



**Midlands State University**  
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**FACULTY OF COMMERCE**

**DEPARTMENT OF ECONOMICS**

**INVESTIGATING THE IMPACT OF THE SHADOW ECONOMY ON TAX  
REVENUE PERFORMANCE IN ZIMBABWE (1980-2015)**

**BY:**

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This dissertation is submitted to the department of Economics in partial fulfillment of the requirements for the Bachelor of Commerce Economics Honours Degree.

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**SUPERVISOR’S APPROVAL FORM**

The undersigned certify that they have supervised Lawrence Peter’s dissertation entitled: Investigating the impact of the shadow economy on tax revenue performance in Zimbabwe (1980-2015), submitted in partial fulfillment of the requirements for the Bachelor of Commerce Economics Honors Degree at the Midlands State University.

**SIGNATURE**

CHAPTER ONE .....

CHAPTER TWO .....

CHAPTER THREE .....

CHAPTER FOUR .....

CHAPTER FIVE .....



**DECLARATION**

I, Lawrence Peter, do hereby declare that this research represents my own work, and that it has never been previously submitted for a degree to this or any other university.

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(Student's Signature)

Date

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(Supervisor's Signature)

Date

## **DISCLAIMER**

This dissertation is submitted in partial fulfillment of the Bachelor of Commerce Honors Degree in Economics at Midlands State University. The ideas in this dissertation represent solely those of the author. Therefore, the University, Economics Department and the Supervisor are not liable for errors and mistakes in this dissertation.

## **DEDICATION**

This piece of work is dedicated to my father, Mr Thomas Peter. His vision steered this wonderful journey through thick storms and his words of hope always gave me power to fight harder and give my best.

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## ABSTRACT

*Despite the tax reforms that have been implemented in Zimbabwe over the years, tax revenue collections have failed to reach sustainable levels that promote growth, development, improve standards of living and most importantly ease the persistent budget deficit problem. One of the major potential threats to tax revenue performance is the shadow economy; it plays a significant role in deteriorating the tax base and this often diminishes tax potential. This motivated an analysis on the potential impact of the shadow economy on tax revenue performance, with the aim of coming up with policy recommendations that will revive the tax performance, help ease the budget deficit problem and boost economic performance. Using annual time series data stretching from 1980 to 2015 and OLS regression, the study examined the impact of the shadow economy on tax revenue performance with a model that included other determinants of tax revenue such as foreign direct investment, government consumption, inflation, real interest rate, agricultural sector share of GDP and manufacturing sector share of GDP. The research results revealed that the shadow economy has a positive significant impact on tax revenue and also indicated that foreign direct investment, government consumption, real interest rate and inflation are compellingly significant in determining tax revenue performance. The study recommend the need to formulate policies that are aimed at enhancing the tax administrative capacity, enforcing voluntary compliance and supporting the informal sector through infrastructure development since it contributes to the well-being of the economy.*



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## ACRONYMS

ADF	Augmented Dickey Fuller
ARDL	Auto Regressive Distributed Lag
CLRM	Classical Linear Regression Model
ESA	European System of Accounts
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GNP	Gross National Product
GNU	Government of National Unity
IMF	International Monetary Fund
MIMIC	Multiple Indicators Multiple Causes
MOF	Ministry of Finance
OLS	Ordinary Least Squares
RBZ	Reserve Bank of Zimbabwe
VAT	Value Added Tax
ZIMRA	Zimbabwe Revenue Authority
ZIMSTAT	Zimbabwe National Statistical Agency

# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

The shadow economy according to Gutmann (1977) refers to economic activity which is not represented in the national accounts, and in which a substantial part escapes both indirect and direct taxation. The shadow economy phenomenon has been an ongoing subject of much controversy among tax authorities and policy makers since the shadow economy's growth bears essential implications on tax revenue performance. An increase in the size of the shadow economy frequently creates problems for governments and policy makers since it often deprives the government of the much needed tax revenue. The expansion of the shadow economy is often a consequence of increased regulations in the official economy, poor administration, the presence of corruption in government operations and increasing tax burdens, among other factors.

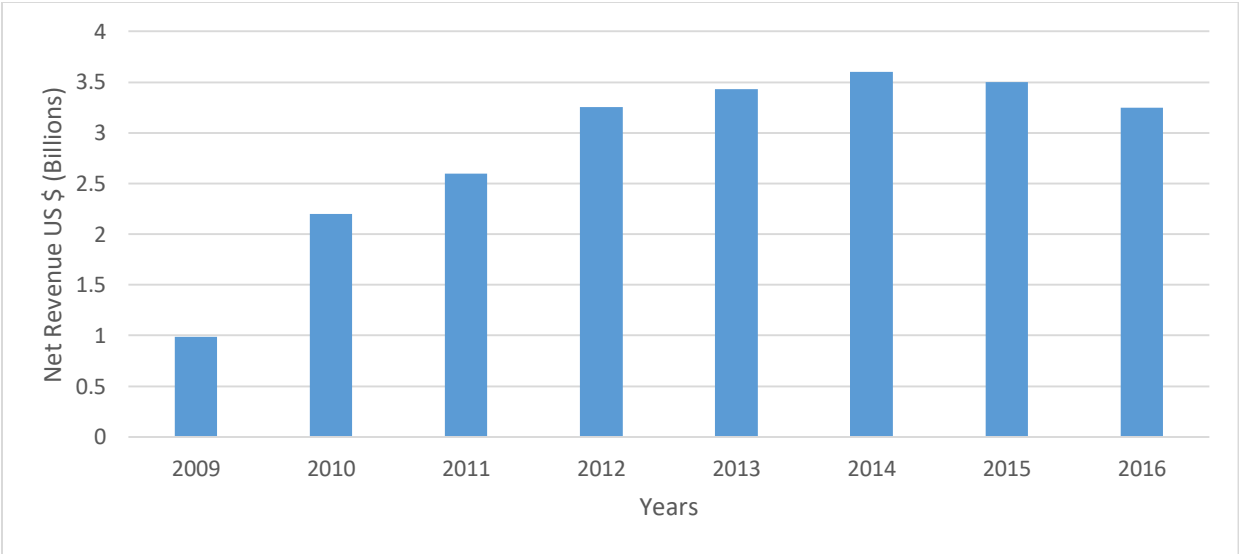
However, according to Greenidge (2005) the shadow economy empowers innovation and entrepreneurship, instigates a decrease in the prices of the official economy, provides employment and a source of income, and generates income which is spent in the official economy. All these factors in turn positively impacts tax revenue performance. Therefore, because of these potential positive and negative implications, the shadow economy and its impact on tax revenue is a pervasive phenomenon that needs to be economically analyzed.

### 1.1 Background of the Study

The government of Zimbabwe over the years has faced massive challenges in raising revenues to sustainable levels that promote economic growth, development and improve standards of living. Unrealized revenues from various sectors of the economy continue to harm the tax revenue generation capacity of the government. Dependency on International donor institutions such as the International Monetary Fund (IMF) and the World Bank, and other regional financiers remained the major source of revenue to bail out the nation in realizing the socially desirable government expenditure. After the emergence of the multicurrency regime in 2009, the tax revenue performance was revived. However, problems such as the massive liquidity crunch, and

the erratic power supplies crippled most operations in the economy and somehow hindered the tax revenue potential in the years that followed. This was reflected by the failure to meet targets set by the Ministry of finance in years 2013 up to 2016. According to ZIMRA (2013) many challenges that created a difficult business environment hindered tax revenue collection. Net revenue collections amounted to US\$3.43 billion against a target of US\$3.64 billion resulting in a negative variance of 6%. Although the year 2014 provided net revenue collections of US\$3.6 billion, the targeted revenue of US\$3.82 billion was not realized.

In 2015 net revenue accumulations amounted to US\$3.5 billion against an objective of US\$3.76 billion. This mirrored the quelled condition of the economy. A ZIMRA (2016) report affirmed that the budget deficit in 2016 kept on expanding as the public sector seriously crowds out the private sector for the constrained US dollar accessible. Subsequently, without any noteworthy significant foreign direct investment, the economy had low investment levels, declining employment levels and low income levels. Consequently, aggregate demand for goods and services continued to fall and this had an unfavorable impact on all tax heads during the year and net revenue collections further declined from US\$3.5 billion to US\$3.248 billion against a target of US\$3.607 billion. The revenue performance from 2009 to 2016 is depicted below in Figure 1.1.



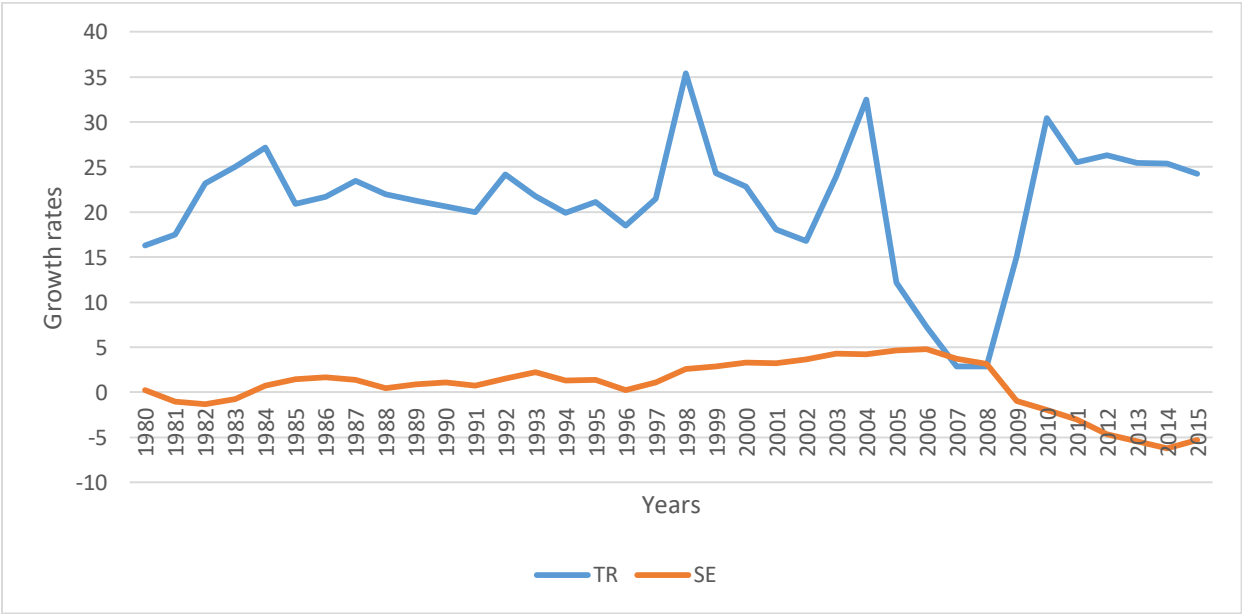
**FIGURE 1.1: Bar graph of Net Revenue (2009-2016).**

**Source: ZIMRA (2016)**



As depicted in Figure 1.1, there was an upward rise in the revenues that were collected by ZIMRA from 2009 to 2014. According to Dzingirai and Tambudzai (2014), the inception of the inclusive government and the adoption of a multicurrency regime in 2009 stabilized the economy and this was reflected by the upward trend in tax revenue collections. However years subsequent to 2014 saw a reduction in tax revenue collections and this was a consequence of the suppressed growth due to low productivity and capacity utilization and other macroeconomic factors (ZIMRA, 2016).

The suppressed revenue collections from the year 2013 up to 2016 coincide with a growing shadow economy and this correlation is likely going to perpetuate into the future if tax compliance measures are not enforced (ZIMRA, 2016). The trends of shadow economy growth and tax revenue as a percentage of GDP are shown in Figure 1.2.



**FIGURE 1.2: Trends of Tax Revenue and Shadow Economy (1980-2015).**

**Source: World Bank (2016) and IMF (2016).**

The trends in Figure 1.2 depict the oscillations of tax revenue performance and the shadow economy growth from 1980 to 2015. From 1980 to 1982 it can be seen that the shadow economy decreased while during the same period tax revenue performed well with 1982 recording a higher share of GDP as compared to 1980. From 1983 to 2008 the relationship between the two variables was not clear since at some points general observation would give a positive

relationship and at other points a negative relationship. However in 2009 and subsequent years up to 2014, decreasing levels of the shadow economy were related to higher levels of tax revenue contribution to GDP. This unpredictable behavior gives more enthusiasm on the relationship between the shadow economy and tax revenue performance.

Furthermore, introspection of Figure 1.2 somehow may not be enough to provide a convincing illustration of the relationship between the shadow economy growth and the tax revenue performance, which therefore makes the current study beneficial. Although tax contribution to GDP is being hindered by the current unfavorable economic conditions, tax revenue is currently performing well considering regional averages. However, the persistent budget deficits and negative variances between the actual and the targeted revenue collections remain a cause for concern. The current economic condition which has seen the tax base shrink continue to pose serious threats to the tax potential of the economy, therefore motivating the need to analyze the impact of the shadow economy on tax revenue performance in order to ascertain measures on curbing its influence and realize the maximum potential of the tax system in Zimbabwe.

## **1.2 Statement of the Problem**

Over the past two decades Zimbabwe has faced challenges in tax revenue generation. As highlighted in the background, 2015 has seen an increase in the size of the informal sector and this is a consequence of the massive deindustrialization and an array of other macroeconomic problems prevailing in the economy. In response, tax contribution to GDP has fallen accordingly. The tax structure over the years has failed to raise adequate revenues to finance government expenditure thereby encouraging domestic borrowing and seeking external finances. However, since external funds could no longer be relied on, the alternative therefore became the need to raise money through taxation and the continuous revision of the tax structure. Various tax reforms were implemented with the view of increasing the tax base in an attempt to reduce the size of the informal sector and boost revenue productivity. Despite these efforts, the tax system still remained less efficient in generating sufficient revenue and continued to drive the government to run unstable budget deficits. The negative variances between the actual and the targeted revenue collections which according to ZIMRA are a result of the rising informal sector, and the unstable economic conditions prevailing, gives more enthusiasm on the need to

investigate the potential impact of the shadow economy on tax revenue performance in Zimbabwe.

### **1.3 Objectives of the Study**

- To analyze the impact of the shadow economy on tax revenue performance.
- To find other factors that influence tax revenue performance.
- To come up with policy recommendations that would help the government to rediscover the full potential of the tax system.

### **1.4 Significance of the Study**

The major aim of the study is to cover the gap that previous studies left. Various studies were carried out in Zimbabwe on the shadow economy notably by Makochehanwa (2010), Ndedzu *et al* (2013), Nhavira (2015) and others. It is quite important to note that the majority of these studies in literature focused on the measurement of the shadow economy and failed to give a convincing analysis on the direct relationship between tax revenue performance and the shadow economy. Nhavira (2015) measured the size of the shadow economy using the Tanzi approach of currency demand and estimated the revenues lost through tax evasion for the period 1980 to 2013. Makochehanwa (2010) only came up with the estimates of the shadow economy using the Tanzi approach while Ndedzu *et al* (2013) analyzed the productivity of Zimbabwe's overall tax system on the basis of estimates of tax buoyancy. Moreover, there is undeniable scarcity of empirical studies that attempted to use the electricity consumption approach in measuring the growth of the underground economy. Ndedzu *et al* (2013) and Nhavira (2015) opted to use the currency demand approach.

On this backdrop, the current study will cover the gap in literature by providing a relevant analysis on the impact of the shadow economy on tax revenue performance adopting the electricity consumption approach. The existence of inadequate literature in Zimbabwe on this phenomenon gives the study a fertile ground to investigate accordingly using current data stretching from 1980 to 2015.

## **1.5 Hypothesis**

H<sub>0</sub>: The shadow economy has no impact on tax revenue performance in Zimbabwe.

## **1.6 Limitations of the Study**

During the compilation of this research quite a number of challenges were faced. Neglecting these challenges would limit the precision of the estimated parameters and consequently reduce reliability and validity of the results. The major challenge was related to the specification of the model. The required data for some of the variables was limited considering the span of the research period. This forced the researcher to drop some of the variables and adopt some other variables in an attempt to specify a model that would reflect the true impact of the shadow economy on tax revenue performance and by so doing improve reliability and validity of the study.

## **1.7 Delimitations of the Study**

This study provides an analysis on the impact of the shadow economy on tax revenue performance in Zimbabwe during the period 1980 to 2015. The chosen period is sufficient to provide a realistic investigation on the underlying phenomenon.

## **1.8 Organization of the Study**

The subsequent chapters are organized as follows:

Chapter 2 will analyze the literature on the foregoing phenomenon. Both theoretical and empirical literature will be critically analyzed to build the foundation upon which the current study will emerge. Chapter 3 presents the methodology of the study, specifies the model and justifies the variables of the model on the basis of empirical research. In Chapter 4 the model will be estimated and the diagnostic tests will be carried out. Presentation and interpretation of the results will be done in Chapter 4 as well. Chapter 5 will conclusively provide policy recommendations and finally suggests areas of possible future study.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.0 Introduction

The chapter will analyse and evaluate the existing theories and empirical studies that have been undertaken on taxation and the shadow economy across the world. A thorough review of these works will facilitate and guide the current study on how the shadow economy affects the tax revenue performance in Zimbabwe.

#### 2.1 Theoretical Literature Review

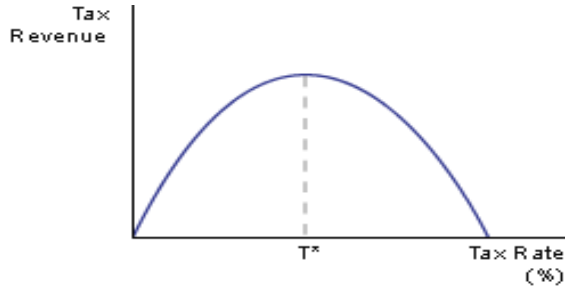
Smith (1994) defines the shadow economy as market-based production of goods and services, whether illegal or legal, that eludes detection in the official estimates of GDP. In general, it refers to all those economic activities whose income circumvents government regulation and observation. The shadow economy thus focuses on productive economic activities that would regularly be incorporated into the national records but which remain underground due to tax or regulatory burdens. Since in literature there is an overabundance of names suggestive of different situations of this classification of economy called shadow, black, unofficial, irregular, unobserved, and informal, etc. many researchers normally employ shadow economy, underground economy and informal economy as the standard terms.

Several approaches are useful for estimating the size of the shadow economy, and among these are; the electricity consumption approach, the currency demand approach, the employment approach and the multiple indicators multiple causes model approach (MIMIC). However the electricity consumption approach and the currency demand approach are commonly used. Kaufmann and Karliberda (1996) developed the electricity consumption approach arguing that electricity power consumption is regarded as the single best physical indicator of overall economic activity. They pointed out that electricity consumption has been empirically observed throughout the world to move in sync with GDP with elasticity usually close to one. This suggests that the growth of total electricity consumption is an indicator for growth of overall (official and unofficial) GDP. By having this proxy measurement for the overall economy and

then subtracting from this overall measure the estimates of official GDP, an estimate of the unofficial GDP can be derived. Although this method is appealing and simple, it can be criticized on various grounds. In this respect, it is important to note that the technique neglects those informal sector activities that do not require increased electricity consumption or that utilize other sources of energy.

Tanzi (1980) developed the currency demand approach assuming that shadow economy transactions are undertaken in the form of cash payments so as to leave no noticeable trace for the authorities. An expansion in the extent of the shadow economy will therefore increase the currency demand and this is attributed to the rising tax burden and the rising shadow economy. Although this method is the most commonly used, it has also faced a lot of criticism. Isachsen and Storm (1985) pointed out that not all exchanges in the shadow economy are paid in cash, which therefore suggests that estimation in light of this method is likely to give biased results.

An endeavour on the relationship that exists between the tax revenue yield and the tax rate was the Laffer curve by Laffer (2004). The basic idea behind the connection between the tax revenue yield and the tax rate is that adjustments in tax rates have two effects on revenues: the arithmetic effect and the economic effect. The arithmetic effect is the static effect which states that tax revenues per dollar of tax base will be raised by the amount of the increase in the tax rate. The reverse is equally true for a decrease in tax rates. The economic effect, however, is the less obvious dynamic effect which recognises the positive impact that lower tax rates have on work, output and employment and thereby the tax base by providing incentives to increase these activities.



**FIGURE 2.1: The Laffer Curve**

**Source: Charumbira and Sunde (2011)**

As shown in Figure 2.1, beyond a certain tax rate ( $T^*$ ) people would not regard it as worth working so hard which stimulates informal sector activities and this lack of incentive would lead to a fall in income and therefore a fall in tax revenue. It is important to note that in the real world the curve might look different contingent upon many factors such as the tax system and the ease of movement into the underground activities, the tax rates already in place and the prevalence of legal and accounting-driven tax loopholes among other factors. It can be deduced that an attempt by the government to increase the tax rate beyond a certain level in anticipation of higher tax revenues may have positive effects on the size of the shadow economy through the changes that occur in the tax base. Generally when the shadow economy increases as a result of a higher tax rate the tax revenue yield is bound to decrease, which clearly points out the inverse relationship between the shadow economy and tax revenue performance.

According to Osoro (1995) low tax revenue productivity of the tax system is mainly credited to generous tax exemptions and low compliance originating from both a weak administration and high tax rates. The possible prompt effect of these factors is the erosion of the country's tax base. Erosion of the tax base may lead to reduced tax buoyancy which poses strong implications on the tax revenue performance. Thus, the relationship between the tax buoyancy and the existence of the shadow economy is an indirect but essential one. Accordingly, it is applicable to hypothesize that there is a reverse connection between high buoyancy and the existence of the shadow economy (Osoro, 1995). That is, as the size of the underground economy rises, tax buoyancy is expected to fall and the vice versa is equally true. Charumbira and Sunde (2011) defined buoyancy of a tax system as the responsiveness of tax revenue to changes in national income and Osoro (1995) clarified that high buoyancy of a tax system is a desirable attribute of a tax system because apart from augmenting the revenue productivity, it also enhances the overall fiscal operations in alleviating the undesirable cyclical movements, thereby acting as a fiscal stabiliser.

Loyza (1996) pointed out that in economies where the statutory tax burden is larger than optimal, and where enforcement of compliance is excessively frail, the expansion in the relative size of the informal economy generates a reduction of economic growth and consequently shutters the performance of tax revenue. Rowley and Schneider (1996) highlighted that an increase in the shadow economy is caused mainly by a rise in the overall tax and social security burden which normally leads to a decrease in tax and social security bases and finally to a decrease in tax

receipts. Therefore, a growing shadow economy can be seen as a reaction by the individuals who feel overburdened by state activities. Accordingly a rising shadow economy both in the short term and in the long term has massive negative implications to the productivity of the tax system (Loyza, 1996).

However, this negative impact of the shadow economy is not broadly accepted. Asea (1996) gave a more detailed criticism of the Loyza model. He pointed out that, one might come to the opposite conclusion, depending on the prevailing view of the informal sector. In the neoclassical view, the underground economy adds to the economy a dynamic and entrepreneurial spirit and can lead to more competition, innovation and higher efficiency. Asea (1996) further added that the informal sector may offer great contributions to the creation of markets and may increase financial resources which induce a higher potential for economic growth and consequently impact the tax revenue performance positively. Shneider (1998) further proposed that earnings in the shadow economy are immediately spent in the formal economy which therefore implies that an expansion of the shadow economy positively impacts tax revenue productivity through indirect taxation.

Other theories claim that taxation of the informal sector will lessen the revenue collection and will hinder the good qualities of the tax system, since the administration costs are likely to exceed the revenue collections owing to the fact that individuals and firms in the informal sector are low income earners. Schneider *et al* (2010) proposed the standard revenue equity argument and highlighted that taxing the informal sector has concentrated on direct and equity implications. At first glance, taxation of the informal economy gives off an impression of being a potentially important source of government revenue, as the informal sector comprises a large and, in many countries, growing share of GDP. However, in practise, revenue is likely to be comparatively modest because individual incomes within the sector are low while the costs of collection are very high, attributable to the substantial number of individual firms in the sector and the difficulty of monitoring them.

Taxation of the informal economy raises equity concerns in the sense that the operators of informal sector firms are frequently low income earners and taxation of such firms is potentially regressive. For these reasons, many tax experts have been sceptical of focusing scarce resources



in developing countries on taxing small informal sector firms (Keen, 2012). This suggests that taxation of the informal sector to a larger extent does not improve the tax revenue performance much. The revenue and equity argument for expanding informal sector taxation thus rest on more indirect benefits. One contention is that taxation of small firms while yielding little revenue in the short term, serves to bring firms in the tax net, thus ensuring higher tax compliance. Therefore, taxation of the informal sector firms is likely to yield more revenue in the long term rather than in the short term.

## **2.2 Empirical Literature Review**

Muchiri (2014) carried out a study on tax revenue collection in Kenya utilizing time series data stretching from 1980-2011. Using Ordinary Least Squares regression, the study formulated a model based on the data for taxation and the informal sector, as well as data for other variables such as per capita GDP, agriculture to GDP ratio, Foreign Direct Investment, Inflation, and trade openness. Muchiri adopted the employment approach to measure the size of the shadow economy and the results provided evidence on the existence of an inverse relationship between the tax to GDP ratio and the informal economy. The study further indicated that FDI, openness to trade, and per capita GDP are compellingly significant in determining tax revenue performance. The key policy recommendations indicated a need to formulate policies that are aimed at including the informal sector in the tax bracket by fostering voluntary compliance and reducing costs of tax compliance. Muchiri's research was a great piece of work in the literature of tax revenue performance and the findings intensified the need to find out whether the impact of the shadow economy on tax revenue performance in Kenya also holds in Zimbabwe especially after considering the fact that both countries are indeed developing nations.

Tedika and Mutascu (2013) came up with a much broader analysis of the shadow economy. Their study based on a panel model approach explored the effects of the shadow economy on tax revenues in the case of several African countries for the period 1999-2007. The study somehow differed from Muchiri's study in that it was based on the hypothesis that the shadow economy has a positive impact on tax revenue share. The OLS model was employed with data sets from countries such as Algeria, Benin, Botswana, Burkina Faso, Cape Verde, Congo Democratic Republic, Congo, Egypt, Ethiopia, Ghana, Kenya, Lesotho, Liberia, Madagascar, Mali, Morocco, Namibia, Niger, Nigeria, Sierra Leone, Togo, Tunisia, Uganda and Zambia. The findings

however rejected the main hypothesis of the study since the shadow economy was found to have a significant and negative impact on tax revenues. In light of these findings, Tedika and Mutascu urged African governments to control the shadow economy phenomenon in order to boost tax revenue collection. `

Teera (2002) had earlier conducted an empirical research on the tax revenue performance of the Ugandan economy relative to Sub-Saharan Africa during the period 1970-1998. The shadow economy variable was measured by the currency demand approach and the OLS regression results showed a negative relationship between the shadow economy and tax revenue performance. These findings helped to ascertain grounds on the formulation of policies that would help to boost the tax potential of the Ugandan economy and eradicate the budget deficit problems. Teera's research was a great literature masterpiece in the spheres of tax revenue performance and it provided a foundation for other studies that attempted to analyse the impact of the shadow economy on tax revenue performance in Africa in the years that followed.

Bird *et al* (2004) confirmed the negative relationship between tax revenue and the shadow economy with their analysis on the determinants of tax revenue using a sample of 110 developing countries including Uganda for the period 1990-1999. An OLS regression technique was employed with the shadow economy, degree of inequality, demographic growth, GDP per capita, trade openness, regulation of entry, political rights, indices of civil liberties, corruption, political stability, and rule of law as the independent variables. The findings suggested that the size of the shadow economy is negatively associated with tax revenue. The study further did some regional comparisons and found that the lower levels of tax revenue in Latin America relative to other developing countries are mainly due to the lower quality of its institutions, larger informal sectors and higher corruption. The study in light of these findings recommended policies that would increase the tax base and impact the size of the shadow economy negatively.

Davoodi and Grigorian (2007) undertook a cross-country analysis on tax potential and tax effort in Armenia using a dataset from 1993-2004. An OLS technique with tax to GDP as the dependant variable and shadow economy, GDP per capita, consumer price inflation, share of agriculture in GDP and the ratio of exports and imports to GDP as the independent variables was utilised. A negative relationship was found between the tax to GDP share and the shadow

economy. The study suggested that tax contribution to GDP can be increased significantly if Armenia enhances its VAT productivity by widening the tax base, removing exemptions, and improving the VAT refund mechanism to boost tax morale and reduce the willingness to stay in the shadow economy. The result of this study strongly backed the findings of Bird *et al* (2004) and Teera (2002).

By employing panel data for 1990-2009, Dioda (2012) analysed the determinants of tax revenue in Latin America and the Caribbean with particular focus on the influence of the shadow economy. The study adopted a panel model using data from 32 Latin American countries and the results indicated that the shadow economy is statistically significant and negatively associated with tax revenue. The researcher urged Latin American countries to concentrate on fiscal reforms that would enlarge the tax regimes in order to strengthen the taxation capacity. It is important to note that findings by Bird *et al* (2004) and Tedika and Mutascu (2013) in Africa are consistent with findings by Dioda (2012) in Latin America.

Although most empirical studies in literature provided evidence of a negative relationship between the shadow economy and tax revenue, one of the few studies that contradicted these findings was undertaken by Profeta and Scabrosetti (2010). Using a panel model approach they investigated on the determinants of tax revenue for 39 developing countries over the period 1990-2004, including 11 Asian, 19 Latin American and 9 recent members of the European Union. For Latin American countries, the size of the shadow economy is positive and significantly related to tax revenue. On the basis of these findings the study advised Latin American nations to improve the administration of tax in the formal economy so as to capture the contribution of the informal economy through indirect taxation. The positive relationship found strongly coincides with Asea's (1996) theory and the neo-classical view of the underground economy which states that the underground economy contributes to the well-being of an economy through the creation of markets and increase of financial resources which therefore induces higher potential for tax revenue performance.

Phiri and Kabaso (2012) carried out a study on taxation of the informal sector in Zambia and their result was in line with the standard revenue equity argument by Schneider *et al* (2010). Using the currency demand approach and OLS technique, they estimated the size of the informal economy and compared it with the formal economy for the period 1973 to 2010. Based on this

comparison they found that the informal economy, had it been included in the formal economy, would increase tax revenues by 7.7% of GDP per annum. They argued that despite this slight increase, tax revenue collections from the informal sector are not enough to cover tax administration costs therefore efforts to tax the informal sector would deteriorate the official sector's output. They further highlighted that the informal sector activities stimulate tax revenue performance in the short run through indirect taxes paid by informal sector players. In light of this, they advocated for policies that would strengthen the administration of VAT, by virtue of it being the most broad-based tax and the tax net for the majority of informal sector players.

Ahmad *et al* (2016) came up with another research that provided a sound basis for the analysis of tax revenue performance. The study was carried out in Pakistan and an annual time series data for the period 1975 to 2012 was utilised. The researchers applied an Auto Regressive Distributed Lag (ARDL) approach, with tax to GDP ratio as the explained variable while informal economy, tax compliance, narrow tax base, and government regime were used as the explanatory variables. The findings proved that the informal economy and the narrow tax base are negative and significant determinants of tax revenue in Pakistan. In appreciation of these findings, the study suggested that Pakistan can raise its tax revenue by documenting the informal economy, widening the tax base, enhancing institutional and political governance and eliminating tax exemptions permitted to any particular pressure group. This study in agreement with recent studies by Muchiri (2014), Tedika and Mutascu (2013) and Dioda (2012) further provided evidence on the inverse relationship between the tax revenue performance and the informal economy.

Maweje and Munyambonera (2016) in a recent study for Uganda again provided evidence on the negative impact of the shadow economy on tax revenue performance. An Auto Regressive Distributed Lag econometric method was adopted and the currency demand approach method was used to estimate the size of the shadow economy. The analysis revealed that the agricultural sector and the informal sectors pose the largest threats to tax revenue performance. Policies based on the findings emphasised the need to unlock the potentially large contributions of the informal sector with a view of widening the tax base. This study being one of the most recent studies on the foregoing phenomenon, its findings strongly emphasizes the diverse impact of the

shadow economy in developing countries which fuels motivation of a similar study in a similar country like Zimbabwe.

### **2.3 Conclusion**

The theoretical and empirical literature analysed provided a sound basis on the existence of both a negative and positive relationship between the shadow economy and tax revenue performance. Although various studies on this phenomenon were done in several developing countries across the world as reviewed in this chapter, very little has been done on the direct relationship between the shadow economy and tax revenue performance in Zimbabwe. Again, very few studies in literature utilised the electricity consumption approach in measuring the growth of the shadow economy with the majority of the studies using the currency demand approach. Therefore, from the reviewed literature a model will be adapted so as to cover this gap that exists and further provide a solution to the tax revenue productivity problem in Zimbabwe. The next chapter will specify the methodology and provide a clear justification of the variables.

## CHAPTER 3

### RESEARCH METHODOLOGY

#### 3.0 Introduction

The researcher through a thorough evaluation of the empirical literature came up with a methodology that will help to explain the impact of the shadow economy on the tax revenue performance in Zimbabwe.

#### 3.1 Model Specification

The model to be used was adapted from the study of Muchiri (2014). The analytical framework from which the model was adapted is shown below:

$$\ln T = \alpha_0 + \alpha_1 \ln Y + \alpha_2 \ln AGDP + \alpha_3 \ln INF + \alpha_4 \ln FDI + \alpha_5 \ln OE + \alpha_6 \ln I + \alpha_7 \ln PS + \varepsilon_t$$

Where T is Tax revenue performance, Y is per capita GDP, AGDP is the agriculture contribution to GDP, INF is the informal sector, FDI is foreign direct investment, OE is openness to trade, I is inflation rate and PS is a dummy variable for political stability.

However, for the purpose of the current research, the variables Y, OE, and PS were removed and were replaced by real interest rate (RIR), manufacturing sector contribution to GDP (MGDP) and government consumption (GCON). This adaptation will be explained in the justification of variables section. Muchiri's model had natural logarithms, but the current study will not adopt the natural logarithms since data on FDI (net inflows % GDP), shadow economy (electricity consumption – GDP) and Inflation has negative values. Furthermore, Muchiri's study used the employment approach to estimate the size of the informal sector but this study will use the electricity consumption approach since data on informal employment and labour force could not fit the stretch of the researcher's time frame. In this regard, the model subjected to empirical tests from the adaptation is as follows:

$$TR = \beta_0 + \beta_1 SE + \beta_2 INF + \beta_3 AGDP + \beta_4 FDI + \beta_5 RIR + \beta_6 MGDP + \beta_7 GCON + \varepsilon_t$$

Where *TR*: Tax revenue performance (proxy; tax to GDP ratio)

*SE*: Shadow economy (proxy; electricity consumption – GDP)

<i>INF:</i>	Inflation (proxy; consumer price index)
<i>AGDP:</i>	Agricultural sector contribution to GDP (proxy; agriculture % of GDP)
<i>FDI:</i>	Foreign Direct Investment (proxy; FDI net inflows % of GDP)
<i>RIR:</i>	Real Interest Rate (proxy; real lending interest rates)
<i>MGDP:</i>	Manufacturing sector contribution to GDP (proxy; manufacturing % of GDP)
<i>GCON:</i>	Government consumption (proxy; government consumption % of GDP)
$\varepsilon:$	Error term

$\beta_0 - \beta_7$  Coefficients to be estimated

A priori condition:  $\beta_1 < 0, \beta_2 < 0, \beta_3 < 0, \beta_4 > 0, \beta_5 < 0, \beta_6 > 0, \beta_7 > 0$ .

### **3.2 Justification of Variables**

The following determinants have been considered and included in the model as explanatory variables: Shadow economy, inflation, agriculture contribution to GDP, foreign direct investment, real interest rate, manufacturing contribution to GDP and government consumption. Each of these variables will be justified to give a strong basis for the inclusion of each in the model.

#### **3.2.1 Shadow economy (SE)**

The shadow economy can modestly be referred to any economic activity that is unrecorded in national statistics. The Kaufman and Karliberda (1996) electricity consumption technique will be utilised since information and data on electricity consumption and GDP is readily available. Various studies in literature utilised this method and came up with estimates of the shadow economy and these include Garvanlieva and Nikolov (2012) and Feige and Urban (2008). Tedika and Mutascu (2013) and Muchiri (2014) found a significant negative relationship between the shadow economy and the tax revenue performance in Nigeria and Kenya respectively and on this backdrop, a negative relationship is expected between the shadow economy and the tax revenue performance.

### **3.2.2 Inflation rate (INF)**

Inflation generally refers to the persistent increase in the general price of goods and services. Muchiri (2014) pointed out that during any period of high inflation, government's upkeep costs for everything rises and the purchasing power of consumers decreases which consequently imply drastic business revenue loses. In this regard, the actual real tax proceeds gathered by the government in periods of hyperinflation are less than those collected in a period of normal inflation. Based on this, it is justifiable to include inflation as one of the control variables in the model. Muchiri (2014) and Chandia *et al* (2014) found a negative relationship between inflation and tax revenue performance and these findings provide a relatively strong justification of the negative relationship that is expected between the inflation rate and the tax revenue performance in this study.

### **3.2.3 Agricultural Sector contribution to GDP (AGDP)**

Agriculture sector share of GDP captures the impact of growth in the agricultural sector on tax revenue. Ahmad *et al* (2016) justified the variable as an important economic determinant of tax revenue because it measures the narrow tax base of the economy. Ayenew (2016) highlighted that the agricultural sector may be difficult to tax since it is not politically feasible, especially in developing countries where the lion's share of the economy is dominated by this sector. Several studies in literature convincingly found a negative relationship between tax revenue and agriculture to GDP ratio and these among others include; Muchiri (2014) and Tedika and Mutascu (2013). On this backdrop the author expects a negative relationship between tax revenue and agriculture to GDP ratio.

### **3.2.4 Foreign Direct Investment (FDI)**

Foreign Direct Investment as defined by Ayyele (2015) is a category of cross-border investment in which an investor resident in one economy establishes a noteworthy level of influence over an enterprise resident in another economy. Gul and Naseem (2015) pointed out that FDI heavily impacts the tax system of a nation because it is one way of attracting the advanced technology and innovation in the country, which in turn transfers the economy into a more advanced economy and positively uplift the domestic investment and ultimately the tax contribution to GDP through increased revenue generation by local firms. Mahmood and Chaudhry (2013)



found a positive contribution of FDI to tax revenue in Pakistan. Therefore, this evidence provides a strong basis for the expected positive relationship between FDI and tax revenue performance.

### **3.2.5 Real Interest Rates (RIR)**

Real interest rates generally refer to the rate of interest an investor or lender receives after allowing for inflation. Real interest rates affect borrowing, lending and investment which may have ripple effects on the taxation capacity through investment performance. The real lending rate has been used since it reflects the cost of capital which is a major driver of investment. Low interest rates often stimulate investment activities and this directly impacts tax revenue through taxes that are paid by corporations. Chang and Tsai (1998) found a negative relationship between the real interest rate and government revenue. On the basis of this finding, a negative relationship is expected between real interest rates and tax revenue performance.

### **3.2.6 Manufacturing sector contribution to GDP (MGDP)**

According to Ayenew (2016) an increase in the growth of the manufacturing sector will increase direct tax through corporate income tax and indirect taxes through sales and excise duty on domestic products. Furthermore, unlike the agricultural sector, this sector is largely dominated by large companies that are registered, which gives the taxing authority better taxing capacity. Mawejje and Manyambonera (2016) found that the manufacturing sector positively impact tax revenue performance in Uganda while Chaudhry and Munir (2010) also found a positive relationship between the manufacturing sector and tax revenue generation in Pakistan. In this respect, the researcher expects a positive coefficient for manufacturing sector share to GDP.

### **3.2.7 Government consumption expenditure (GCON)**

Government consumption expenditure refers to expenditure incurred by the government sector on goods and services that are used for the direct satisfaction of individual needs. Government consumption expenditure was added to the model basically because the author deemed it to be a significant factor in determining tax revenue after evidence from studies by Ullah (2016), Saungweme (2013) and Mehrara and Rezaei (2014). Ullah (2016) provided evidence on the positive impact of government consumption expenditure on tax revenue in Malaysia while Mehrara and Rezaei (2014) found causality running from government consumption expenditure

to government revenue. On the basis of these results, a positive relationship is expected between tax revenue and government consumption expenditure.

### **3.2.8 Error term**

According to Andren (2008) an error term basically means that the model is not completely exact, thus the error term will capture the divergence of this research's model from the real world situation. The error term will be critical in capturing variances in tax to GDP not explained by the exogenous variables of the model.

### **3.3 Data Sources and Characteristics**

The study used annual time series data for tax to GDP ratio, Agriculture to GDP ratio, Inflation, Government consumption expenditure, Manufacturing to GDP ratio, Real Interest Rate, GDP, Electricity consumption and Foreign Direct Investment. The data which is secondary in nature ranges from 1980-2015 and was extracted from the following institutions; World Bank, IMF, RBZ and ZIMRA. This data has an advantage of being relatively easy to access on the internet. Nevertheless, by virtue of the data being annual time series, it is vulnerable to various data smoothing processes which may influence the model's estimation capacity. It is important to note that the shadow economy variable was devised by subtracting the GDP value from the electricity consumption value. The study adopts the OLS regression method and E-views 8 Statistical Package will be utilised to run the data.

### **3.4 Diagnostic Tests**

Diagnostic tests will be performed in order to analyse the validity of the variables so that results guarantees reliable and valid conclusions. The econometric problems of autocorrelation, multicollinearity, stationarity, heteroscedasticity, model misspecification and cointegration will be tested.

#### **3.4.1 Unit Root Test**

According to Gujarati and Porter (2009) a time series is said to be stationary if its statistical properties such as the mean and variance are all constant over time. The diagnosis of the unit root problem on time series is of great significance since it helps to avoid the likelihood of having spurious regression results. Various tests can be applied when testing for the unit root

problem, and these include the Dickey Fuller Test (DF), the Augmented Dickey Fuller Test (ADF) and the Phillips Peron Test (PP), however the Augmented Dickey Fuller Test will be employed and the hypothesis below will be tested:

$H_0$ : The time series is non-stationary.

$H_1$ : The time series is stationary.

Decision: If ADF statistic < ADF critic at 5% level of significance do not reject  $H_0$  and conclude that the time series is non-stationary.

### **3.4.2 Cointegration Test**

Gujarati and Porter (2009) states that cointegration indicates the long-term relationship between variables contained in the model. The cointegration test is carried out to test for the long run relationship between the variables of the model and it is important if the variables do not have a true relationship or are not stationary at the same time. To test for cointegration in this research, the researcher will utilize the Johansen cointegration test and the hypothesis below will be tested:

$H_0$ : There is cointegration.

$H_1$ : There is no cointegration.

Decision: If t-statistic is greater than t-critic we do not reject  $H_0$  and conclude that there is cointegration.

### **3.4.3 Autocorrelation Test**

Gujarati (2004) clarifies autocorrelation as correlation between members of a series of observations ordered in time. The presence of autocorrelation violates the mean variance property of the OLS estimators and this consequently limits the precision of the results. In this study, the Bruesch-Godfrey Serial Correlation LM Test for serial correlation will be employed to test for the presence of autocorrelation. The hypothesis below will be tested:

$H_0$ : There is no autocorrelation.

$H_1$ : There is autocorrelation.

At 5% level of significance, we do not reject the null hypothesis if the probability value of the Bruesch-Godfrey Serial Correlation LM Test is greater than 0.05.

#### **3.4.4 Heteroscedasticity Test**

Heteroscedasticity occurs when the error term variance fluctuates across all the observations (Gujarati and Porter, 2009). Allowing for heteroscedasticity using the OLS estimation will give unnecessary large confidence intervals and as a result the t and F tests are likely to give inaccurate results and overestimated standard errors (Gujarati and Porter, 2009). Gujarati (2004) further emphasized that if we persist in using the usual testing procedures despite heteroscedasticity, the conclusions we draw or inferences we make may be misleading. The study will utilize the Bruesch Pagan Godfrey Test and the hypothesis below will be tested:

$H_0$ : There is absence of heteroscedasticity.

$H_1$ : There is presence of heteroscedasticity.

At 5% level of significance we do not reject the null hypothesis if the probability value of the Bruesch-Pagan Godfrey test is greater than 0.05.

#### **3.4.5 Multicollinearity Test**

According to Gujarati (2004) multicollinearity is the existence of more than one perfect linear relationship among some or all explanatory variables of a regression model. It is quite important to note that, the multicollinearity problem frequently results in inefficient computation of parameters and it can be detected by pairwise correlation of regressors. The pairwise correlation of regressors is constantly present and can never be eradicated, but nevertheless, it can to some degree be controlled. In addition, severe multicollinearity is whereby the pairwise correlation is more than 0.8 and this correlation is detected by the correlation matrix.

$H_0$ : There is no severe multicollinearity.

$H_1$ : There is severe multicollinearity.

The null hypothesis is rejected if the correlation is greater than 0.8.

### **3.4.6 Model Specification Test**

One of the classical linear regression model assumptions states that the regression model used in an analysis should be correctly specified. Gujarati and Porter (2009) highlighted that if the model is not accurately specified, we experience the problem of model specification bias. In this study, a correctly specified model will facilitate proper investigation on the impact of the shadow economy on tax revenue performance. Using the Ramsey RESET Test, the following hypothesis will be tested:

$H_0$ : The model is correctly specified.

$H_1$ : The model is not correctly specified.

At 5% level of significance, we do not reject the null hypothesis if the probability value of the Ramsey Reset Test F-statistic is greater than 0.05.

### **3.4.7 Normality Test**

The normality test will be carried out to examine if the generated residuals are random. According to Gujarati (2004) the common suggestion of the test is that the mean of the residuals should be zero and the variance should be constant for all observations. The Jacque-Bera Test of normality will be utilized since it is based on the OLS residuals. The following null and alternative hypothesis will be tested:

$H_0$ : The residuals are normally distributed.

$H_1$ : The residuals are not normally distributed.

We do not reject the null hypothesis if the probability value of the Jacque Bera f-statistic is greater than 0.05, kurtosis is close to 3 and the mean of the series is equal or close to zero at 5% level of significance.

## **3.5 Conclusion**

In this chapter the researcher has outlined and specified the model adapted and the changes that have been made to suit the Zimbabwean case. Sources and characteristics of data were

highlighted and the methods of estimation were discussed as well. The variables of the model were justified giving the basis on the build up to the presentation of findings and interpretations. The chapter further highlighted and briefly discussed the diagnostic tests to be applied. In the next chapter, analysis and interpretation of the results will be done.

## CHAPTER 4

### PRESENTATION AND INTERPRETATION OF RESULTS

#### 4.0 Introduction

This chapter presents the regression results of the model specified in chapter 3 and proceeds to carry out the diagnostic tests in order to ensure that the model satisfies all the CLRM assumptions. The chapter further proceeds to give a presentation of the results obtained using E-views 8 statistical package. This chapter is of great importance since the diagnostic tests that were conducted help to improve the precision of the estimated parameters and this further improves the reliability and validity of the results. If the model satisfies all the CLRM assumptions it is appropriate and worthwhile to design a set of strategies and policies to mitigate the diminishing productivity of the tax structure in Zimbabwe.

#### 4.1 Results of Diagnostic Tests

##### 4.1.1 Stationarity Test Results

The Augmented Dickey Fuller Test was used to test for unit root problems for all the variables in the model. Table 4.1 gives a summary of the Unit Root Tests for stationarity.

**Table 4.1: Stationarity Test Results**

Variable	ADF Statistic	Critical values	Order of integration	Intercept
TR	-3.109211**	1% -3.632900	I(1)	YES
		5% -2.948404		
		10% -2.612874		
SE	-4.019005***	1% -2.634731	I(1)	NO
		5% -1.951000		
		10% -1.610907		
INF	-5.533750***	1% -2.632688	I(0)	NO
		5% -1.950687		

		10%	-1.611059		
AGDP	-3.515330**	1%	-3.632900	I(0)	YES
		5%	-2.948404		
		10%	-2.612874		
FDI	-3.121683**	1%	-3.632900	I(0)	YES
		5%	-2.948404		
		10%	-2.612874		
RIR	-4.175339***	1%	-2.632688	I(0)	NO
		5%	-1.950687		
		10%	-1.611059		
MGDP	-6.654879***	1%	-2.634731	I(1)	NO
		5%	-1.951000		
		10%	-1.610907		
GCON	-6.445976***	1%	-2.634731	I(1)	NO
		5%	-1.951000		
		10%	-1.610907		

*\*means significant at 10% \*\*significant at 5% and \*\*\*significant at 1% and at all levels. See appendix 2.1 for full results.*

The unit root tests in Table 4.1 reveals that all the variables are stationary at level with the exception of SE, MGDP, and GCON which are stationary at first difference, hence integrated of order one. Therefore,  $H_0$  must be rejected since the data is free from the unit root problem and the variables can be considered for model estimation.

#### **4.1.2 Cointegration Test Results**

The Johansen Cointegration Test was utilised to test for cointegration and the results are presented in Table 4.2. It is desirable to have a long run relationship among the variables of the model, and if the time series is cointegrated the possibility of having a spurious regression is eliminated.



**Table 4.2: Johansen Cointegration Test Results**

Hypothesized No of CE (s)	Eigen value	Trace statistic	Critical value	Probability
None *	0.992254	160.3977	56.70519	0.0000
At most 1 *	0.923596	84.86668	50.59985	0.0000
At most 2	0.657728	35.38094	44.49720	0.3428
At most 3	0.624511	32.32437	38.33101	0.2083
At most 4	0.404340	17.09683	32.11832	0.8562
At most 5	0.326926	13.06472	25.82321	0.7987
At most 6	0.223939	8.366307	19.38704	0.7876
At most 7	0.215106	7.992830	12.51798	0.2523

*\*denotes number of cointegrating equations. See appendix 2.2 for full results.*

The Johansen cointegration test was done to ascertain the long run relationship between the variables of the estimated model. As aforementioned in Chapter 3, we do not reject the null hypothesis (There is cointegration) if the t-statistic value is greater than the t-critic value and conclude that the variables are cointegrated. The model has 2 cointegrating equations, which implies that there is a long run relationship among the variables.

#### **4.1.3 Autocorrelation Test Results**

The Bruesch Godfrey Serial Correlation LM Test was used to test the relationship that exists between the disturbance terms. The results are presented in Table 4.3.

**Table 4.3: Autocorrelation Test Results**

F-Statistic	Prob.F(2.25)	Observed* R-Squared	Prob.Chi-Square(2)
3.255602	0.0554	7.232100	0.0269

*See appendix 2.3 for full results.*

Since the probability value of the test is greater than 0.05, we do not reject the null hypothesis and conclude that there is no autocorrelation.

#### **4.1.4 Heteroscedasticity Test Results**

The Bruesch-Pagan Godfrey Test was utilised to detect the presence of heteroscedasticity in the model and the results are presented in Table 4.4.

**Table 4.4: Bruesch-Pagan Godfrey Test Results**

F-Statistic	0.209602	Prob. F(7.27)	0.9803
Obs* R-squared	1.803913	Prob. Chi-Square(7)	0.9699
Scaled explained SS	1.910380	Prob. Chi-Square(7)	0.9646

*See appendix 2.4 for full results.*

The Bruesch-Pagan Godfrey Test concludes that if the probability value is greater than 0.05, there is no heteroscedasticity, and in this case the probability value of the test is 0.9803 which is way greater than 0.05 at 5% level of significance. Therefore, there is no heteroscedasticity.

#### **4.1.5 Multicollinearity Test Results**

The correlation matrix shows the correlation of the independent variables. If all the independent variables have correlation of less than 0.8, the problem of multicollinearity does not exist. The correlations of the variables are presented in Table 4.5.

**Table 4.5: Multicollinearity Test Results**

	AGDP	GCON	SE	FDI	INF	RIR	MGDP
AGDP	1.000000						
GCON	-0.303211	1.000000					
SE	0.037770	-0.290424	1.000000				
FDI	0.008463	0.089720	-0.035820	1.000000			
INF	0.279073	-0.132736	-0.140660	0.019057	1.000000		
RIR	0.285472	-0.162961	-0.063046	0.019624	0.208534	1.000000	
MGDP	-0.286253	-0.011446	0.094831	-0.129978	-0.013256	0.067942	1.000000

*See appendix 2.5 for full results.*

As shown in Table 4.5, the highest pairwise correlation of 0.303211 is between AGDP and GCON but however it lies below 0.8 which therefore imply that all the independent variables are free from the problem of multicollinearity. Therefore, we do not reject the null hypothesis and we conclude that the model does not experience the effects of multicollinearity.

#### **4.1.6 Model Specification Test Results**

The Ramsey RESET Test was used to test for specification errors. A correctly specified model will provide a clear analysis of the impact posed by the shadow economy on tax revenue performance which makes Model Specification Test one of the most important diagnostic tests in this study. Table 4.6 presents the results of the test.

**Table 4.6: Ramsey RESET Test for Model Specification**

F. Statistic	Probability	D.W Statistic	R <sup>2</sup>	Adjusted R <sup>2</sup>
0.000817	0.9774	2.351421	0.720668	0.634719

*See appendix 2.6 for full results.*

The probability value of the Ramsey RESET Test is 0.9774 which is greater than 0.05, therefore we do not reject the null hypothesis that the model is correctly specified. Furthermore, the D.W statistic of 2.351421 is greater than the R<sup>2</sup> and the adjusted R<sup>2</sup>, hence dismissing the likelihood of spurious regression.

#### 4.1.7 Normality Test Results

The Jarque Bera Normality Test was used to test for the normality of the time series and the results are presented in Table 4.7.

**Table 4.7 Normality Test Results**

Mean	Skewness	Kurtosis	Jarque-Bera Statistic	Probability	Standard Dev
1.19e-15	0.581031	4.559120	5.514318	0.063472	3.660089

*See appendix 2.7 for full results.*

The probability value of the Jarque Bera Normality Test is greater than 0.05 which is acceptable. The asymmetric dispersion around the mean in a time series is measured by skewness and the results shows that the distribution is positively skewed as reflected by 0.581031. However the kurtosis value is greater than 3 which suggest that the peakedness of the dispersion is too high. Nevertheless, Rose *et al* (2015) provides a solution to this problem. According to Rose *et al* (2015) whenever the kurtosis value goes beyond the acceptable value 3, a simple rule of thumb must be applied before rejecting the hypothesis that the residuals are normally distributed. They specified that if the result of dividing the kurtosis value by the standard deviation lies within

$\pm 1.96$ , it suggests that the departure from normality is not too extreme. An application of this rule of thumb in this study gives 1.2456 which is well within the range  $\pm 1.96$ , suggesting that the departure from normality is insignificant. De Carlo (1997) highlighted that excess kurtosis can arise because outliers are present, yet the distribution is normal. On the basis of these propositions in theory there is no strong basis for rejecting the null hypothesis which states that the residuals are normally distributed.

#### 4.2 Presentation of Results

An OLS model was used to estimate an equation for the phenomenon under study. Table 4.8 presents the results of the estimated equation.

**Table 4.8 Summary of Regression Results**

Variable	Coefficient	Std Error	t-Statistic	Probability
Constant	22.03056	4.063013	5.422221	0.0000
SE	2.006822	0.718726	2.792194	0.0095
INF	-0.000494	0.000183	-2.697193	0.0119
AGDP	-0.028116	0.247293	-0.113695	0.9103
FDI	1.279487	0.459994	2.781527	0.0097
RIR	-0.008409	0.001945	-4.323185	0.0002
MGDP	0.083390	0.377539	0.220878	0.8268
GCON	0.515269	0.178778	2.882174	0.0077

*See appendix 3 for full results.*

$$R^2 = 0.720659$$

$$\text{Adjusted } R^2 = 0.648237$$

D W statistic= 2.353381

F statistic= 9.950855

Prob (F-statistic) = 0.000004

The estimation equation in Table 4.8 can be shown in the form of equation 4.1.

$$TR = 22.03056 + 2.006822SE - 0.000494INF - 0.028116AGDP + 1.279487FDI - 0.008409RIR + 0.083390MGDP + 0.515269GCON \dots\dots\dots 4.1$$

In equation 4.1 TR is representing tax revenue, SE; shadow economy, INF; inflation, AGDP; agricultural sector % of GDP, FDI; foreign direct investment, RIR; real interest rate, MGDP; manufacturing sector % of GDP and GCON; government consumption expenditure % of GDP.

### 4.3 Interpretation of Results

All the variables included in the model were expected to have a significant impact in influencing tax revenue, however AGDP and MGDP emerged insignificant since their p-values are greater than 0.05. The implication is that the tax revenue performance is influenced by all the other factors except these two variables. Although AGDP and MGDP had no significant impact, their signs conformed to expectation. All the other remaining variables also conformed to expectation except the shadow economy.

The variables included in the model explain 72.07% of variations in tax revenue as reflected by the R<sup>2</sup> while other variables outside the model explain 27.93%. The adjusted R<sup>2</sup> shows that about 64.82% of oscillations in tax revenue are determined by the research model after taking into account the degrees of freedom, while other factors account for the remaining 35.18%. The F-statistic value of 9.950855 implies that the model is viable while the Durbin Watson statistic value of 2.353381 which is close to 2 dismisses the possibility of serial correlation. The foregoing confirms that the specified model did not lead to spurious regression therefore this result can be considered worth to form the basis for policy formulation.

Prior to the estimation of the model a negative relationship was expected between the shadow economy and tax revenue performance. However, shockingly the results provided evidence on the positive relationship between the two variables. Despite the fact that this result opposed prior

expectation, it was found that the shadow economy is statistically significant in determining tax revenues. The p-value for SE of 0.0095 is less than 0.05 and the modulus of the t-statistic is 2.79219 which is marginally greater than 2 to prove significance. The coefficient of SE is 2.006822 which imply that a percentage increase in the shadow economy will result in a 2.007% increase in tax revenue, holding other factors constant.

The unexpected positive impact of the shadow economy can be justified on the basis of findings by other studies. Profeta and Scabrosetti (2010) found a positive relationship between tax revenue and the shadow economy for Latin American countries during the period 1990-2004. Phiri and Kabaso (2012) also found that the informal sector positively contributes to tax revenue performance in Zambia. As indicated by Biau (2011) informality has constructive outcomes in low income countries with diminishing returns to scale. Zimbabwe being a low income country is no exception, which suggests that findings of this study somehow reflect the true impact of the shadow economy in Zimbabwe. Empirical findings by Schneider and Enste (2000) clearly show that over 66% of the earnings in the shadow economy are rather immediately spent in the official economy and the undeniable linkages between the informal sector and the formal sector therefore suggest that growing informal economies tend to fuel revenue outputs of the formal economy through indirect taxes. According to ZIMRA (2015) VAT is the most important source of indirect tax revenue, therefore indirect taxation of the informal sector justifies the fact that over the years the informal sector has contributed to tax revenues in Zimbabwe.

#### **4.4 Conclusions**

The estimation of the model provided a superior analysis on the determinants of tax revenue in Zimbabwe. The chapter presented the findings of the estimated equation and conducted diagnostic tests in a bid to ensure the reliability of the regression results. The chapter further interpreted the results giving a critical justification of every outcome. The variable of critical concern proved to be an important determinant of tax revenue although its impact opposed expectations of the researcher. Chapter 5 will give possible policy recommendations and suggestions for future study on the basis of the results obtained in this chapter.

## CHAPTER 5

### SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

#### 5.0 Introduction

This chapter provides concluding remarks of the research and an evaluation of the achievement of objectives that were highlighted in the first chapter. Based on these objectives the chapter further provides a solution to the problem that motivated the study by suggesting potential strategies and economic policies. The chapter goes on to give suggestions and motivation on potential further studies that relate to the phenomenon under study.

#### 5.1 Summary of the Study

The motivation behind this research was the need to ascertain the potential impact of the shadow economy on tax revenue performance in Zimbabwe between the period 1980 and 2015. The driving forces behind this motivation were the economic problems that the nation is currently facing, for instance, the massive budget deficit, the increasing degree of informality and the declining tax revenues. The first chapter provided an introspective analysis of the general relationship between the shadow economy and tax revenue yields over the years. In chapter two, literature was critically reviewed to provide an overview of the relationship between the foregoing variables in various countries across the globe. The literature review further assisted in building a foundation for this study. The third chapter specified the model on the basis of empirical literature and chapter four provided an estimation of the model. Chapter four also presented the diagnostic tests in an attempt to ensure that the model estimation results are reliable. The findings of the study revealed that the shadow economy positively impacts tax revenue while real interest rates, foreign direct investment, government consumption expenditure and inflation were also revealed to be significant determinants.

#### 5.2 Conclusions

The underlying objective of this study was to analyse the potential impact of the shadow economy on tax revenue performance in Zimbabwe. Results provided evidence on the positive impact of the shadow economy, which therefore calls for measures that are designed to complement and support the informal sector in order to broaden its positive influence in tax



revenue generation while at the same time encouraging voluntary compliance which will broaden the tax base in the long term. It is important to note that a move to consider policy implications on other variables that were found to be significant determinants will further strengthen efforts to achieve the maximum potential of the tax system in Zimbabwe. Findings of this study further justify the rejection of the null hypothesis mentioned in the first chapter (shadow economy has no impact on tax revenue performance in Zimbabwe) and guide the conclusion which states that the shadow economy impacts the tax revenue performance in Zimbabwe.

### **5.3 Policy Recommendations**

The result of this study indicated that the shadow economy contributes to the revenue performance of the country which calls for the need to formulate policies within this scope. As highlighted by Joshi *et al* (2014) this outcome raises eyebrows since on the surface direct taxation of the informal economy appears to be a potential wellspring of tax revenue, however empirical evidence dismissed this hypothesis. In this regard, policies that complements and support the sector should be enforced. It is important to note that efforts to expand the tax base through incorporating the informal sector into the formal sector are likely to undermine the good qualities of a tax system since the administration costs are high and revenue yields are usually low provided the majority of firms and individuals in the sector earn low incomes. This proposition is supported by the standard revenue equity argument by Schneider *et al* (2010).

In this light, the dominant approach would be to focus on enhancing the administrative capacity of the tax system in the formal economy while maintaining the long run goal of improving the tax capacity by broadening the tax base through enforcing measures that encourage voluntary compliance. This suggestion is built upon the propositions of Schneider (1998). He highlighted that earnings in the shadow economy are spent in the formal economy; therefore improving the administrative capacity in the formal economy will capture the earnings from the shadow economy through indirect taxes. In this respect ZIMRA should foster tax compliance in the formal sector relying on the fact that small informal firms will bear costs of VAT and trade taxes paid higher up the value chain. ZIMRA should also put in place massive inspection measures to reduce corruption and foster compliance at the border posts and in all the productive sectors of the economy. These efforts will reduce smuggling of goods by informal sector players and the

ZIMRA officials and as well minimise tax evasion and avoidance in all formal sectors of the economy.

The government should also improve the provision of government services and infrastructure to support the informal sector since the sector supports livelihoods, contribute to production, employment and consumption of goods and services which goes a long way to curb poverty and improve the general standards of living. Therefore the government should take into account the fact that informal sector activities necessitate the achievement of one of its major objective and pillar of the ZIMASSET policy: Social service and poverty eradication.

However empirical evidence on the positive impact of the shadow economy does not conclusively and convincingly imply that formalization of firms deteriorates tax revenue performance and furthermore as proven by Phiri and Kabaso (2012) this positive relationship is often a short-medium term phenomenon. Therefore, in this light the government should reduce costs of compliance and formalization so as to build a culture of tax compliance. The idea is that while firms are still small and earn low incomes taxing them will only worsen the tax potential of the country, however if a culture of tax compliance is created these small firms when they eventually grow big they are likely to comply with the tax system and its requirements. This, in the long run will build the tax base by driving informal sector firms into the tax net and ultimately ensure that the tax revenue capacity improves by greater margins in order to help ease the budget deficit and improve the general economic performance without the need to source funds from external sources.

Conclusively, all these suggested policies if considered and implemented, desired revenue performances can be achieved and the budget deficit problem will be curbed while the general economic performance will be stimulated.

#### **5.4 Suggestions for Future Research**

It is important to note that the model in this research has excluded other important tax revenue determinants such as government effectiveness, corruption, trade openness and GDP because of reasons beyond the control of the author. This motivates another study along these lines. Furthermore this study used the electricity consumption approach to measure the growth of the shadow economy and it is important to note that this is only a proxy measure of the shadow

economy which reflects the increase or decrease in the actual size of the shadow economy. In addition the method has its own drawbacks, thus creating a gap for other studies to measure the actual size of the shadow economy in Zimbabwe using other methods like the currency demand approach and the MIMIC model approach.

## REFERENCES

- Ahmad, H.K., Ahmad, S., Mushtaq, M. and Nadeen, M. (2016) 'Socio Economic Determinants of Tax Revenue in Pakistan: An Empirical Analysis', *Journal of Applied Environment and Biological Sciences*, ISSN: 2090- 4274, TextRoad Publication.
- Alm, J., Martinez-Vazquez, J., and Schneider, F. (2003). 'Sizing the problem of the hard to tax'. *Journal of Economic Psychology* (pp. 283–338). New York: Springer.
- Asea, P.K. (1996) 'The Informal Sector: Baby or Bath Water?', *Carnegie- Rochester Conference Series Public Policy*, 45pp.163-171.
- Aynew, W. (2016) 'Determinants of Tax Revenue in Ethiopia (Johannsen Co-Intergration Approach)', *International Journal of Business, Economics and Management*, ISSN (e): 2312-0916/ISSN (p): 2312-5772.
- Andren, T. (2008) 'Econometrics Part III', Bussiness Sum Up, Sweden.
- Ayyele, B.Z. (2015) '*Determinants of Tax Revenue Performance: Ethiopian Federal Government*', Addis Ababa University.
- Barro, R.J. (1974) 'On the determinants of the public debt', *Journal of Political Economy*, 81, 940-71.
- Biau, J. (2011) 'Engine for growth or drag on productivity? The Informal sector and domestic Investment in developing countries', Georgetown University: Washington DC.
- Bird, R. M., Martinez-Vasquez, J. and Togler, B. (2004) 'Societal Institutions and tax effort in developing countries', Andrew Young School of Policy Studies, *Working Paper 04- 06*, Georgia State University.
- Chandia, K.E., Sabir, R.I., Zulfiquar, S., Sarwer, B. and Bahadur, W. (2014) 'Determinants of Revenue Generation Capacity in the Economy of Pakistan', *Journal of Basic and Applied Scientific Research*: TextRoad Publication.
- Chang, W and Tsai, H. (1998) 'Government spending and real interest rate in an open economy', *Review of International Economics*, Vol 6, Issue 2, 284-291.

Charumbira, M. and Sunde, T. (2011) '*Public Sector Economics*', Midlands State University.

Chaudhry, I.S. and Munir, F. (2010) 'Determinants of Low Tax Revenue in Pakistan', *Journal of Social Sciences (PJSS)*, Vol. 30, No. 2, pp. 439-452.

Davoodi, H. R, and Grigorian, D. A. (2007) 'Tax Potential vs. Tax Effort: A cross-country analysis of Armenia's stubbornly low tax collection', *IMF Working Paper*, WP/07/106.

De Carlo, L.T. (1997) '*On the meaning and use of Kurtosis*', Fordham: American Psychological Association Inc.

Dioda, L. (2012) 'Structural Determinants of Tax Revenue in Latin America and the Caribbean, 1990-2009', *ECLAC*, LC/MEX/L.1087, Mexico.

Dzingirai, C. and Tambudzai, Z. (2014) 'Causal Relationship between government tax revenue growth and economic growth: A case of Zimbabwe (1980-2012)', *Journal of Economics and Sustainable development*, ISSN-1700 (Paper) ISSN 2222-2855, Vol.5, No.17, 2014.

Feige, E. and Urban, I. (2008) 'Measuring Underground (Unobserved, Non-Observed, Unrecorded) Economies in Transition Countries: Can we Trust GDP?', *Journal of Comparative Economics*, Vol.36.

Garvanlieva, V and Nikolov, V.A.M. (2012) 'Shadow economy in Macedonia', *Center for Economic Analyses (CEA)*, 1000 Skopje.

Greenidge, K. (2005) 'Estimating the Size of the Underground Economy in Barbados', Presented at the Annual Review Seminar Research Department Central Bank of Barbados.

Gujarati, D.N. (2004) '*Basic Econometrics*', 4<sup>th</sup> Edition, New York: McGraw Hill Company.

Gujarati, D.N. and Porter, D.C. (2009) '*Basic Econometrics*', 5<sup>th</sup> Edition, New York: McGraw Hill Irwin.

Guttman, P. (1977) 'The Subterranean Economy', *Financial Analysts Journal*, 34:1, pp.24-27.

Gul, M.K. and Naseem, I. (2015) 'Impact of foreign Direct Investment on Economic Growth of Pakistan', *American Journal of Business and Management*; Vol.4, No.4, 190-202.

International Monetary Fund. (2016). World Economic Outlook Database, October 2016. Available at: <https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx>.

Isachsen, A.J. and Storm, S. (1985) 'The size and growth of the hidden economy in Norway', *Review of Income and Wealth*, 31/1, pp.21-38.

Joshi, A., Prichard, W and Heady, C. (2004) 'Taxing the Informal Economy: The Current State of Knowledge and Agendas for Future Research', *The Journal of Development Studies*, DOI: 1080/00228388.2014.01440910.

Kaufmann, D. and Karliberda, A. (1996) 'Integrating the Unofficial Economy into the Dynamics of Post-Socialist Economics: A framework of Analysis and Evidence', *World Bank Policy Research Working Paper Series*, No.1691. Washington, D.C. World Bank.

Keen, M. (2012). 'Tax and development-Again', *Critical Issues in Taxation in Developing Countries* (pp.13-44). Cambridge, MA: MIT Press.

Laffer, A. (2004) 'The Laffer Curve: Past, Present and Future', Laffer Associates, January 24, 2004.

Loyza, N.V. (1996) 'The Economics of the Informal Sector: A simple model and some empirical evidence from Latin America', *Carnegie- Rochester Conference Series Public Policy*, 45, pp. 129- 62.

Mahmood, H and Chaudhry, A. R. (2013) 'Impact of FDI on Tax Revenue in Pakistan', *Pakistan Journal of Commerce and Social Sciences*, Vol.7(1), 59-69.

Makochekanwa, A. (2010) 'Estimating the size and trends of the second economy in Zimbabwe', *MPRA Paper No. 37807*.

Mansour, M. (2014) 'A tax revenue dataset for Sub-Saharan Africa: 1980-2010', *Working Paper*, 119, International Monetary Fund.

Mawejje, J. and Manyambonera, E. (2016) 'Improving tax revenue performance in Uganda', *Policy Brief*, Issue No.59.

- Mehrara, M. and Elyasi, M, P. (2011) 'Government revenue and government expenditure nexus in Asian countries: Panel Cointegration and Causality', *International Journal of Business and Social Science*, Vol.2. No.7.
- Mehrara, M. and Rezai, A. (2014) 'The relationship between government revenue and government expenditure in Iran', *International Journal of Academic Research in Business and Social Sciences*, Vol. 4, No. 3. ISSN: 2222-6900.
- Muchiri, B.K. (2014) 'An analysis of the effect of the growth of the Informal Sector on tax revenue performance in Kenya', University of Nairobi, Kenya.
- Ndedzu, D., Macheke, A., Masevere, M.I. and Zivengwa, T. (2013) 'Revenue Productivity of Zimbabwe's Tax System', *Asian Journal of Social Sciences and Humanities*, Vol.2. No.4.
- Nhavira, J.D.G. (2015) 'Measuring the Shadow Economy in Zimbabwe: Using the Monetary Approach', *Global Journal of Contemporary Research in Accounting, Auditing and Business Ethics*, (GJCRA) ISSN: 2311- 3162, Vol: 1, Issue: 1.
- Osoro, N. (1995) 'Tax Reform in Tanzania: Motivations, Directions and Implications', *AERC Research Paper Series*, No. 62, Nairobi, Kenya Africa Economics Research Consortium.
- Phiri, S. C. and Kabaso, P. (2012) 'Taxation of the Informal Sector in Zambia', *Zambia Institute for Policy Analysis and Research*, Working Paper No.5.
- Profeta, P. and Scabrosetti, S. (2010) 'The political economy of Taxation: Lesson for Developing Countries', Edward Elgar Publishing Limited.
- Rawley, C.K, and Schneider, F. (1996) 'The Encyclopedia of Public Choice', Vol 1, New York: Kluwer Academic Publishers.
- Rose, S., Spinks, N. and Canhoto, A, I. (2015) 'Management Research: Applying the Principles', New York; Routledge Taylor and Francis Group.
- Saungweme, T. (2013) 'Causality between government expenditure and revenue: The Zimbabwe case 1980-2004', Great Zimbabwe University, Masvingo.

Schneider, F. (1998) 'Further empirical results of the size of the shadow economy of 17 OECD-countries over time', *Congress of the IIPF Cordoba, Argentina and discussion paper*, Department of Economics, University of Linz, Linz, Austria.

Schneider, F. and Buehn, A. (2016) 'Estimating the size of the Shadow Economy: Methods, Problems and Open Questions', Johannes Kepler University of Linz and IZA, IASS Potsdam. Discussion paper No. 9820.

Schneider, F., Buehn, A., and Montenegro, C. (2010). 'Shadow economies all over the world: New Estimates for 162 countries from 1999 to 2007'. *World Bank Policy Research Working Paper No.5356*. Washington DC: The World Bank.

Schneider, F. and Enste, D.H. (2000) 'Shadow Economies: Size, Causes, and Consequences', *Journal of Economic Literature*, Vol. 38. pp.77-114.

Smith, P. (1994) 'Assessing the size of the Underground Economy: The Canadian Statistical Perspectives', *Canadian Economic Observer*, Cat. No. 11- 010, 3. 16- 33.

Tanzi, V. (1980) 'The Underground Economy in the United States', *BancaNazionale del Lavoro*, 135: 4, pp. 427- 53.

Tedika, O.K. and Mutascu, M. (2013) 'Shadow economy and tax revenue in Africa', *MPRA Paper No. 50812*.

Teera, J.M. (2002) 'Could Do Better: An Appraisal of Uganda's Tax Performance Relative to Sub- Saharan Africa', University of Bath.

The U.S. Energy Information Administration (2016), [www.TheGlobalEconomy.com](http://www.TheGlobalEconomy.com).

Ullah, N. (2016) 'The Relationship of Government Revenue and Government Expenditure: A case of Malaysia', Munich Personal RePEc Archive International Center for Education in Islamic Finance.

World Bank. (2016) Zimbabwe World Bank Economic Indicators. Available at: <https://data.worldbank.org/country/Zimbabwe>.



ZIMRA. (2011) Revenue Performance Report 2011.

ZIMRA. (2012) Statement by the Zimra Board on Revenue performance for the year ending 31 December 2014.

ZIMRA. (2013) Revenue Performance Report 2013.

ZIMRA. (2014) Revenue performance report for the year ending 31 December 2014.

ZIMRA. (2015) Revenue performance report for the year ended 31 December 2015.

ZIMRA. (2016) Revenue performance report for the year ended 31 December 2016.

## APPENDICES PAGES

### Appendix 1

#### Data set used in regression model

Year	TR(% GDP)	SE(KWh-US\$Billion)	INF(%)	GCON(%GDP)	MGDP(%GDP)	AGDP(%GDP)	FDI(%GDP)	RIR(%)
1980	16.30	0.22	5.40	18.51	21.58	15.70	0.02	4.26
1981	17.50	-1.01	13.15	16.19	21.77	17.74	0.04	12.75
1982	23.20	-1.34	10.63	18.59	20.88	16.12	-0.01	18.43
1983	25.00	-0.76	23.12	17.29	23.01	11.24	-0.03	37.53
1984	27.20	0.75	20.15	20.04	22.65	14.86	-0.04	47.47
1985	20.90	1.46	8.49	20.20	19.85	22.67	0.05	41.19
1986	21.70	1.68	14.33	20.65	21.45	17.76	0.12	4.60
1987	23.50	1.36	12.47	23.37	22.69	14.41	-0.45	5.42
1988	22.00	0.49	7.42	27.49	21.51	16.38	-0.23	4.84
1989	21.30	0.91	12.88	18.69	25.60	14.93	-0.12	12.11
1990	20.60	1.12	17.36	19.45	22.76	16.48	-0.14	12.75
1991	20.00	0.76	23.34	16.12	27.16	15.27	0.03	23.90
1992	24.20	1.55	42.06	24.16	29.54	7.41	0.22	39.48
1993	21.80	2.24	27.59	14.95	23.01	15.04	0.43	41.70
1994	19.90	1.31	22.26	16.69	21.17	18.97	0.50	40.33
1995	21.10	1.39	22.59	18.01	21.80	15.24	1.66	30.76
1996	18.50	0.25	21.43	16.94	18.78	21.77	0.95	23.17
1997	21.50	1.07	18.74	16.32	18.01	18.93	1.58	36.48
1998	35.40	2.60	31.82	15.78	16.63	21.79	6.94	94.73
1999	24.30	2.84	58.52	17.79	16.35	19.18	0.86	43.87
2000	22.80	3.31	55.87	24.27	15.61	18.26	0.35	67.16
2001	18.10	3.22	76.71	17.69	14.56	17.31	0.06	38.20
2002	16.80	3.66	140.06	17.92	13.25	14.03	0.41	32.87
2003	24.00	4.27	431.70	17.92	13.65	16.59	0.07	81.33
2004	32.50	4.19	282.38	21.00	15.12	19.58	0.15	252.12
2005	12.15	4.67	302.12	15.21	16.38	18.58	1.79	219.28
2006	7.25	4.76	1,096.68	5.88	16.89	20.28	0.73	509.00
2007	2.90	3.71	24,411.03	3.21	16.40	21.60	1.30	573.00
2008	2.90	3.12	34,527.60	2.05	16.66	19.40	1.17	2,250.00
2009	15.10	-1.00	6.20	11.17	15.48	15.07	1.29	30.00
2010	30.40	-1.94	3.03	15.89	13.93	14.54	1.76	22.00
2011	25.56	-3.04	3.28	20.29	13.98	13.21	3.53	20.00
2012	26.28	-4.68	3.92	19.14	13.57	13.15	3.22	20.00
2013	25.43	-5.41	1.63	21.22	12.82	12.00	2.97	30.00
2014	25.36	-6.20	-0.22	24.06	11.91	14.01	3.84	28.00
2015	24.27	-5.29	-2.40	25.08	12.60	12.53	3.03	30.00

Source: World Bank, ZIMRA, RBZ and IMF

## Appendix 2: Diagnostic test

### 2.1 Results of unit root tests

#### 2.1.1 TR unit root test results

Null Hypothesis: TR has a unit root  
Exogenous: Constant  
Lag Length: 0 (Automatic - based on SIC, maxlag=0)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.109211	0.0350
Test critical values:		
1% level	-3.632900	
5% level	-2.948404	
10% level	-2.612874	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
Dependent Variable: D(TR)  
Method: Least Squares  
Date: 03/13/17 Time: 12:55  
Sample (adjusted): 1981 2015  
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TR(-1)	-0.449308	0.144509	-3.109211	0.0038
C	9.643038	3.185958	3.026731	0.0048
R-squared	0.226572	Mean dependent var		0.227714
Adjusted R-squared	0.203135	S.D. dependent var		6.561809
S.E. of regression	5.857551	Akaike info criterion		6.428785
Sum squared resid	1132.260	Schwarz criterion		6.517662
Log likelihood	-110.5037	Hannan-Quinn criter.		6.459466
F-statistic	9.667190	Durbin-Watson stat		1.678363
Prob(F-statistic)	0.003849			

#### 2.1.2 SE unit root test results

Null Hypothesis: D(SE) has a unit root  
Exogenous: None  
Lag Length: 0 (Automatic - based on SIC, maxlag=0)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.019005	0.0002
Test critical values:		
1% level	-2.634731	
5% level	-1.951000	
10% level	-1.610907	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(SE,2)  
 Method: Least Squares  
 Date: 03/13/17 Time: 12:54  
 Sample (adjusted): 1982 2015  
 Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SE(-1))	-0.647811	0.161187	-4.019005	0.0003
R-squared	0.326745	Mean dependent var		0.062838
Adjusted R-squared	0.326745	S.D. dependent var		1.207343
S.E. of regression	0.990650	Akaike info criterion		2.848061
Sum squared resid	32.38581	Schwarz criterion		2.892954
Log likelihood	-47.41703	Hannan-Quinn criter.		2.863370
Durbin-Watson stat	2.066944			

### 2.1.3 INF unit root test results

Null Hypothesis: INF has a unit root  
 Exogenous: None  
 Lag Length: 0 (Automatic - based on SIC, maxlag=0)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.533750	0.0000
Test critical values:		
1% level	-2.632688	
5% level	-1.950687	
10% level	-1.611059	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(INF)  
 Method: Least Squares  
 Date: 03/13/17 Time: 12:46  
 Sample (adjusted): 1981 2015  
 Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF(-1)	-0.947733	0.171264	-5.533750	0.0000
R-squared	0.473867	Mean dependent var		-0.222873
Adjusted R-squared	0.473867	S.D. dependent var		5771.597
S.E. of regression	4186.431	Akaike info criterion		19.54524
Sum squared resid	5.96E+08	Schwarz criterion		19.58968
Log likelihood	-341.0417	Hannan-Quinn criter.		19.56058
Durbin-Watson stat	2.001158			

## 2.1.4 AGDP unit root test results

Null Hypothesis: AGDP has a unit root  
 Exogenous: Constant  
 Lag Length: 0 (Automatic - based on SIC, maxlag=0)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.515330	0.0134
Test critical values:		
1% level	-3.632900	
5% level	-2.948404	
10% level	-2.612874	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(AGDP)  
 Method: Least Squares  
 Date: 03/13/17 Time: 12:42  
 Sample (adjusted): 1981 2015  
 Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AGDP(-1)	-0.564725	0.160646	-3.515330	0.0013
C	9.259614	2.710385	3.416346	0.0017
R-squared	0.272447	Mean dependent var		-0.090356
Adjusted R-squared	0.250400	S.D. dependent var		3.562460
S.E. of regression	3.084357	Akaike info criterion		5.146009
Sum squared resid	313.9376	Schwarz criterion		5.234886
Log likelihood	-88.05515	Hannan-Quinn criter.		5.176689
F-statistic	12.35754	Durbin-Watson stat		1.916018
Prob(F-statistic)	0.001300			

## 2.1.5 FDI unit root test results

Null Hypothesis: FDI has a unit root  
 Exogenous: Constant  
 Lag Length: 0 (Automatic - based on SIC, maxlag=0)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.121683	0.0340
Test critical values:		
1% level	-3.632900	
5% level	-2.948404	
10% level	-2.612874	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(FDI)

Method: Least Squares  
 Date: 03/13/17 Time: 12:44  
 Sample (adjusted): 1981 2015  
 Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI(-1)	-0.473656	0.151731	-3.121683	0.0037
C	0.559708	0.273955	2.043069	0.0491
R-squared	0.227978	Mean dependent var		0.085918
Adjusted R-squared	0.204584	S.D. dependent var		1.512879
S.E. of regression	1.349278	Akaike info criterion		3.492462
Sum squared resid	60.07822	Schwarz criterion		3.581339
Log likelihood	-59.11809	Hannan-Quinn criter.		3.523142
F-statistic	9.744903	Durbin-Watson stat		2.184675
Prob(F-statistic)	0.003726			

### 2.1.6 RIR unit root test results

Null Hypothesis: RIR has a unit root  
 Exogenous: None  
 Lag Length: 0 (Automatic - based on SIC, maxlag=0)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.175339	0.0001
Test critical values:		
1% level	-2.632688	
5% level	-1.950687	
10% level	-1.611059	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(RIR)  
 Method: Least Squares  
 Date: 03/13/17 Time: 12:52  
 Sample (adjusted): 1981 2015  
 Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RIR(-1)	-0.677979	0.162377	-4.175339	0.0002
R-squared	0.338950	Mean dependent var		0.735429
Adjusted R-squared	0.338950	S.D. dependent var		481.1630
S.E. of regression	391.2095	Akaike info criterion		14.80452
Sum squared resid	5203525.	Schwarz criterion		14.84896
Log likelihood	-258.0791	Hannan-Quinn criter.		14.81986
Durbin-Watson stat	2.113893			

## 2.1.7 MGDG unit root test results

Null Hypothesis: D(MGDG) has a unit root  
 Exogenous: None  
 Lag Length: 0 (Automatic - based on SIC, maxlag=0)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.654879	0.0000
Test critical values:		
1% level	-2.634731	
5% level	-1.951000	
10% level	-1.610907	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(MGDG,2)  
 Method: Least Squares  
 Date: 03/13/17 Time: 12:49  
 Sample (adjusted): 1982 2015  
 Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(MGDG(-1))	-1.147620	0.172448	-6.654879	0.0000
R-squared	0.573012	Mean dependent var		0.014772
Adjusted R-squared	0.573012	S.D. dependent var		3.120660
S.E. of regression	2.039173	Akaike info criterion		4.291936
Sum squared resid	137.2215	Schwarz criterion		4.336829
Log likelihood	-71.96292	Hannan-Quinn criter.		4.307246
Durbin-Watson stat	2.035110			

## 2.1.8 GCON unit root test results

Null Hypothesis: D(GCON) has a unit root  
 Exogenous: None  
 Lag Length: 0 (Automatic - based on SIC, maxlag=0)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.445976	0.0000
Test critical values:		
1% level	-2.634731	
5% level	-1.951000	
10% level	-1.610907	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(GCON,2)  
 Method: Least Squares

Date: 03/13/17 Time: 12:45  
Sample (adjusted): 1982 2015  
Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GCON(-1))	-1.111393	0.172417	-6.445976	0.0000
R-squared	0.557248	Mean dependent var		0.098246
Adjusted R-squared	0.557248	S.D. dependent var		6.638716
S.E. of regression	4.417377	Akaike info criterion		5.837940
Sum squared resid	643.9363	Schwarz criterion		5.882833
Log likelihood	-98.24498	Hannan-Quinn criter.		5.853250
Durbin-Watson stat	1.959419			

## 2.2 Cointegration test results

Date: 03/13/17 Time: 13:07  
Sample (adjusted): 1982 2015  
Included observations: 34 after adjustments  
Trend assumption: Linear deterministic trend (restricted)  
Series: AGDP GCON SE FDI INF RIR TR MGD  
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.992254	359.4904	187.4701	0.0000
At most 1 *	0.923596	199.0927	150.5585	0.0000
At most 2	0.657728	114.2260	117.7082	0.0813
At most 3	0.624511	78.84506	88.80380	0.2106
At most 4	0.404340	46.52069	63.87610	0.5757
At most 5	0.326926	29.42386	42.91525	0.5365
At most 6	0.223939	16.35914	25.87211	0.4641
At most 7	0.215106	7.992830	12.51798	0.2523

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

## 2.3 Autocorrelation test results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	3.255602	Prob. F(2,25)	0.0554
Obs*R-squared	7.232100	Prob. Chi-Square(2)	0.0269

Test Equation:  
Dependent Variable: RESID  
Method: Least Squares



Date: 03/13/17 Time: 13:05  
Sample: 1980 2015  
Included observations: 36  
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.722872	3.771682	0.191658	0.8496
AGDP	-0.022558	0.229079	-0.098472	0.9223
GCON	-0.112102	0.182343	-0.614785	0.5443
SE	-0.207643	0.672149	-0.308924	0.7599
FDI	0.150147	0.429920	0.349244	0.7298
INF	-0.000258	0.000197	-1.304917	0.2038
RIR	-0.001331	0.001892	-0.703707	0.4881
MGDP	0.164954	0.355564	0.463924	0.6467
RESID(-1)	-0.383689	0.207524	-1.848892	0.0763
RESID(-2)	-0.527051	0.232562	-2.266282	0.0323
R-squared	0.206631	Mean dependent var		-7.87E-16
Adjusted R-squared	-0.078981	S.D. dependent var		3.660089
S.E. of regression	3.801882	Akaike info criterion		5.743826
Sum squared resid	361.3576	Schwarz criterion		6.188211
Log likelihood	-90.51695	Hannan-Quinn criter.		5.897227
F-statistic	0.723467	Durbin-Watson stat		2.047876
Prob(F-statistic)	0.683337			

## 2.4 Heteroskedasticity test results

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.209602	Prob. F(7,27)	0.9803
Obs*R-squared	1.803913	Prob. Chi-Square(7)	0.9699
Scaled explained SS	1.910380	Prob. Chi-Square(7)	0.9646

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 03/13/17 Time: 13:04

Sample: 1980 2015

Included observations: 36

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.884981	26.92937	-0.329937	0.7440
AGDP	1.389363	1.639042	0.847667	0.4041
GCON	0.152667	1.184926	0.128841	0.8984
SE	0.095689	4.763664	0.020087	0.9841
FDI	0.220457	3.048810	0.072309	0.9429
INF	-0.000709	0.001214	-0.583743	0.5642
RIR	-0.000473	0.012892	-0.036728	0.9710
MGDP	2.390524	2.502303	0.955330	0.3479
R-squared	0.051540	Mean dependent var		13.01350

Adjusted R-squared	-0.194357	S.D. dependent var	24.90922
S.E. of regression	27.22244	Akaike info criterion	9.643592
Sum squared resid	20008.66	Schwarz criterion	9.999100
Log likelihood	-160.7629	Hannan-Quinn criter.	9.766314
F-statistic	0.209602	Durbin-Watson stat	1.535386
Prob(F-statistic)	0.980268		

## 2.5 Multicollinearity test results

	AGDP	GCON	SE	FDI	INF	RIR	MGDP
AGDP	1.000000	-0.303211	0.037770	0.008463	0.279073	0.285472	-0.286253
GCON	-0.303211	1.000000	-0.290424	0.089720	-0.132736	-0.162961	-0.011446
SE	0.037770	-0.290424	1.000000	-0.035820	-0.140660	-0.063046	0.094831
FDI	0.008463	0.089720	-0.035820	1.000000	0.019057	0.019624	-0.129978
INF	0.279073	-0.132736	-0.140660	0.019057	1.000000	0.208534	-0.013256
RIR	0.285472	-0.162961	-0.063046	0.019624	0.208534	1.000000	0.067942
MGDP	-0.286253	-0.011446	0.094831	-0.129978	-0.013256	0.067942	1.000000

## 2.6 Model specification test results

Ramsey RESET Test  
Equation: UNTITLED  
Specification: TR C AGDP GCON SE FDI INF RIR MGDP  
Omitted Variables: Squares of fitted values

	Value	Df	Probability
t-statistic	0.028580	27	0.9774
F-statistic	0.000817	(1, 27)	0.9774
Likelihood ratio	0.001100	1	0.9735

F-test summary:

	Sum of Sq.	Df	Mean Squares
Test SSR	0.014309	1	0.014309
Restricted SSR	455.4726	28	16.86935
Unrestricted SSR	455.4583	27	17.51763
Unrestricted SSR	455.4583	27	17.51763

LR test summary:

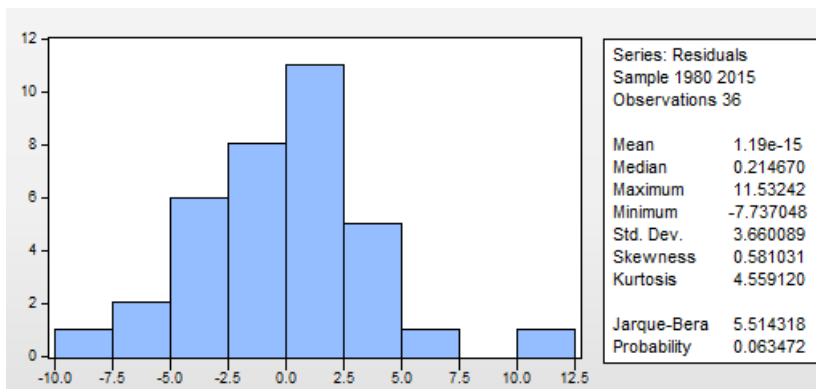
	Value	Df
Restricted LogL	-94.56763	28
Unrestricted LogL	-94.56708	27

Unrestricted Test Equation:  
Dependent Variable: TR  
Method: Least Squares  
Date: 03/13/17 Time: 13:05  
Sample: 1980 2015  
Included observations: 36

Variable	Coefficient	Std. Error	t-Statistic	Prob.
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C	21.39345	22.67320	0.943557	0.3541
AGDP	-0.025472	0.268443	-0.094888	0.9251
GCON	0.485826	1.046174	0.464383	0.6462
SE	1.887594	4.235474	0.445663	0.6595
FDI	1.197064	2.921767	0.409705	0.6854
INF	-0.000481	0.000503	-0.955043	0.3484
RIR	-0.008150	0.009279	-0.878342	0.3878
MGDP	0.079771	0.405025	0.196954	0.8454
FITTED^2	0.001292	0.045207	0.028580	0.9774
<hr/>				
R-squared	0.720668	Mean dependent var	21.18286	
Adjusted R-squared	0.634719	S.D. dependent var	6.925070	
S.E. of regression	4.185406	Akaike info criterion	5.918119	
Sum squared resid	455.4583	Schwarz criterion	6.318065	
Log likelihood	-94.56708	Hannan-Quinn criter.	6.056180	
F-statistic	8.384882	Durbin-Watson stat	2.351421	
Prob(F-statistic)	0.000014			

## 2.7 Normality test results



## Appendix 3

### Regression Results

Dependent Variable: TR

Method: Least Squares

Date: 03/13/17 Time: 13:09

Sample : 1980 2015

Included observations: 36

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.03056	4.063013	5.422221	0.0000
AGDP	-0.028116	0.247293	-0.113695	0.9103
GCON	0.515269	0.178778	2.882174	0.0077
SE	2.006822	0.718726	2.792194	0.0095
FDI	1.279487	0.459994	2.781527	0.0097
INF	-0.000494	0.000183	-2.697193	0.0119
RIR	-0.008409	0.001945	-4.323185	0.0002
MGDP	0.083390	0.377539	0.220878	0.8268
R-squared	0.720659	Mean dependent var		21.18286
Adjusted R-squared	0.648237	S.D. dependent var		6.925070
S.E. of regression	4.107232	Akaike info criterion		5.861007
Sum squared resid	455.4726	Schwarz criterion		6.216515
Log likelihood	-94.56763	Hannan-Quinn criter.		5.983729
F-statistic	9.950855	Durbin-Watson stat		2.353381
Prob(F-statistic)	0.000004			