
Urban	-.040	-.035	-.035	-.156	-.159	-.422***	-.488***
	(.153)	(.158)	(.158)	(.111)	(.113)	(.150)	(.151)
Schooling	-.150*	-.175**	-.191**				
	(.079)	(.082)	(.082)				
Excdep	.187**	.227***		.253***	.269***		
	(.079)	(.083)		(.077)	(.077)		
Minshare						.113	.231
						(.372)	(.376)
Dum_Inf						.308***	
						(.104)	
Dum_Exr							.321**
							(.126)
Dum_Afr						-.252	-.301*
						(.172)	(.176)
Dum_Asia						-.740***	-.791***
						(.202)	(.207)
Constant	-1.763*	1.109	.085	1.761***	2.081***	2.732***	3.053***
	(.998)	(.818)	(.745)	(.567)	(.562)	(.712)	(.729)
Obs.	233	233	233	295	295	242	242
Countries	44	44	44	68	68	57	57

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.9. RE Estimates with Top Bracket Statutory Individual Income Tax Rate (Dependent Variable-Currency/M2)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Taxrat3	9.067**	-.890	-.925	-.939			
	(4.021)	(1.228)	(1.224)	(1.016)			
Enf	.968***						
	(.372)						
Taxrat3*Enf	-1.823*	.634**	.646**	.560**	.346***	.429***	.425***
	(.987)	(.286)	(.284)	(.237)	(.052)	(.058)	(.058)
Income	-.266***	-.312***	-.310***	-.348***	-.362***	-.360***	-.368***
	(.089)	(.089)	(.088)	(.073)	(.071)	(.078)	(.079)
Inflation	.104	.096	.120**	.097	.101		
	(.088)	(.089)	(.060)	(.077)	(.077)		
Intrate	.004	.010	.015	-.031	-.038	.014	.028
	(.039)	(.039)	(.037)	(.031)	(.030)	(.029)	(.031)
Urban	-.068	-.040	-.036	-.018	-.005	-.124	-.127
	(.147)	(.149)	(.148)	(.126)	(.125)	(.137)	(.138)
Schooling	.016	-.006	-.005				
	(.082)	(.082)	(.082)				
Excdep	.042	.037		.089	.092		
	(.102)	(.103)		(.088)	(.087)		
Minshare						-.291	-.317
						(.372)	(.373)
Dum_Inf						.225**	
						(.111)	
Dum_Exr							.124
							(.125)
Dum_Afr						-.337**	-.349**
						(.156)	(.156)
Dum_Asia						-.545***	-.545***
						(.188)	(.188)
Constant	-4.508**	-.298	-.454	.242	.269	1.113	1.167*
	(1.808)	(.831)	(.730)	(.649)	(.651)	(.692)	(.704)
Obs.	232	232	232	322	322	275	275
Countries	41	41	41	57	57	53	53

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.10. Hausman Test Results for Comparing FE and RE Estimators

*Equation**	*df*	χ^2	*Prob*(χ^2)
1	9	13.4	.146
2	8	18.04	.021
3	7	20.74	.004
4	7	22.45	.002
5	6	19.8	.003
6	6	19.56	.003
7	6	43.06	.000

*A given equation refers to the pair of corresponding specifications in Tables 1.6 and 1.9.

Table 1.11. 2SLS Estimates with Direct Tax Revenue per GDP (Dependent Variable-Currency/M2)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Taxrat1	-36.670	-72.581**	-68.203**	-66.554			
	(45.435)	(30.422)	(30.763)	(41.025)			
Enf	.684						
	(.977)						
Taxrat1*Enf	9.698	17.235**	15.410*	14.204	-2.727	-4.424*	-4.123*
	(11.694)	(8.104)	(8.160)	(10.988)	(1.750)	(2.381)	(2.318)
Income	-.267*	-.231*	-.191	-.177	-.271*	-.064	-.085
	(.161)	(.133)	(.135)	(.141)	(.147)	(.234)	(.225)
Inflation	-.017	.121	.241***	.136	.117		
	(.156)	(.097)	(.066)	(.096)	(.090)		
Intrate	-.181***	-.067	-.040	-.082	-.114***	-.009	-.003
	(.057)	(.050)	(.042)	(.052)	(.040)	(.044)	(.045)
Urban	.251**	.091	.020	-.205	-.412**	-.487*	-.527*
	(.105)	(.178)	(.186)	(.166)	(.185)	(.278)	(.269)
Schooling	-.041	-.177*	-.197**				
	(.087)	(.092)	(.092)				
Excdep	.435***	.180		.188	.264***		
	(.167)	(.116)		(.118)	(.098)		
Minshare						.330	.432
						(.542)	(.529)
Dum_Inf						.301*	
						(.158)	
Dum_Exr							.273
							(.180)
Constant	-3.064	-.666	-1.205	.336	2.049***	1.348	1.602*
	(4.798)	(1.046)	(.927)	(.935)	(.740)	(.898)	(.885)
Obs.	198	198	198	229	229	195	195
Countries	41	41	41	50	50	46	46

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.12. 2SLS Estimates with Total Taxes per GDP (Dependent Variable-Currency/M2)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Taxrat2	-52.70	-28.99***	-31.4***	-52.18**			
	(79.08)	(8.82)	(10.24)	(23.34)			
Enf	-1.391						
	(4.904)						
Taxrat2*Enf	13.96	7.65***	8.23***	13.86**	.425	-.222	-.340
	(21.113)	(2.167)	(2.535)	(6.135)	(.702)	(.828)	(.876)
Income	-.402	-.283**	-.236	-.195	-.474***	-.410***	-.386***
	(.574)	(.130)	(.145)	(.221)	(.087)	(.114)	(.116)
Inflation	.150	.068	.218**	.207	.127		
	(.286)	(.152)	(.100)	(.202)	(.088)		
Intrate	-.099	-.120**	-.063	-.003	-.072	.013	.017
	(.085)	(.059)	(.055)	(.099)	(.045)	(.043)	(.041)
Urban	.346	.280**	.246*	-.028	-.230*	-.089	-.189
	(.362)	(.116)	(.135)	(.192)	(.121)	(.134)	(.141)
Schooling	-.166	-.123	-.166*				
	(.140)	(.085)	(.096)				
Excdep	.164	.235		-.046	.224**		
	(.242)	(.165)		(.257)	(.101)		
Minshare						.280	.443
						(.381)	(.399)
Dum_Inf						.318***	
						(.118)	
Dum_Exr							.279**
							(.134)
Constant	4.790	-.913	-1.980**	-1.507	2.123***	1.852***	2.090***
	(21.430)	(1.015)	(.928)	(1.690)	(.676)	(.537)	(.576)
Obs.	218	218	218	251	251	214	214
Countries	41	41	41	50	50	46	46

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.13. 2SLS Estimates with Top Bracket Statutory Individual Income Tax Rate (Dependent Variable-Currency/M2)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Taxrat3	56.519	-20.903***	-21.05***	-17.283**			
	(67.441)	(7.878)	(7.426)	(7.141)			
Enf	6.832						
	(5.769)						
Taxrat3*Enf	-13.651	4.955**	5.078***	4.626***	.905***	1.159***	1.154***
	(16.628)	(2.052)	(1.951)	(1.593)	(.291)	(.345)	(.385)
Income	-.016	-.046	-.046	-.139	-.35***	-.359***	-.374***
	(.152)	(.158)	(.152)	(.120)	(.092)	(.099)	(.088)
Inflation	-.011	.002	.060	.093	.145		
	(.215)	(.147)	(.129)	(.136)	(.106)		
Intrate	-.116	.023	.029	.040	.032	-.011	.034
	(.106)	(.080)	(.064)	(.068)	(.050)	(.046)	(.060)
Urban	.013	-.096	-.075	.048	.384*	.509**	.453**
	(.180)	(.179)	(.171)	(.185)	(.230)	(.255)	(.204)
Schooling	.026	-.173	-.131				
	(.130)	(.190)	(.169)				
Excdep	.251	.100		-.105	-.137		-.042
	(.278)	(.243)		(.206)	(.155)		(.245)
Minshare						-.821	-.806*
						(.505)	(.428)
Dum_Inf						.229	
Dum_Exr							.074
							(.371)
Constant	-29.607	-.991	-1.447	-1.944	-2.497*	-2.401*	-2.175*
	(23.661)	(1.581)	(1.001)	(1.437)	(1.489)	(1.325)	(1.246)
						(.155)	
Obs.	218	218	218	241	241	217	217
Countries	38	38	38	43	43	42	42

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.14. Arellano-Bond GMM Dynamic Panel Estimates with Direct Tax Revenue per GDP (Dependent Variable-Currency/M2)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
$(C/M2)_{t-1}$	.498***	.575***	.656***	.640***	.922***	.925***
	(.146)	(.164)	(.157)	(.182)	(.104)	(.102)
Taxrat1	24.115	19.515	-10.072	-13.872*	-8.451	
	(20.670)	(18.454)	(7.209)	(7.487)	(7.592)	
Enf	.672	.663				
	(.462)	(.419)				
Taxrat1*Enf	-5.267	-4.961	2.549	3.404*	1.870	-.189
	(5.513)	(4.994)	(1.889)	(1.890)	(2.031)	(.508)
Income	-.090	.017	.016	.166	-.169	-.210
	(.431)	(.328)	(.296)	(.292)	(.193)	(.178)
Inflation	-.181	-.084	-.053	.089	-.072	-.078
	(.274)	(.145)	(.146)	(.116)	(.130)	(.139)
Intrate	-.089	-.056	-.073	.008	-.111*	-.127**
	(.064)	(.066)	(.070)	(.061)	(.062)	(.058)
Urban	-.474	-.740	-.598	-.762	.313	.350
	(.500)	(.725)	(.565)	(.641)	(.234)	(.222)
Schooling	-.278	.065	.031	.061		
	(.249)	(.212)	(.173)	(.193)		
Excdep	.450	.273	.308*		.341**	.386**
	(.275)	(.164)	(.168)		(.160)	(.151)
Minshare	-.623					
Constant	-.209	-.356	1.786	.308	.520	.758
	(3.264)	(2.675)	(2.560)	(2.704)	(1.158)	(1.163)
	(.929)					
Obs.	116	129	129	129	168	168
Countries	37	40	40	40	61	61
Hansen p-value	.022	.015	.012	.072	.002	.002
AR(1) p-value	.137	.0148	.197	.476	.222	.174
AR(2) p-value	.885	.862	.645	.736	.510	.332

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.15. Arellano-Bond GMM Dynamic Panel Estimates with Total Taxes per GDP (Dependent Variable-Currency/M2)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
$(C/M2)_{t-1}$	.700***	.605**	.653***	.636***	.829***	.853***
	(.139)	(.227)	(.173)	(.209)	(.125)	(.122)
Taxrat2	-2.506	-.251	-6.586**	-7.215**	-5.667*	
	(7.295)	(7.647)	(2.667)	(2.958)	(3.254)	
Enf	.249	.377				
	(.442)	(.469)				
Taxrat2*Enf	.446	-.101	1.516**	1.661**	1.288	-.195
	(1.881)	(1.995)	(.712)	(.760)	(.880)	(.152)
Income	.133	.195	.149	.242	-.224	-.291
	(.285)	(.343)	(.305)	(.299)	(.202)	(.185)
Inflation	-.208	-.041	-.042	.049	.033	.092
	(.259)	(.122)	(.123)	(.093)	(.127)	(.120)
Intrate	-.061	-.015	-.048	.005	-.126***	-.160***
	(.057)	(.077)	(.067)	(.052)	(.047)	(.047)
Urban	-.146	-.589	-.519	-.635	.313	.405*
	(.337)	(.579)	(.499)	(.579)	(.249)	(.231)
Schooling	-.353**	-.019	-.036	-.009		
	(.130)	(.159)	(.147)	(.161)		
Excdep	.369	.128	.209		.294**	.308**
	(.233)	(.191)	(.168)		(.126)	(.120)
Minshare	-.817					
Constant	-.886	-1.407	.376	-.516	.370	.425
	(2.721)	(2.932)	(2.403)	(2.469)	(.929)	(.940)
	(.925)					
Obs.	124	138	138	138	181	181
Countries	37	40	40	40	62	62
Hansen p-value	.017	.088	.014	.076	.001	.002
AR(1) p-value	.452	.316	.281	.525	.23	.281
AR(2) p-value	.784	.846	.658	.807	.23	.382

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.16. Arellano-Bond GMM Dynamic Panel Estimates with Top Bracket Statutory Individual Income Tax Rate (Dependent Variable-Currency/M2)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
$(C/M2)_{t-1}$	.557***	.605***	.598***	.597***	.802***	.804***
	(.166)	(.211)	(.217)	(.220)	(.100)	(.100)
Taxrat3	-5.797	4.081	-1.677	-1.620	-.833	
	(8.582)	(7.515)	(1.577)	(1.584)	(1.517)	
Enf	-.411	.543				
	(.616)	(.675)				
Taxrat3*Enf	1.705	-.806	.629*	.616*	.401	.216***
	(2.092)	(1.919)	(.347)	(.339)	(.318)	(.078)
Income	-.026	-.284	-.322	-.326	-.363*	-.394*
	(.322)	(.262)	(.255)	(.247)	(.189)	(.200)
Inflation	.163	.050	.056	.045	-.042	-.018
	(.223)	(.157)	(.161)	(.136)	(.122)	(.114)
Intrate	-.067	.008	-.005	-.008	-.022	-.033
	(.092)	(.100)	(.095)	(.089)	(.064)	(.065)
Urban	.112	-.005	.065	.068	.476	.540**
	(.361)	(.688)	(.674)	(.674)	(.313)	(.257)
Schooling	-.366**	-.012	-.036	-.035		
	(.148)	(.148)	(.153)	(.155)		
Excdep	-.004	-.064	-.025		.088	.082
	(.138)	(.178)	(.186)		(.156)	(.154)
Minshare	.088					
Constant	-.471	-1.245	.969	1.043	.622	.513
	(3.359)	(3.507)	(1.671)	(1.401)	(1.641)	(1.538)
	(.637)					
Obs.	142	153	153	153	232	232
Countries	41	41	41	41	57	57
Hansen p-value	.021	.064	.053	.049	.003	.005
AR(1) p-value	.076	.323	.185	.172	.353	.343
AR(2) p-value	.968	.754	.755	.811	.756	.651

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.17. Author's Underground Economy (Percentage of GDP)

Countries	*Underground Economy*	*Countries*	*Underground Economy*
Argentina	6.3	Latvia	3.0
Azerbaijan	14.8	Lithuania	3.7
Bolivia	13.6	Malawi	45.1
Botswana	7.7	Malaysia	7.1
Brazil	10.1	Malta	5.4
Bulgaria	8.6	Morocco	8.2
Cameroon	39.4	Mozambique	23.3
Chile	12.9	Nicaragua	41.3
China	16.2	Nigeria	22.6
Colombia	9.5	Papua New Guinea	16.8
Congo, Rep.	31.0	Peru	9.6
Costa Rica	4.5	Philippines	25.1
Croatia	9.0	Poland	6.9
Cyprus	8.0	Russia	3.5
Czech Republic	3.5	Senegal	36.9
Dominican Republic	6.8	Slovak Republic	5.2
Ecuador	10.0	Slovenia	7.4
El Salvador	20.2	South Africa	5.3
Estonia	2.1	Sri Lanka	18.0
Gabon	9.8	Tanzania	66.7
Ghana	14.4	Thailand	20.8
Guatemala	8.2	Trinidad and Tobago	9.2
Guyana	13.3	Uganda	14.2
Honduras	23.2	Ukraine	9.4
Hungary	4.0	Venezuela	6.6
Indonesia	28.5	Vietnam	25.3
Jamaica	10.2	Zambia	58.8
Kenya	44.0	Zimbabwe	12.5

Table 1.18. Schneider's Estimates of the Underground Economy, Percentage of GDP

Country	*Koyame's Estimates**	*Author's Estimates*
Botswana	1.6	7.7
Congo, Dem. Rep.	17.5	---
Kenya	3.5	44
Malawi	2.3	45.1
Niger	8.3	---
Senegal	10.2	36.9
Zambia	9.4	58.8
Zimbabwe	3.2	12.5

*Source: Koyame (1996). The under ground economy estimate are percentage of GNP.

Table 1.19. Schneider's Estimates of the Underground Economy, Percentage of GDP

Countries	*Underground Economy*	Countries	*Underground Economy*
Argentina	25.4	Latvia	39.9
Azerbaijan	60.6	Lithuania	30.3
Bolivia	67.1	Malawi	40.3
Botswana	33.4	Malaysia	31.1
Brazil	39.8	Malta	---
Bulgaria	36.9	Morocco	36.4
Cameroon	32.8	Mozambique	40.3
Chile	19.8	Nicaragua	45.2
China	13.1	Nigeria	57.9
Colombia	39.1	Papua New Guinea	36.1
Congo, Rep.	48.2	Peru	59.9
Costa Rica	26.2	Philippines	43.4
Croatia	33.4	Poland	27.6
Cyprus	---	Russia	46.1
Czech Republic	19.1	Senegal	45.1
Dominican Republic	32.1	Slovak Republic	18.9
Ecuador	34.4	Slovenia	27.1
El Salvador	46.3	South Africa	28.4
Estonia	38.4	Sri Lanka	44.6
Gabon	---	Tanzania	58.3
Ghana	41.9	Thailand	52.6
Guatemala	51.5	Trinidad and Tobago	---
Guyana	---	Uganda	43.1
Honduras	49.6	Ukraine	52.2
Hungary	25.1	Venezuela	33.6
Indonesia	19.4	Vietnam	15.6
Jamaica	36.4	Zambia	48.9
Kenya	34.3	Zimbabwe	59.4

Source: Schneider (2004)

Table 1.20. Summary Statistics, Comparison of Authors and Schneider's Estimates of Underground Economy

Estimates	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Author's	56	16.2	14.2	2.1	66.7
Author's	51	16.9	14.7	2.1	66.7
Schneider	51	38.6	12.6	13.1	67.1

Figure 1.1. Regression of Author’s and Schneider’s Estimates of Underground Economy

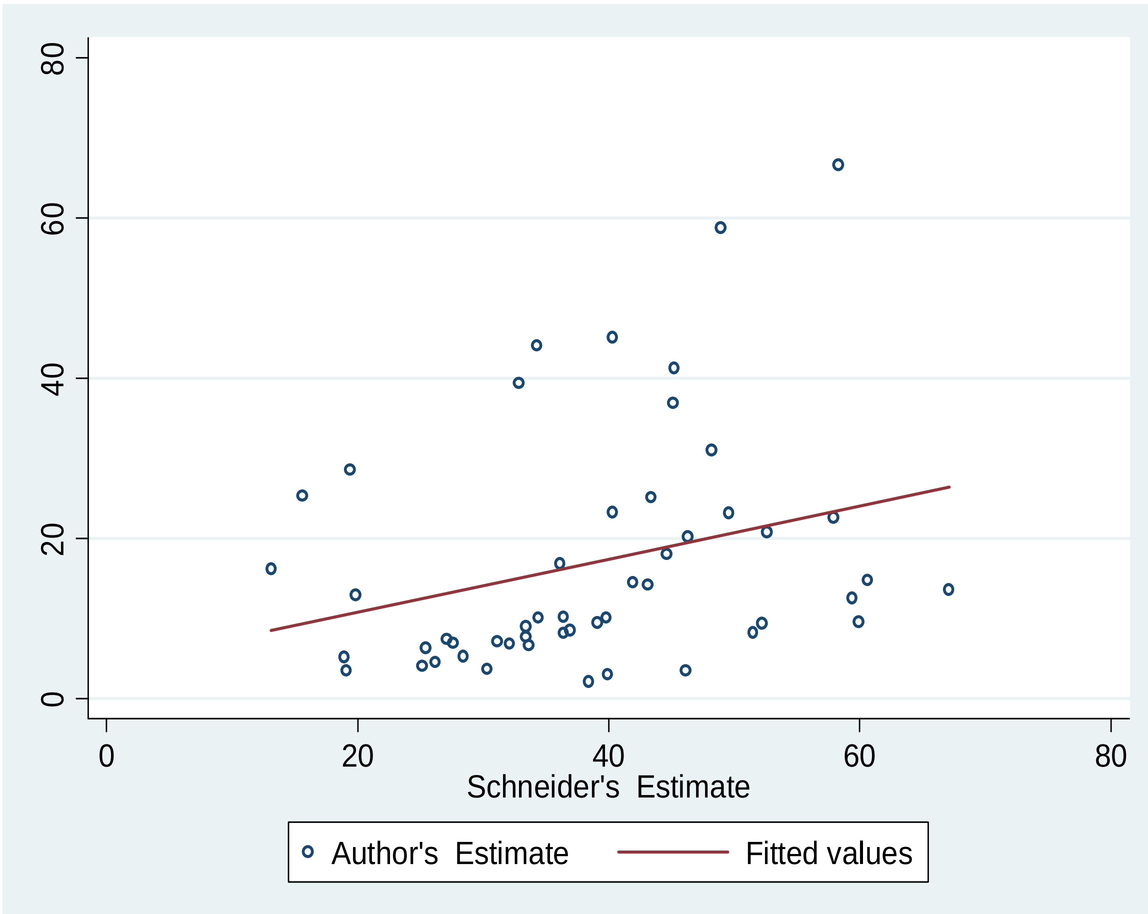
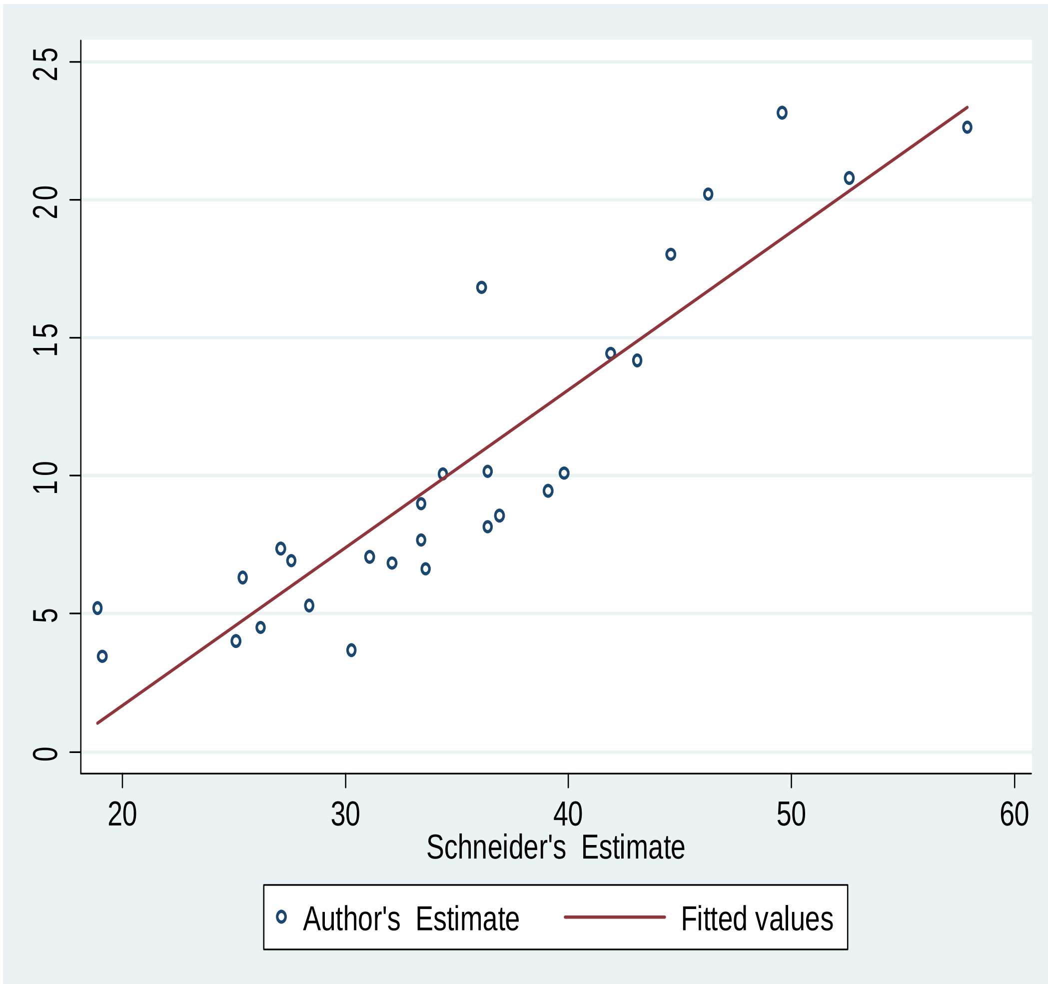


Figure 1.2. Regression (Outlier removed) of Author's and Schneider's Estimates of Underground Economy



Appendix B. Appendix to Essay II

Table 2.1. Summary Statistics

Variables	*Obs.*	*Mean*	*Std. Dev.*	*Min.*	*Max.*	*Average growth rate (%)**
C/M2	41	.09	.02	.06	.12	-1.60
CCAP	46	6.52	.924	4.71	8.95	1.42
τ	46	6.64	2.06	3.48	10	1.69
WS	46	59.51	3.23	50.68	63.66	-.004
r	46	13.16	4.66	6.50	22.75	1.06
y	46	168.99	35.96	97.31	244.34	2.04
Gei	45	77.14	27.27	32.01	109.18	2.60
π	45	1.09	.05	1.01	1.19	.02

*The growth rate is exponential. C/M2= Ratio of currency to M2, CCAP=real currency per capita, τ= tax rate, WS=Consumption per GDP, r=interest rate, Gei=Government employment index, y=real GDP per capita, π=the rate of inflation.

Table 2.2. Dickey-Fuller Unit Root Tests

	Levels		*First Difference*	
Variable	*Test Statistic Z(t)*	*Mackinnon Approximate P-value for Z(t)*	*Test Statistic Z(t)*	*Mackinnon Approximate P-value for Z(t)*
C/M2	-3.455	.044	-5.737	.000
CCAP	-2.398	.381	-5.687	.000
τ	-2.138	.525	-7.831	.000
WS	-2.108	.542	-5.790	.000
r	-1.162	.918	-6.579	.000
y	-2.273	.449	-4.280	.003
Gei	.683	.997	-5.843	.000
π	-1.01	.943	-6.081	.000

Table 2.3. Generalized ECM Estimation (Dependent Variable- Real per Capita Currency)

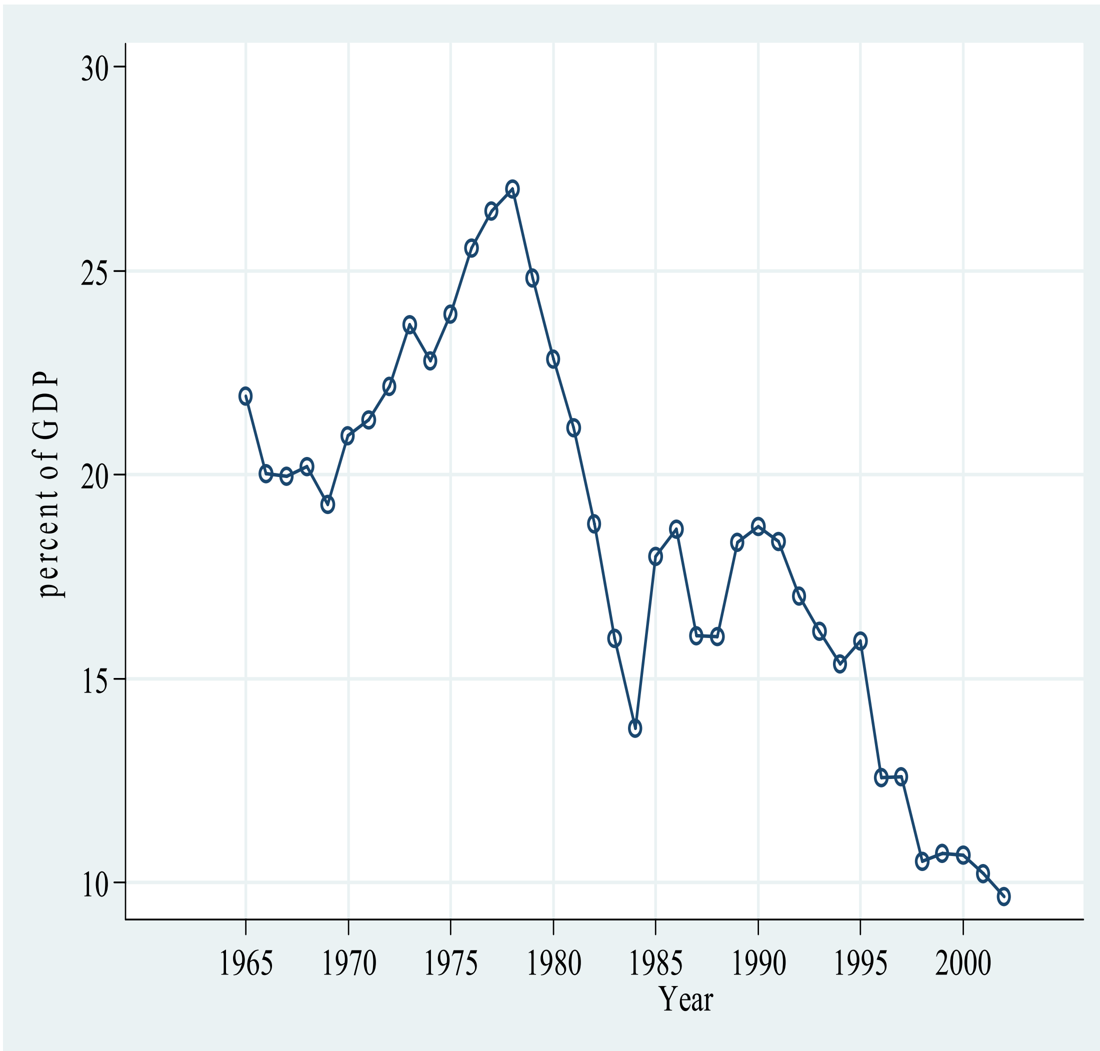
Variables	*Coef.*	*Std. Err.*	*t*	*prob>t*
$(CCAP)_{t-1}$	-.666	.163	-4.08	.000
τ_{t-1}	.188	.099	1.89	.068
WS_{t-1}	-.051	.254	-.20	.842
r_{t-1}	-.001	.071	-.01	.992
y_{t-1}	.594	.199	2.99	.005
Gei_{t-1}	-.270	.131	-2.06	.048
$\Delta \tau$	.216	.118	1.82	.077
ΔWS	.764	.393	1.94	.061
Δr	-.041	.059	-.69	.496
Δy	1.428	.305	4.69	.000
ΔGei	-.125	.290	-.43	.67
Constant	-2.030	1.389	-1.46	.154

Δx denotes the first difference of the variable x. All the variable are in logarithm form.

Table 2.4. Estimate of South African Underground Economy, 1965-2002 (in Percentage of GDP)

Year	*Underground Economy*	*Year*	*Underground Economy*
1965	21.92	1984	13.78
1966	20.03	1985	18.01
1967	19.97	1986	18.67
1968	20.20	1987	16.06
1969	19.27	1988	16.04
1970	20.96	1989	18.35
1971	21.35	1990	18.74
1972	22.17	1991	18.38
1973	23.68	1992	17.03
1974	22.79	1993	16.16
1975	23.94	1994	15.36
1976	25.57	1995	15.93
1977	26.47	1996	12.58
1978	27.00	1997	12.61
1979	24.83	1998	10.52
1980	22.85	1999	10.71
1981	21.16	2000	10.69
1982	18.80	2001	10.23
1983	15.99	2002	9.66

Figure 2.1. Underground Economy for South Africa, percentage of GDP



Appendix C. Appendix to Essay III

Table 3.1. Variable Definitions and Data Sources

Variable	*Units*	*Data Source*
Total population	Millions	South African Reserve Bank (SARB)
White population, as percent of total	Percentage	Statistics South Africa
White personal per Capita Income	Millions of rand	Burea of Market Research (2004)
GDP	Millions of rand	SARB
Government expenditure	Millions of rand	SARB
Disaggregated Government Spending	Millions of rand	Statistics South Africa
Government revenue, taxes	Millions of rand	SARB
Compensation of employees	Millions of rand	SARB
Employment in mining and quarrying, manufacturing, construction and electricity	Thousands	Statistics South Africa
Value of exports and imports	Millions of rand	SARB

Table 3.2. Summary Statistics

Variable	*Obs.*	*Mean*	*Std. Dev.*	*Min.*	*Max.*	*Average growth*
Gov. Expenditure	43	62695	83001	881	285953	15
Real Gov. Expenditure Per capita (G)	43	41	12.6	16	56.2	3.1
Real GDP per Capita	43	20467.35	1772	15690	23354	.83
Population	43	30.6	8.7	17.4	44.8	2.3
Wage Rate	43	1200.6	454.6	664.7	2332	3.1
Openness	43	56.5	6.52	42.3	68.3	.42
Terms of Trade	43	1071.9	113	887	1342	.29
Inflation	42	9.2	4.8	1.28	18.7	7.4
G1	43	27.07	9.59	9.58	41.13	3.64
G2	43	9.48	3.79	4.24	18.19	.05
G3	43	36.55	9.01	16.63	46.85	2.64
G4	43	38.80	9.75	17.39	48.57	2.61
G5	43	2.25	.98	.73	4.04	3.04
Total revenue per expenditure	43	.85	.06	.74	.98	.41
Total tax revenue per expenditure	43	.84	.06	.72	.96	.43
Income tax per expenditure	43	.48	.05	.40	.58	.93
Individual income per expenditure	43	.27	.05	.16	.39	1.34
Corporate income tax per expenditure	43	.21	.06	.09	.35	1.71
Indirect tax per expenditure	43	.38	.05	.26	.47	.72
VAT tax per expenditure	33	.15	.08	.03	.24	6.76

Notes: G1= government consumption; G2=government investment; G3=government consumption plus investment; G4=government spending less interest payments; G5=transfers to households and subsidy for businesses.

Table 3.3. Augmented Dickey-Fuller Tests

	Test for $H_0: I(1)$		Test for $H_0: I(2)$	
Variables	*Test Statistic Z(t)*	*Mackinnon Approximate P-value for Z(t)*	*Test Statistic Z(t))*	*Mackinnon Approximate P-value for Z(t)*
Real government spending per capita	-1.46	.843	-7.81	.000
Real GDP per capita	-2.74	.221	-3.89	.012
White population per capita income	-1.49	.832	-6.63	.000
Population	7.54	1.000	-3.18	.088
Wage Rate	-1.55	.811	-4.09	.007
Terms of Trade	-1.94	.635	-5.24	.001
Openness	-.96	.949	-4.03	.008
G1	-1.684	.758	-5.89	.000
G2	-1.861	.674	-4.03	.008
G3	-1.963	.621	-4.58	.001
G4	-1.858	.676	-4.65	.001
G5	-.643	.977	-6.61	.000
Total revenue per expenditure	-3.34	.050	-6.86	.000
Total tax revenue per expenditure	-3.32	.064	-7.09	.000
Income tax per expenditure	-3.13	.100	-7.97	.000
Individual income per expenditure	-2.44	.359	-5.49	.000
Corporate income Tax per expenditure	-2.01	.596	-6.62	.000
Indirect tax per expenditure	-2.92	.157	-6.68	.000
VAT tax per expenditure	-1.03	.939	-3.49	.000

All variables are in logarithm form. The Mackinnon p-value is the probability at which the hypothesis of a unit root can be rejected.

Table 3.4. Cointegration Results with Real GDP per Capita as the Median Income (Dependent Variable- Real per capita Government expenditure)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*
y	1.410***	1.242***	1.208***	1.178***	1.337***
	(.095)	(.101)	(.081)	(.094)	(.100)
τ	-.606***	-.739***	-.731***	-.777***	-.584***
	(.117)	(.114)	(.092)	(.103)	(.114)
N	1.272***	1.425***	.964***	1.321***	1.141***
	(.113)	(.113)	(.103)	(.093)	(.129)
W	-.262***	-.349***	-.027	-.270***	-.081
	(.094)	(.089)	(.083)	(.076)	(.130)
Openness		.253***			
		(.080)			
TOT			.440***		
			(.081)		
TOT*Openness				.036***	
				(.008)	
post94					-.079*
					(.041)
post90					
post75					
post73					
vorster					
botha					
deklerk					
mandela					
mbeki					
Constant	-16.52***	-17.00***	-14.96***	-15.46***	-14.10***
	(1.237)	(1.124)	(.980)	(1.037)	(1.726)
Obs.	43	43	43	43	43
R-squared	.98	.99	.99	.99	.99
Tau-statistics	-3.625	-3.947	-4.840	-4.259	-3.551
Stationary at 10% level?	No	No	Yes	No	No

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
[£] The critical values for testing for cointegration are from Mackinnon (1991). For our sample of T=43, and 4 endogenous variables, the 1%, 5% and 10% percent critical values are approximately -5.02, -4.32, -3.98, respectively; for 5 variables, they are -5.42, -4.70 and -4.43; and for 6 variables, they are -5.78, -5.05 and -4.69.

Table 3.4.-continued.

Variables	*(6)*	*(7)*	*(8)*	*(9)*
y	1.163*** (.134)	1.337*** (.085)	1.263*** (.078)	1.382*** (.193)
τ	-.745*** (.124)	-.584*** (.101)	-.614*** (.090)	-.614*** (.130)
N	1.217*** (.109)	1.031*** (.117)	.966*** (.104)	1.209*** (.226)
W	-.075 (.116)	-.172** (.084)	-.137* (.076)	.012 (.207)
Openness				
TOT				
TOT*Openness				
post94				
post90	-.107** (.043)			
post75		.107*** (.029)		
post73			.137*** (.026)	
vorster				-.062 (.048)
botha				-.097 (.071)
deklerk				-.134 (.090)
mandela				-.206* (.106)
mbeki				-.269* (.137)
Constant	-12.60*** (1.968)	-14.43*** (1.205)	-13.26*** (1.129)	-14.06*** (2.909)
Obs.	43	43	43	43
R-squared	.99	.99	.99	.99
tau-statistics	-3.677	-4.194	-5.027	-4.532
Stationary at 10% level?	No	No	Yes	No

Table 3.5. Cointegration Results with Alternative Measure Median Income (Dependent Variable- Real per capita Government expenditure)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*
y	.226***	.186***	.156***	.166***	1.686***
	(.054)	(.042)	(.047)	(.041)	(.233)
τ	-.499*	-.876***	-.756***	-.905***	-.636***
	(.252)	(.206)	(.214)	(.195)	(.178)
N	.920***	1.328***	.492*	1.080***	.271
	(.302)	(.243)	(.264)	(.220)	(.235)
W	.350	.039	.577**	.189	.044
	(.279)	(.221)	(.233)	(.204)	(.202)
Open		.673***			
		(.127)			
TOT			.797***		
			(.177)		
TOT*Openness				.078***	
				(.013)	
post94					2.296***
					(.361)
post90					
post75					
post73					
vorster					
botha					
deklerk					
mandela					
mbeki					
Constant	.434	-5.400**	-1.435	-2.807	-15.4***
	(2.531)	(2.226)	(2.105)	(1.912)	(3.058)
Obs.	43	43	43	43	43
R-squared	.93	.96	.95	.96	.97
tau-stat.	-2.141	-2.734	-3.227	-3.029	-2.397
Stationary at 10% level?	No	No	No	No	No

Standard errors in parentheses
*significant at 10%; ** significant at 5%; *** significant at 1%
£The alternative measure of median income is one that includes white per capita personal income for the period before 1994

Table 3.5.-Continued.

Variables	*(6)*	*(7)*	*(8)*	*(9)*
y	.086*	.197***	.175***	.096
	(.046)	(.054)	(.049)	(.070)
τ	-.996***	-.480*	-.535**	-.444**
	(.202)	(.241)	(.221)	(.212)
N	1.000***	.659**	.528*	1.159***
	(.220)	(.313)	(.286)	(.373)
W	.536**	.384	.403	.397
	(.205)	(.267)	(.244)	(.343)
Open				
TOT				
TOT*Openness				
post94				
post90	-.333***			
	(.056)			
post75		.147**		
		(.068)		
post73			.222***	
			(.062)	
vorster				.124**
				(.061)
botha				.037
				(.107)
deklerk				-.165
				(.141)
mandela				-.223
				(.170)
mbeki				-.319
				(.212)
Constant	2.928	1.763	2.508	1.366
	(1.887)	(2.498)	(2.287)	(3.264)
Obs.	43	43	43	43
R-squared	.96	.94	.95	.97
tau-stat.	-3.165	-2.376	-2.575	-3.535
Stationary at 10% level?	No	No	No	No

Table 3.6. Cointegration Results with Real GDP per Capita as Median Income (Dependent Variable- Disaggregated Expenditures)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Variables	*Pub. Ord & Safety*	*Comm. & Soc. Serv.*	*Pub. Ord. & Safety*	*Comm. & Soc. Serv.*	*Pub. Ord. & Safety*	*Comm. & Soc. Serv.*
y	-.793	-.079	-.788	-.082	-.284	-.212
	(.510)	(.481)	(.503)	(.487)	(.568)	(.583)
τ	-.053	-.282	-.005	-.313	.075	-.316
	(.230)	(.217)	(.230)	(.223)	(.230)	(.236)
N	1.692***	.654*	1.766***	.606	1.701***	.652*
	(.358)	(.337)	(.358)	(.346)	(.338)	(.347)
W	.308*	.294*	.354**	.264*	.132	.340*
	(.149)	(.140)	(.152)	(.147)	(.175)	(.179)
post94			-.048	.031		
			(.040)	(.038)		
post90					.102	-.027
					(.061)	(.062)
Constant	5.151	3.419	5.161	3.412	-1.118	5.055
	(6.745)	(6.355)	(6.650)	(6.432)	(7.370)	(7.568)
Obs.	20	20	20	20	20	20
R-squared	.98	.94	.98	.94	.99	.94
tau-stat.	-4.625	-3.885	-5.217	-4.504	-4.827	-4.048
Stationary at 10% level?	Yes	No	Yes	No	Yes	No

Standard errors in parentheses.
significant at 10%; ** significant at 5%; *** significant at 1%
£For sample size of T=20, and 4 endogenous variables, the 1%, 5% and 10% percent Mackinnon critical values are approximately -5.66, -4.69, -4.24, respectively; for 5 variables they are -6.16, -5.15 and -4.68; for 6 variables they are -6.66, -5.59, -5.09.

Table 3.7. Cointegration Results with Alternative Measure of Median Income (Dependent Variable- Disaggregated Expenditures)

Variables	*Pub. Ord. & Safety*	*Comm. & Soc. Serv.*	*Pub. Ord. & Safety*	*Comm. & Soc. Serv.*	*Pub. Ord. & Safety*	*Comm. & Soc. Serv.*
y	.030	-.022	-1.269**	-.436	.034	-.023
	(.029)	(.026)	(.491)	(.520)	(.025)	(.027)
τ	-.277	-.331**	.317	-.142	.077	-.382*
	(.170)	(.150)	(.266)	(.282)	(.203)	(.215)
N	2.152***	.652**	2.492***	.760**	1.860***	.693**
	(.263)	(.233)	(.257)	(.272)	(.254)	(.270)
W	.235	.250*	.223*	.246*	.119	.267*
	(.140)	(.124)	(.118)	(.125)	(.129)	(.137)
post94			-1.880**	-.599		
			(.710)	(.752)		
post90					.123**	-.018
					(.049)	(.052)
Constant	-5.230**	2.585	7.884	6.761	-4.972***	2.548
	(1.777)	(1.570)	(5.174)	(5.479)	(1.530)	(1.622)
Obs.	20	20	20	20	20	20
R-squared	.98	.94	.99	.95	.94	.70
tau-stat.	-5.325	-4.551	-5.913	-4.480	-5.644	-4.725
Stationery at 10% level?	Yes	Yes	Yes	No	Yes	Yes

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
£The alternative measure of median income is one that includes white per capita personal income for the period before 1994

Table 3.8. Cointegration Results with Real GDP as proxy for Median Income (Dependent Variable- Other Classifications of Disaggregated Government Expenditures)

Variables	*(1)*[+]	*(2)*[++]	*(3)* [+++]	*(4)* [++++]	*(5)* [+++++]
y	.875***	3.357***	1.506***	1.442***	.576
	(.126)	(.305)	(.145)	(.144)	(.400)
τ	-.417***	-.647**	-.556***	-.604***	-1.320***
	(.116)	(.280)	(.134)	(.132)	(.368)
N	1.571***	-1.377***	.702***	.860***	3.511***
	(.102)	(.246)	(.118)	(.116)	(.323)
W	-.127	.441	.067	-.028	-1.709***
	(.109)	(.264)	(.126)	(.124)	(.346)
post90	-.146***	-.316***	-.129***	-.144***	-.361***
	(.041)	(.098)	(.047)	(.046)	(.129)
post94					
Constant	-11.66***	-23.524***	-13.363***	-13.856***	-28.603***
	(1.845)	(4.460)	(2.130)	(2.103)	(5.852)
Obs.	43	43	43	43	43
R-squared	.99	.94	.98	.98	.93
Tau-stat.	-3.447	-4.012	-3.529	-3.681	-4.483
Stationery	No	No	No	No	Yes

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
[+] Government consumption
[++] Government investment
[+++] Government consumption plus investment
[++++] Government spending less interest payments
[+++++] Government transfers for households and subsidy for businesses

Table 3.8.-continued

Variables	*(6)*[+]	*(7)*[++]	*(8)*[+++]	*(9)*[++++]	*(10)*[+++++]
y	1.087***	4.001***	1.709***	1.665***	1.136***
	(.090)	(.245)	(.107)	(.106)	(.294)
τ	-.189*	-.209	-.360***	-.383***	-.768**
	(.103)	(.280)	(.123)	(.121)	(.336)
N	1.422***	-1.368***	.599***	.738***	3.209***
	(.116)	(.317)	(.139)	(.137)	(.379)
W	-.070	.101	.077	-.007	-1.662***
	(.118)	(.321)	(.140)	(.139)	(.384)
Post90					
Post94	-.136***	-.093	-.102**	-.119***	-.295**
	(.037)	(.101)	(.044)	(.043)	(.120)
Constant	-12.85***	-32.242***	-14.947***	-15.489***	-32.77***
	(1.564)	(4.254)	(1.861)	(1.837)	(5.094)
Obs.	43	43	43	43	43
R-squared	.99	.93	.97	.98	.93
Tau-stat.	-3.012	-3.331	-3.146	-3.264	-4.296
Stationary at 10% level?	No	No	No	No	Yes

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
[+] Government consumption
[++] Government investment
[+++] Government consumption plus investment
[++++] Government spending less interest payments
[+++++] Government transfers for households and subsidy for businesses

Table 3.9. Cointegration Results with Real GDP per Capita as Median Income and With Different Tax Shares (Dependent Variable- Real per capita Government expenditure)

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
y	1.410***	1.572***	1.234***	1.704***	1.269***	1.103***	1.276***
	(.095)	(.107)	(.151)	(.171)	(.243)	(.099)	(.093)
N	1.272***	1.073***	1.547***	1.213***	1.882***	1.609***	1.277***
	(.113)	(.147)	(.128)	(.180)	(.210)	(.094)	(.112)
W	-.262***	-.122	-.403***	-.347***	-.599***	-.392***	-.154*
	(.094)	(.119)	(.114)	(.116)	(.106)	(.077)	(.086)
T1	-.606***						
	(.117)						
T2		-.539***					-.377***
		(.119)					(.091)
T3			-.178*				
			(.099)				
T4				-.139**			
				(.057)			
T5					-.105***		
					(.029)		
T6						-.480***	-.396***
						(.076)	(.067)
Constant	-16.5***	-16.8***	-16.8***	-19.9***	-19.6***	-5.86***	-15.0***
	(1.237)	(1.293)	(1.799)	(1.504)	(3.377)	(1.154)	(.986)
Obs.	43	43	43	43	33	43	43
R-squared	.98	.98	.98	.98	.92	.99	.99
Tau-stat.	-3.625	-3.986	-3.459	-3.873	-5.237	-4.343	-4.774
Stationary at 10% level?	No	Yes	No	No	Yes	Yes	Yes

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
T1=Total tax share
T2=Total income and wealth tax share
T3=Individual income and wealth tax share
T4=Corporate income tax share
T5=VAT tax share
T6=Production and imports tax share

Figure 3.1. Government Expenditure (in Millions of Rand and Constant 2000 Prices)

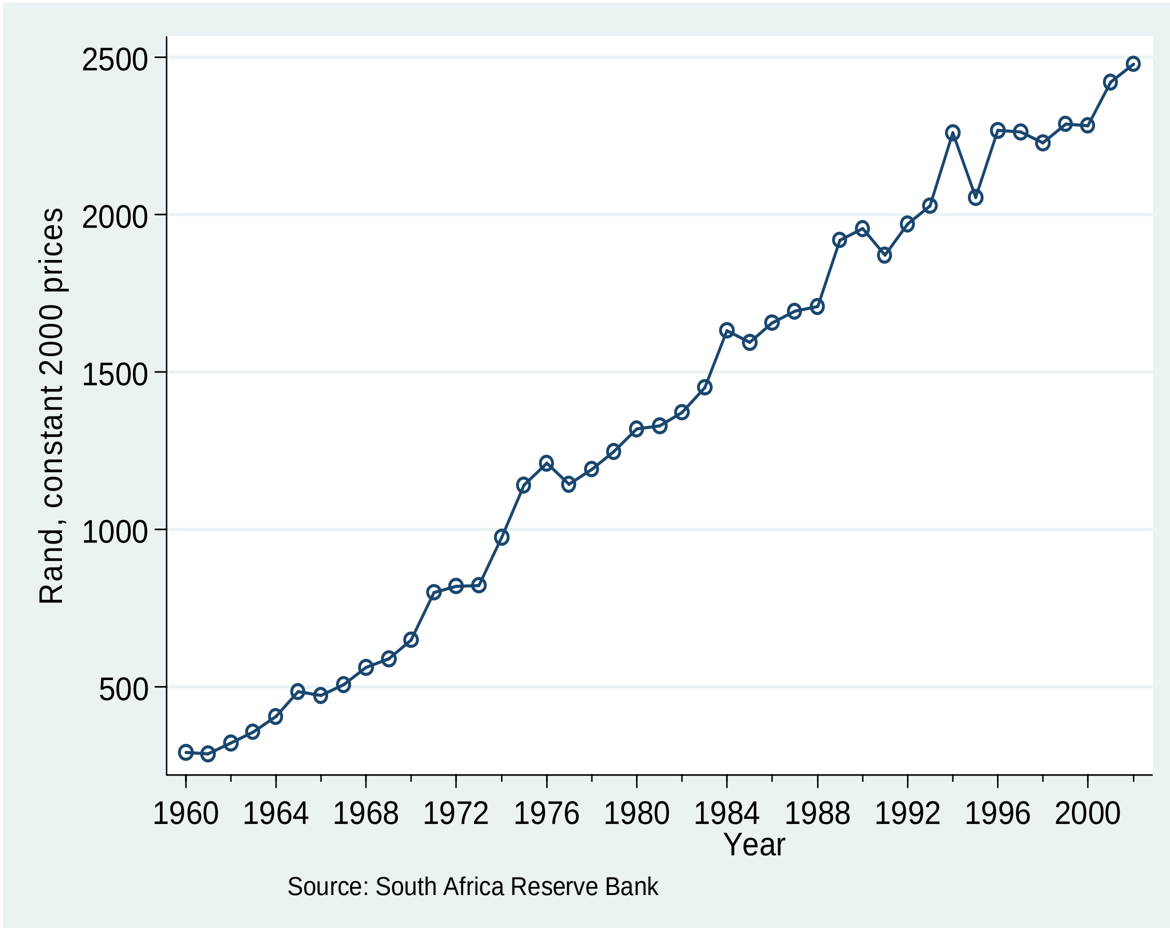


Figure 3.2. Government Expenditure per Capita (in Constant 2000 Prices)

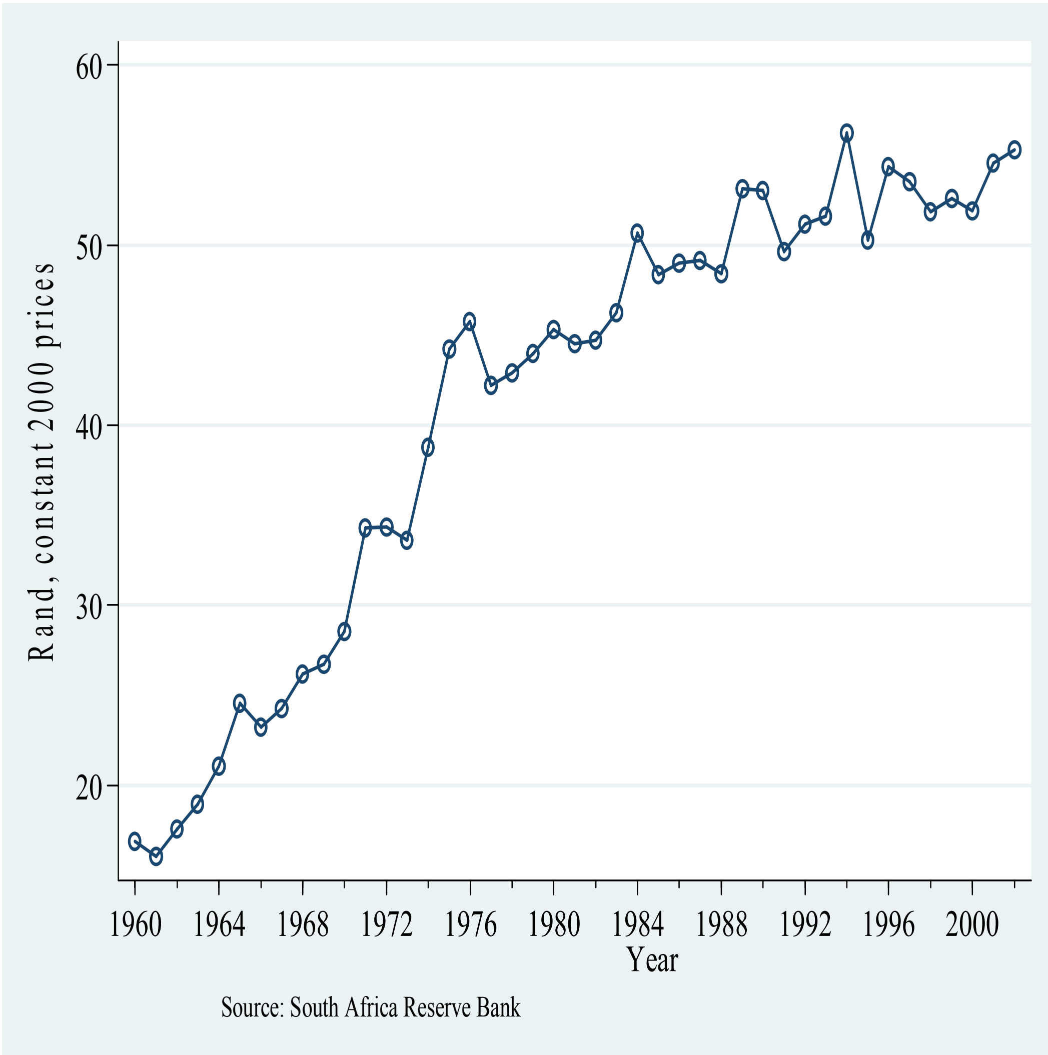


Figure 3.3. Government Expenditure Percentage of GDP

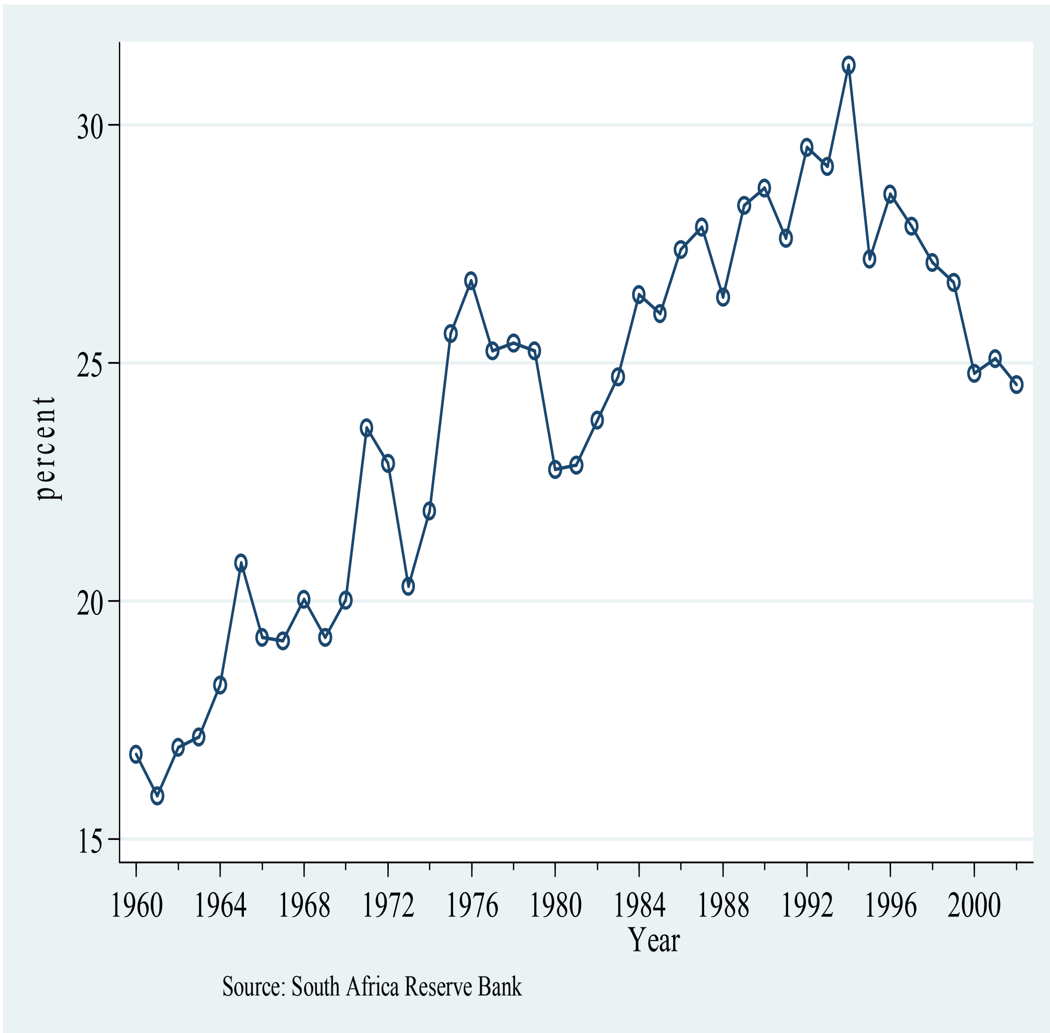


Figure 3.4. GDP per Capita (in Constant 2000 Prices)

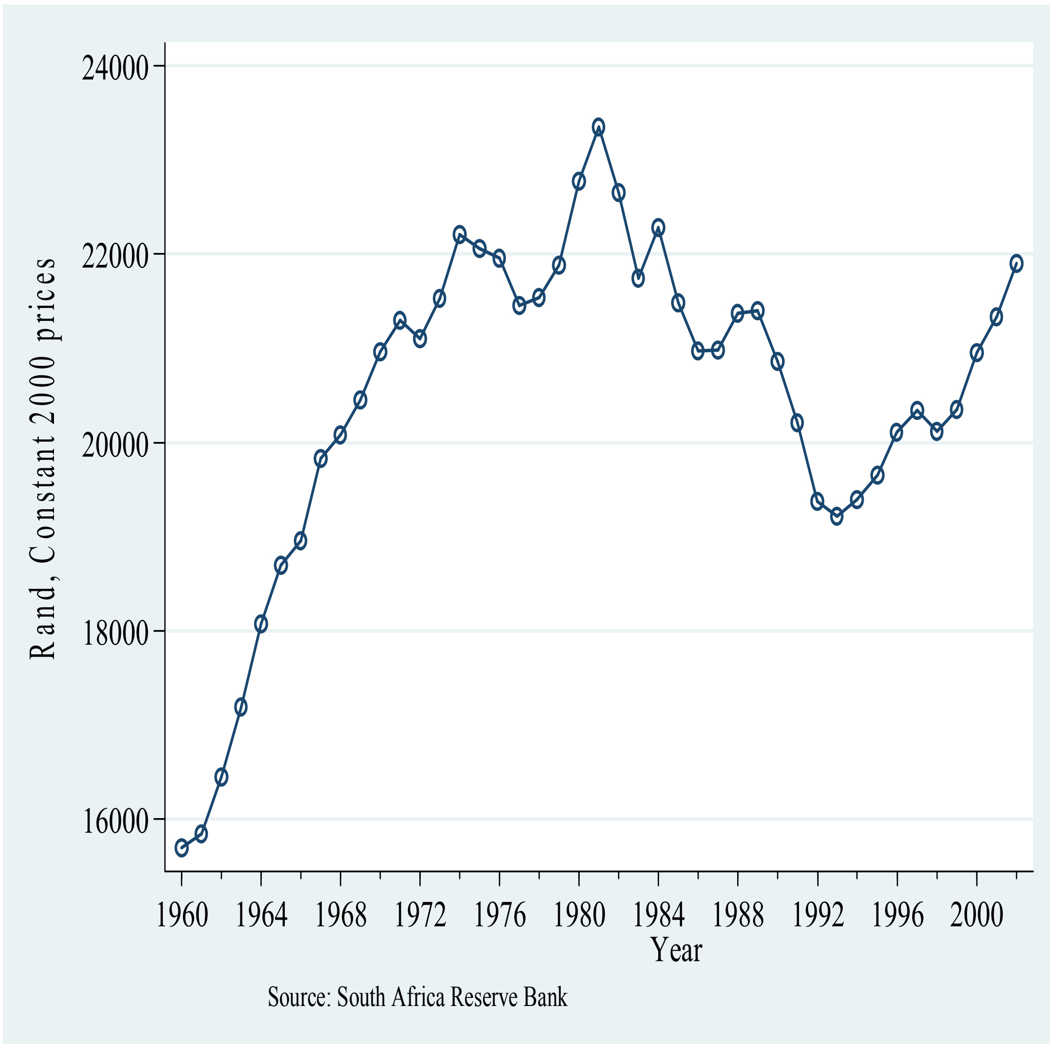
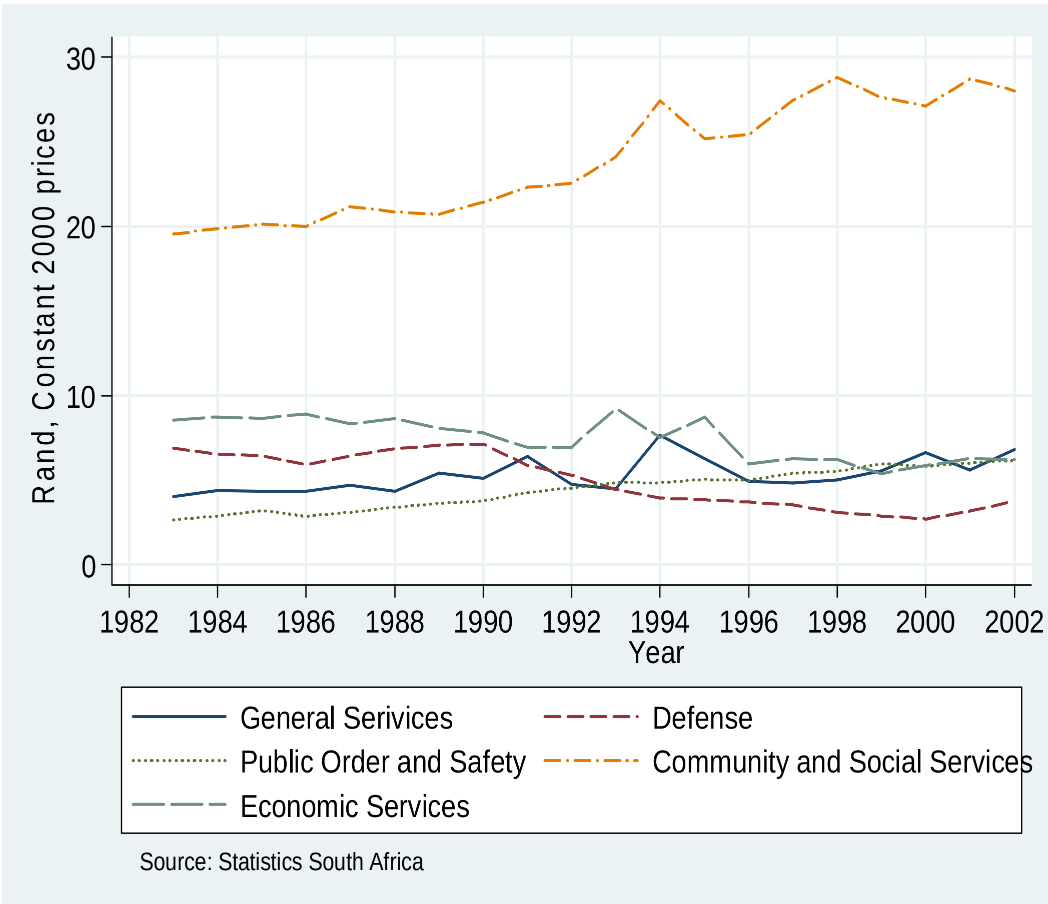


Figure 3.5. Disaggregate Government Spending per Capita, Constant 2000 Prices



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While pursuing his doctorate, Embaye worked as Graduate Research Assistant and later Teaching Assistant at the Department of Economics and was involved in a number of research projects in public finance and macroeconomics. Embaye was twice (2002 and 2003) recipient of the Carolyn McClain Young Leadership Fund Award in recognition of his excellent academic performance. Embaye has also tutored and taught a number of undergraduate classes in Microeconomics during his PhD studies.

Embaye's research interests are in the field of public economic, particularly in the area of tax evasion and government spending. In addition, he has keen interest in macroeconomics and applied econometrics. His current research focuses on tax evasion and government spending in developing countries.