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SHADOW ECONOMY IN TURKEY AND THE ROLE OF THE TAX AUDIT FOR THE PREVENTION OF THE SHADOW ECONOMY

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ABSTRACT

The main aim of the thesis is to identify what determine shadow economy in Turkey, with particular emphasis on the role of tax auditing. In this study, the variables that affecting the size of shadow economy are examined through the VAR analysis that is one of the methods of the time series. For this purpose, yearly data between 2000 and 2014 is employed for the variables. Especially, the impact of tax inspector number, audit number and tax burden on the size of shadow economy is examined. Unit root test, co-integration test, correlation test, Granger causality/Wald test is conducted in the study. In empirical analysis, as expected, negative correlation between audit number and the size of shadow economy is found but could not be determined Granger Causality between them. Moreover, it is not determined any Granger Causality between the size of shadow economy and tax burden. As regards to unemployment, there is statistically significant positive correlation between the size of shadow economy and unemployment rate. Additionally, unemployment rate is determined as the Granger causes of the size of shadow economy. Statistically significant positive correlation and bi-directional Granger causal relationship is observed between the size of shadow economy and GDP per capita. Finally, statistically significant negative correlation is determined between the size of shadow economy and corruption. However, it is not found Granger causality between the size of shadow economy and corruption for Turkish economy in observed period.

Key words: VAR Analysis, Granger Causality, Correlation, Size of Shadow Economy, Wald Test, Co-integration, Toda-Yamamato.

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CONTENTS

LIST OF TABLES

LIST OF GRAPHS

LIST OF ABBREVIATIONS

GDP: Gross Domestic Product

MIMIC: Multiple Indicators Multiple Causes

TTIB: Turkish Tax Inspection Board

TRA: Turkish Revenue Administration

TGDP: Turkish Ministry of Finance General Directorate of Personnel

DLSE: First Difference of Size of Shadow Economy Series

DLAN: First Difference of Auditing Number Series

DLGDPC: First Difference of Gross Domestic Product per Capita Series

DLTB: First Difference of Tax Burden Series

DLC01: First Difference of Corruption Index Series

DLU: First Difference of Unemployment Series

VAR: Vector Autoregressive Model

LSE: Logarithmic Series of Size of Shadow Economy

LIN: Logarithmic Series of Inspector Number

LAN: Logarithmic Series of Auditing Number

LGDPC: Logarithmic Series of Gross Domestic Product per Capita

LC01: Logarithmic Series of Corruption Index

LTB: Logarithmic Series of Tax Burden

LU: Logarithmic Series of Unemployment

SE: Size of Shadow Economy

IN: Inspector Number

AN: Auditing Number

TB: Tax Burden

GDPC: Gross Domestic Product per Capita

U: Unemployment Rate

C01: Corruption Index

ADF: Augmented Dickey Fuller Test

CHAPTER 1

INTRODUCTION

The phenomenon of globalisation has led to a major transformation of the world economy since the beginning of the 1980s. The elimination of borders between countries has accelerated global trade. With the increase occurring in world trade volume, the size of the shadow economy has increased as well. Although the shadow economy is defined in various ways by many scientists, taken in its broadest definition, it involves both legal activities which is unrecorded and illegal activities besides it involves issues such as marginal sectors, tax informality and shadow employment.

Yet, different in sizes in each country, shadow economy remains a major problem for both developed and developing countries by fiscal, economic and social reasons. Therefore, combating shadow economy has been a significant policy objective in most countries in order to eliminate its negativities during recent decades (Dogu 2011). Countries try to control unofficial economic activities through various policy instruments such as education, punishment, prosecution or economic growth (Schneider et al. 2010). In order to allocate resources more efficiently, determining the extent of the shadow economy is crucial for a country. However, it is very difficult to obtain accurate information about shadow economy activities because undeclared economic activities are conducted in privacy and people who engage in these activities do not want to be identified (Buehn and Schneider 2011). First studies to measure the size of shadow economy is conducted in America in the 1950s. In Turkey, similar studies has been commenced in the 1990s (Tütüncü 2013).

In recent literature, it is observed that the size of shadow economy in developed countries is lower than in developing and least developed countries. Schneider et al. (2010) and Schneider (2011) reveal that there is a negative relationship between the size of shadow economy and countries' level of development. Large percentage of shadow economies in developing countries may be indicators of serious problems such as insufficient fiscal capacity and growth performance (Besley and Persson 2010).

The prevalence of undeclared activities show the weakness of state control and supervision, which means a weak state. As is known, states need revenue in order to finance public expenditure. Taxes are the most important source for government expenditure funding. By sovereignty principle, governments collect taxes by force,

however, individuals are always unwilling to pay tax because it reduces their income level. Shadow economy leads to the inability to collect expected budget revenues from the economy for any country. Under budget pressure, governments have to find a way to increase their tax base and relieve their budget constraint (Buehn and Schneider 2011). In this sense, reducing the size of the shadow economy will make great contribution in order to finance increasing public expenditure and budget deficit. Governments may incentivise the official economy through stimulatory measures. Reforming the tax and social security system may direct taxpayers from shadow economy to official economy. In literature, authors mostly measure the size of shadow economy for different countries and analyse the relationship between the size of shadow economy and specific economic indicators. For Turkish economy, there are a great deal of studies on shadow economy but there is no specific study revealing the relationship between the size of shadow economy and tax auditing indicators. We consider that the informal economy can be kept under record solely through an effective and efficient audit process. Determination of the causes of shadow economy is an important step to implement strategy in order to fight against the informal economy. In that respect, the main focus of our study is to reveal the impact of tax audit on the size of shadow economy. For this purpose, the impact of tax audit, increase in the number of inspectors, tax burden, unemployment, GDP per Capita and corruption on the size of the shadow economy is analyses. Causal relations between the variables are revealed. For this purpose, time series analysis is conducted with the abovementioned variables included the period 2000 and 2014. This dissertation consists of five chapters.

In chapter two, general consideration for shadow economy will be made. Literature related to the research will be reviewed. It will be revealed interrelationship between the some of the indicators related to tax audit such as number of inspector, number of tax audit, tax burden, macroeconomic indicators such as unemployment, GDP per Capita, corruption perception index and size of shadow economy. Determinants of shadow economy which will be used in the empirical analysis will be explained in brief.

In chapter three, firstly, information about data which will be used for time series analysis will be given. Then, methodology of this study will be explained. The philosophy of the time series analysis is described. Moreover, time series analysis such

as correlation and Granger Causality analysis and unit root test, co-integration test used in making time series analysis is described

In chapter four, empirical analysis and findings are revealed. Descriptive statistics are commented and the trends of series is revealed by using graphs. Stationary, Correlation, Co-integration and Granger Causality test results are evaluated given the previous studies in the literature.

In conclusion part, evaluations and recommendations about combating the shadow economy for Turkish economy are given in the light of empirical findings.

CHAPTER 2

GENERAL CONSIDERATION OF SHADOW ECONOMY

2.1. Definition of Shadow Economy

In literature, shadow economy is described as underground, informal, black, non-tax, hidden, unofficial, unrecorded economy (Ünal 2014).

"The term 'informal' tends to refer to artisanal and very small-scale activities and is mostly associated with the so-called less developed country context. The term 'hidden' and 'underground' tends to be associated with tax evasion. The terms 'parallel', and 'black' seem to be most associated with currency dealings. 'Unofficial' and 'unrecorded' activities seem to be mostly referred to economic activities that escape the national statistics collection agencies."

(Eilat and Zinnes 2000).

Just like there are multiple wording of shadow economy, there are many different definitions. System of National Accounts (SNA) (1993) defines it as *"the value-added activities that the official statistics do not register although they should".*

(Jie et al. 2011).

Smith (1994) defines it as *"market-based production of goods and services, whether legal or illegal, that escapes detection in the official estimates of GDP".*

Shakibaee (2007) defines shadow economy "*as an economic activity that includes production and distribution of all goods and services that are hidden from the eyes of the authorities knowingly or with other reasons.*

(FiroozAbadi et al. 2015).

The preferred definition as defined by Schneider and Williams (2013) as *"…those economic activities and the income derived from them that circumvent or otherwise avoid government regulation, taxation or observation".*

When we examine the studies done on the shadow economy, we see that shadow economy involves many characteristics. The shadow economy is generally defined as illegal, statistically incommensurability, remain non-tax, providing income or benefit (Unal, 2014). Table 1 below summarizes the types of shadow economy.

Table 2.1: Types of shadow economy: Illegal, Unreported, Unrecorded and Informal

Types of shadow economic	Definition	Activities
Illegal Economy	"Totality of the revenues that are generated by those economic activities that violate the legal status of legitimate forms of trade"	Illegal activities such as illegal drugs dealing, black market of currency exchange, money laundering, unlicensed money lending, illegal gambling prostitution and pornography.
Unreported Economy	"Totality of economic activities that escape or avoid fiscal rules as they are defined in fiscal codes"	Unreported revenue either from legal sources or illegal sources.
Unrecorded Economy	"Activities that avoid institutional conventions that define the necessary requirements for the report to governmental agencies for statistics	-
Informal Economy	"Economic activities that avoid costs and excluded from the rights and benefits that come along with leasing, work contracts, loan and social security"	Revenue that generated by economic agents that operate informally.

Source :(Feige, 1997) and (Rădulescu, Propescu and Matei, 2010)

In this study, the following narrow definition of the shadow economy is used[1]. "*The shadow economy includes all market-based legal production of goods and services that are deliberately concealed from public authorities for one or more reasons:*

1) *to avoid payment of income, value added or other taxes,*
2) *to avoid payment of social security contributions,*
3) *to avoid certain legal labor market standards, such as minimum wages, maximum working hours, safety standards, etc., and*
4) *to avoid certain administrative obligations, such as completing statistical questionnaires or other administrative forms".*

(Feld and Schneider 2010)

[1] See also the excellent discussion of the definition of the shadow economy in Kazemier (2005a) and Pedersen (2003, pp. 13–19) who use a similar one.

In this way, illegal underground economic activities, crime activities (such as drug dealing, robbery and etc.) and all household services and productions are excluded from shadow economy.

2.2. The Importance of the Shadow Economy

The governments rise the problem of shadow economy in the 1960s, while shadow economy attracts the attention of researchers in the 1970s. Since 1990s, shadow economy has been the subject many studies in Turkey (Nas 2014; Önder 2012). Before examining the determinants of the shadow economy, we will review potential positive and negative effects of shadow economy are discussed in literature.

Eilat and Zinnes (2002) state that there is considerable positive effects of shadow economy on employment during recession or early stages of transformation periods. During recession periods, large numbers of employee may not be employed in the official economy but may be employed in the unofficial economy and by this way many sector may keep surviving during recession. That is, shadow economy may lessen the negative impact of recession in the economy by reducing wages. On the other hand, majority of the money earned in the shadow economy is spent in the official sector. According to Schneider (2002) around 66 % of unrecorded income is returned to the formal economy via consumption. Hence, informal sector have low cost due to shadow employment, which leads to low price in comparison to market price. In that way, welfare of society may increase owing to the increase in purchasing power of individuals.

Negative effects of shadow economy are more discussed in the literature. Unpaid taxes due to the unrecorded transactions lead to the budget deficit. This causes the reduction of investment, increase of unemployment and unregistered employment, deterioration in the financial structure of the social security institutions, distortion of distribution of income, increase of inflation and so on. Besides, it is stated that unregistered produced goods and services that produce lower cost lead to unfair competition. Moreover, since the informal economy is not included in the official records, economic indicators specified in the formal economy (such as inflation, employment, GDP, labour force) are not measured correctly (Nas 2014; Önder 2012). Generally, governments have made policy objectives to reduce the size of shadow

economy, because of the negative impact of the shadow economy on the entire economy (Schneider, F. and Williams, C. C., 2013).

In order to be protected from the negative effects of the shadow economy and to combat it, the major reasons of the shadow economy must be determined first. Schneider (2012) argues that the main determinants of the shadow economy are deterrence, tax and social security contribution burdens, intensity of regulations, public sector services and tax morale. Unal and Onder (2014, 2012) find inflation, income distribution, unemployment, economic instability, tax morale, tax burden, justice of taxation, and the uncertainty of the tax environment as the main causes of the shadow economy. Below, we will reveal the determinants of the shadow economy by displaying literature review.

2.3 The Problem of Shadow Economy in Turkey

Schneider (2015) states that the average size of shadow economy for 28 EU countries is 18.6 per cent in 2014 and is expected to be 18.3 per cent in 2015. As for Turkey, the size of shadow economy is 27.2 per cent in 2014 and expected to be 27.8 per cent in 2015. Compared to the EU average, the size of the shadow economy for Turkey is one of the most important problem that needs to be solved. For this reason in recent years, Turkish government has prepared an action plan in order to combat the shadow economy and to approach the EU average. Turkish Revenue Administration is assigned to ensuring coordination between public institutions by the Turkish government. For this purpose, firstly four different independent tax inspection units were merged under a single tax inspection board. Then, the number of inspectors employed was increased. Moreover, increase the exchange of information between relevant public institutions in terms of dealing with the informal economy decided. In the light of above, in this thesis, firstly the relationship between the size of the shadow economy and deterrence of tax audit is tested.

2.4. Literature Review

This chapter summarizes some existing works on shadow economy in literature. There are lots of study about shadow economy in literature in order to reveal the relationship between shadow economy and other economic, social, fiscal, political indicators such as corruption, social development, tax burden, unemployment, public expenditures, population growth and so on.

In most recent study, Schneider et al. (2015) measured the size of shadow economy of 31 European Countries (including Turkey, Switzerland and Norway) in 2014 and 28 European Union countries over 2003-2014 (in per cent of official GDP). MIMIC method is used in this study. According to this study, the average size of the shadow economy in 28 EU countries was 22.6 per cent in 2003 and this ratio decreased to 18.6 per cent in 2003 2014 period. They also determine the largest driving forces of the shadow economy in terms of countries included in the analysis. These are respectively unemployment and self-employment with 14.6 per cent, tax morale with 14.5 per cent and GDP growth with 14.3 per cent. In addition to this result, the proportional effect of tax evasion on the size of shadow economy for countries included in the analysis is found as 4.2 per cent of GDP.

Dreher and Schneider (2006) investigated the impact of shadow economy on corruption and vice versa. They hypothesized that shadow economy and corruption are substitutes in high income countries whereas they are complements in low income countries. The hypotheses were tested for a cross-section of 120 countries and a panel of 70 countries for the period 1994 and 2002. The result confirmed their hypothesis and revealed that shadow economy reduces corruption in high income countries, however, it increases corruption in low income countries. They also find that stricter regulations increase both corruption and the shadow economy.

Polonskyi (2009) examined the relationship between corruption and shadow economy in Ukraine and Russia. 2SLS, GMM and 3SLS estimation methods were applied. In previous study Dreher and Schneider (2007) concluded that there was a complementary relationship between corruption and shadow economy for Ukraine and Russia. However, Polonskyi (2009), contrary to Dreher and Schneider (2007), finds no clear evidence of complementary relationship between corruption and shadow economy for low income countries such as Ukraine and Russia in his study. Therefore, he pointed out that further analysis should be conducted with more data by using panel data and expanding the sample.

Vlachaki (2015) empirically analysed the impact of the shadow economy on indirect tax revenues of 125 countries for the 1990 – 2011 period. Under the absolute tax compliance assumption, this study depends on a government would prefer to depend on less indirect taxation, considering indirect taxation's distorting nature. The author tries to find answer to the following question.

Due to the size of black economy, if a government fail to raise direct tax revenues, do the government change its decision and tend towards indirect taxation more. The author concludes that the size of shadow economy increases the proportion of indirect tax revenues to GDP as long as the size of shadow economy does not exceed a cut-off value, however, any further increase above the threshold value affects indirect taxation negatively.

Katrechka and Dahlberg (2014) analysed the effect of the shadow economy on social development. In their research, life expectancy, HIV prevalence, school enrolment, mortality under age 5 were selected as determinants of social development. Investigation of the relationship between the shadow economy and social development were carried out within a sample of advanced and least-developed 58 countries, during period of 39 years (1970-2008 period). The result of the empirical analysis revealed that there is a negative relationship between the shadow economy and social development.

Dobre and Alexandru (2010) used time-series data for the USA hidden economy and unemployment rate in order to explore the linkage between unemployment rate and the size of shadow economy in USA from 1980's to 2007. Granger causality tests carried out and it was found that both series are cointegrated and there is strong evidence of Granger causality from unemployment rate to shadow economy. Moreover, there is no "reverse causation" from shadow economy to unemployment rate.

Kara (2014) analyse the effect of tax amnesties on tax revenue and shadow economy after 1985 in Turkey. Cross-examination of amnesty effects was carried out with Ordinary Least Squares regression (OLS) and Error Correction Model (ECM). Empirical results suggest that tax amnesties are proved to be ineffective both in terms of revenue and size of the shadow economy in Turkey. Only 1989 amnesty yields statistically significant results in increasing total tax revenues. As for shadow economy, all of the amnesties being insignificant except 2002 and 2008 amnesties. Post effects of 2008 amnesty indicate that shadow economy size increase.

Torgler and et.al (2008) analysed the relationship between local autonomy and tax morale or the size of the shadow economy in Switzerland. Multiple regression analysis was employed and the data of 1990, 1995 and 2000 was collected for the

study. Centralisation, Direct Democracy, GDP, transfers, population size, tax burden, labour force, unemployment rate, education expenditures data were used as an independent variables. The findings suggest that there is a positive relationship between local autonomy and tax morale, negative relationship between local autonomy and the size of shadow economy.

Dreher and et.al (2008) examined the relationship between institutional quality, the shadow economy and corruption. These predictions were tested using data from 78-135 countries between 2000 and 2002. OLS, 3SLS and 2SLS regression models were used in the study. Shadow economy, corruption, GDP per Capita, Fiscal burden, age of democracy, school enrolment are employed as variables in the analysis. Model shows that an improvement in institutional quality reduces both shadow economy and corruption.

Schneider (2013) examine shadow economy, tax evasion and corruption in Portugal and in other OECD countries. In his study, in addition to the above, he revealed the dimension of shadow economy for 31 European countries over 2003 – 2012. His analysis showed shrinking in the size of shadow economy for most OECD countries and increasing the extent of corruption and the damage from it.

Schneider and et.al (2010) revealed the main causes, indicators, size and development of the shadow economy for 162 countries between 1999 and 2007. The authors find a clear negative trend in the size of shadow economy from 1999 to 2007 for observed countries. Authors used the MIMIC (Multiple Indıcators Multiple Causes) estimation method in order to measure the size of shadow economy. They conclude that the driving forces of the shadow economy are an increased tax burden, combined with labour market regulations and the quality of public goods and services, as well as state of the official economy.

Yendi (2011), firstly revealed the different measurement methods of shadow economy in her study. Then, she discussed the causes of the shadow economy. She obtains panel data analysis and uses three models for 56 countries between 1999 and 2007 in order to investigate economic, financial and institutional reasons of shadow economy. Contrary to expectations, she finds that the size of shadow economy increases as GDP growth rate per capita increases, however, the size of shadow economy decreases as unemployment increases in the observed country economy. Her

results show impact of inflation, economic freedom and government spending on shadow economy are ambiguous. She also found as marginal corporate tax rate increases, the size of shadow economy increases.

Rakici (2011) evaluated the new structure of tax audit and the role of tax auditing in preventing shadow economy for Turkey. He stated that there is negative relationship between tax audit and shadow economy. He emphasized that the size of shadow economy will decrease by increasing the tax audit rate. The author advocates that increases the number of inspector will make positive contribution to prevent shadow economy, however, he highlighted that increasing only the quantitative capacity will not enough to become more functional in terms of tax audits beside this qualitative capacity of tax inspectors should be increased.

Cebula (1997) established a model in order to analyse the effect of federal income tax rates, Internal Revenue Service (IRS) tax penalties on unpaid tax liabilities by taxpayers and tax audit rates of the IRS on the size of the shadow economy in the USA. In the study, period between 1973 -1994 were examined for USA economy by employing ordinary least square (OLS) method. The author concluded that the maximum marginal personal income tax rate increases the size of shadow economy. Moreover, the author confirmed that as the probability of being audited and expected tax penalty imposed by the IRS from underreporting income increases, the size of shadow economy decreases for USA economy.

Yıldız (2013) estimated the black economy between 2001 and 2012 by using quarterly data in Turkey. She explained the reasons and consequences of the black economy in Turkey. The currency demand approach is conducted for the estimation by taking real GDP per capita, inflation, interest rate and tax rate as independent variables and real currency in circulation as a dependent variable. The result revealed that there is a positive relation between tax rate and money demand as anticipated. Moreover, the results uncovered that, besides tax burden, other important factors such as economic crises, unemployment and informal employment, demographic structure and cash based economy effecting underground economy in Turkey.

Dobre and Alexandru (2015) estimates the size of the Romanian shadow economy by using the currency demand approach. Then, using Granger causality tests and ECMs, they examines the impact of unemployment rate on the Romanian shadow

economy involving the quarterly period between 2000 and 2010. The empirical result revealed the existence of a negative relationship in the short-run and a positive relationship in the long-run between both the unemployment rate and the size of the shadow economy.

2.5. Determinants of Shadow Economy

The severity of mentioned reasons of shadow economy varies according to each country's own characteristics. In literature generally the reasons of shadow economy differ in both developed and developing countries. In studies on developed countries, the height of the tax and social security contributions, deficiency in the auditing system and excessive government regulations are often being displayed as the determinants of the shadow economy. As for developing countries, high tax rates, complex tax system, low rate of industrialization, unskilled labour, corruption, excessive regulations and bureaucracy are being displayed mostly as the determinants of shadow economy. In the following table, the determinants of shadow economy mentioned in the literature are summarized under three headings.

Table 2.2. The Determinants of Shadow Economy

Economic Determinants	Fiscal Determinants	Social and Political Determinants
• Inflation • Unemployment • Income Distribution • Economic Development • GDP per Capita • Reasons arising from tax audit • Globalisation and Foreign Trade • The share of agricultural and service sectors in the economy • Economic Instability	• The height of the tax and social security contributions • Tax Burden • Social Transfers • Public expenditures • Vagueness in taxation	• Tax Morale • Education Level of Individuals • The Effectiveness of Tax Administration and Tax Auditing • Tax Awareness • Corruption • Population Growth

Source: It has been compiled from various sources found in the literature. (Schneider 2000; Schneider and Williams 2013; Nas 2014; Unal 2014; Yendi 2011)

Below, determinants used in this study will be explained shortly.

2.5.1. Tax Burden

Tax burden is generally defined as the ratio of total taxes to gross domestic product (GDP). Schneider and Williams (2013) stated almost all studies reveal that the overall tax and social security contribution burdens are among the main causes of the shadow economy. There is positive correlation between shadow economy and tax burden. If tax burden increase in a country, economic units move from formal economy to informal economy over time. An increase in the existing tax rates would increase the country tax burden on individuals. Economically, heavy tax burden on companies and individuals are directed them to operate outside the formal economy (Nas 2014).

In terms of employment, the increases of the tax burden affect labour-leisure choices of individuals and decreases labour supply to the formal economy. Additionally, as tax rates increases, tax avoidance and tax evasion would increase (Nas 2014).

2.5.2. Unemployment

One of the factors that creates instability in the economy is unemployment. As unemployment increases, unregistered individuals who cannot find a job in the formal economy begin to operate in the shadow economy, which in turn leads to an increase the size of the shadow economy. On the other hand, high level of unemployment is an indicator of recession and crisis in the economy. Given that the economy is the sum of formal and informal sectors, informal sector will be affected by negative economic conditions, which may lead to a reduction in the size of informal economy.

As mentioned the literature, Schneider (2015) find one of the largest driving forces of shadow economy is unemployment in his study. Yendi (2011) concluded that there is negative relationship between the rate of unemployment and the size of shadow economy in her study. Yıldız (2013) reveals that unemployment has impact on the shadow economy in Turkey. Dobre and Alexandru (2015) find negative relationship in short-run and a positive relationship in long-run between both the unemployment rate and the size of the shadow economy for Romanian economy.

2.5.3. Corruption

Corruption is defined in many different ways, however, Tanzi (1998) defines the most popular definition of corruption as the abuse of public power for private benefit. According to the Tanzi (1998), there is inversely proportional relationship between the development level of a country and corruption-bribery. As a country's level of development increases, the corruption- bribery rate reduces. Corruption-bribery rate is lower in developed countries than less developed and developing countries (Nas 2014). Number of researchers have studied the relationship between the shadow economy and corruption. Dreher and Schneider (2006) concluded that there is negative relationship between shadow economy and corruption in high income countries, positive relationship between them in low income countries. Dreher and et.al (2008) reveales that corruption and shadow economy are substitutes in their study.

2.5.4. Tax Auditing

Effective and efficient way to collect the tax can only be achieved through the establishment of justice in taxation. If a country does not ensure justice in taxation, economic units (individuals and corporations) consider that there is unfairness in taxation and they will be shifted from formal economy to the shadow economy. The effectiveness of tax administration and adequacy of tax audit is one of the most significant factors affecting the shadow economy. Tax audits, which determines whether taxpayers comply with the tax laws has an important role in reducing the shadow economy. Under an effective tax auditing system, taxpayers do not choose operating in the informal sector because they think that will be subjected to tax auditing by tax administration. On the other hand, the lack of effective tax auditing system leads to unfair competition between taxpayers who work in formal and informal economy. In addition to the lack of an efficient tax system, insufficient number and quality of tax auditing, low level of auditing risk, low tax penalties are the stimulants for shadow economy. As the tax auditing risk increases, taxpayers prefer staying in formal economy. Therefore, frequent audits and investigations have a deterrent effect on shadow economy (Nas 2014; Yendi 2011; Unal 2014). As Schneider (2012) revealed in his study, deterrence is one of the main determinants of the shadow economy. In this sense, Cebula (1997) observed the impact of federal income tax rate, tax audit rates of the IRS and expected tax penalties levied by IRS to underreporting income on

the size of shadow economy in USA. The author concluded that as deterrence (probability of being audited and the height of the penalty) increases, the size of shadow economy decreases for USA economy.

2.5.5. GDP Per Capita

GDP per capita is one of determinants of the shadow economy. In the earlier studies on the shadow economy, it is emphasized that informality is the problem of underdeveloped countries and it is anticipated as development level of countries rise, size of shadow economy could be alleviated (Kuehn 2007). However, recent studies indicate that informality reached massive proportions in the developed countries. This shows shadow economy can be solved with economic development. This case reveals once again the fact that shadow economy is a multi-dimensional problem. Yendi (2011) finds negative relationship between GDP per capita and size of shadow economy in her study.

CHAPTER 3

DATA AND METHODOLOGY

In this chapter, relationship between the size of shadow economy and its determinants such as tax burden, tax auditing number, tax inspectors number, GDP per capita, unemployment, corruption are investigated empirically. Time series analysis is used as econometric methods in order to investigate the relationship between the shadow economy and its determinants for Turkey in period 2000 and 2014. In this context, firstly unit root tests are used in order to analyse the stationarity of data. If the stationarity of the variables are not ensured for the analysis, it might be an indication of spurious regression. Then, correlation between the variables is revealed. Before making Granger Causality Test, co-integration of series is tested. After that, optimum lag length of series is determined in order to complete causality test. Finally, causal relationship between variables is tested with Granger Causality and Var Granger Causality/Block Exogeneity Wald Tests. E-views 7.2 statistical program is used for these tests.

3.1. THE DATA

The relationship between the size of shadow economy and other variables mentioned above has been analysed in this dissertation for Turkey. Data set in this study consists of Turkey's annual taxational and macroeconomic time series (15 observation) from 2000 to 2014. The size of shadow economy is used as a dependent variable, whereas tax inspector number, auditing number, tax burden, GDP per capita, unemployment rate and corruption perception index are used as an independent variables. The data about the size of shadow economy for Turkey is obtained from Schneider (2015)'s study. Data on tax inspector number, auditing number and tax burden are compiled from Turkish Tax Inspection Board (TTIB), Turkish Revenue Administration (TRA) and Turkish Ministry of Finance General Directorate of Personnel (TGDP). Data on GDP per capita and unemployment rate are collected "DataStream" website. Corruption index is obtained from "Transparency International". In time series analysis, economic variables are generally transformed to logarithmic form in order to stabilise the variance of a series (Lutkepohl and Xu 2009). For this purpose, raw data of all variables that used in this study are converted to logarithmic form.

3.1.1 Model and Variables

As mentioned below, first difference of all variables are employed in order to ensure stationary in the model. In this sense, all analysis except Var Granger Causality/Block Exogeneity Wald Test made below has performed considering first difference of the logarithmic series. Variables used in the model are as follows:

Dependent Variable

DLSE: First Difference Logarithm of Size of Shadow Economy

Independent Variables

DLIN: First Difference Logarithm of Inspector Number Series

DLAN: First Difference Logarithm of Auditing Number Series

DLGDPC: First Difference Logarithm of Gross Domestic Product per Capita

DLTB: First Difference Logarithm of Tax Burden Series

DLC01: First Difference Logarithm of Corruption Index

DLU: First Difference Logarithm of Unemployment Series

$ß_0$, $ß_1$…….$ß_n$: Coefficient of Variables

The model in this study is established as follows:

$$DLSE = ß_0 + ß_1\,DLIN + ß_2\,DLAN + ß_3\,DLGDPC + ß_4\,DLTB + ß_5\,DLC01 + ß_6\,DLU \quad (1)$$

3.2. METHODOLOGY

Model estimations are made for several purposes: these are structural analysis and forecasting the future values. Structural analysis is interested in testing economic theories. Forecasting the future, based on the estimated model, is interested in determining the future value of dependant variables. Time series shows the hourly, daily, weekly, monthly and yearly change in the value of the variables. The purpose of time series analysis is to predict future values by examining the value for the previous period. Time series consist of four components (impacts): These are respectively trend, seasonality, cyclical fluctuations and random movements (incidental).

Trend (T_t) reflects the long-run general tendency of time series (stable condition) during the time after falling and rising process.

Seasonality (S_t) indicates the changes occurring in the time series according to the seasons (if monthly or quarterly data is used in analysis).

Cyclical fluctuations (C_t) state the fluctuations which are influenced by changes occurring in economy.

Random movements (R_t) point out non-periodic changes of random events which cannot be determined previously.

In the light of above time-series (Y_t) can be formulated as $Y_t = T_t + S_t + C_t + R_t$

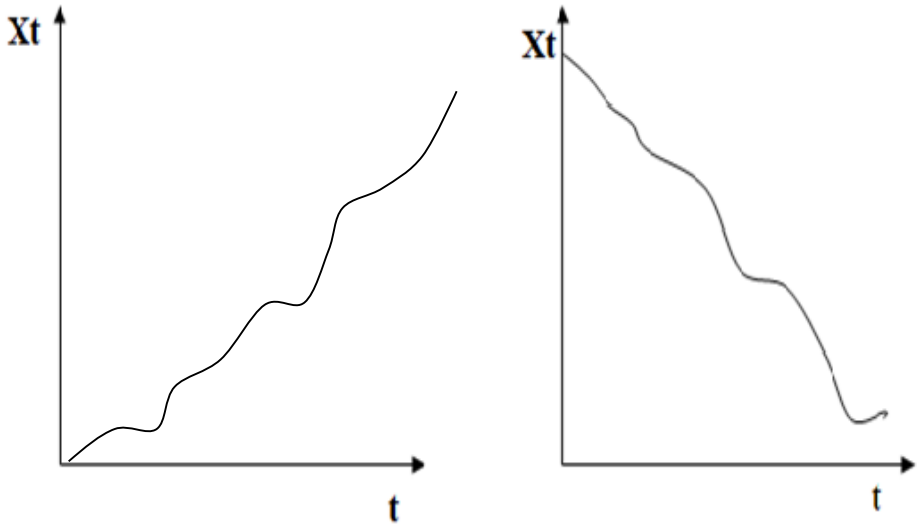
Time series work with random, that is stochastic variables (depending on the rules of probability).

A time series analysis should be made by taking into account the deterministic or stochastic properties of the variables. Deterministic properties reveals the existence of trend, seasonality and constant coefficient. Stochastic properties are concerned with the stationary of variables. Stationarity of a time series is to approach towards a specific value over time. More precisely, time series is to have a constant average, constant variance and constant covariance depending on the delay length. Stationarity is defined as a time series data that is not continuously increase or decrease in a given time period. That is, data shows scatter along a horizontal axis over time. If an economic time series have non-stationary behaviour, the impact of any shock being exposed by the series will be permanent. The respective trend impact is the most important reason for non-stationary behaviours of economic time series. In order to remove the non-stationary nature of time series the first difference of variable is taken, if the trend is stochastic. If the trend is of deterministic nature, it is necessary to eliminate the trend impact of time series in order to remove the non-stationary nature of the time series (Yesilyurt 2011). Time series analysis assume that the series is stationary. Classical regression model was used to explore the relationship between stationary variables. Before examining causal relationship between variables, it is necessary to determine degree of stability of series. Spurious regression may arise if analysis is conducted with non-stationary time series. Although there may be high R^2 and significant t statistic value, parameter estimates are economically nonsense. The use of non-stationary time series may actually cause in obtaining a non-existing (irrelevant) relationship between the variables to be estimated in the model. Therefore, regression should not applied to non-stationary series. For these reasons, in studies conducted with time series analysis firstly the stability of time series needs to be tested

in order to avoid spurious regression. There are many ways for determining whether a time series is stationary or not. Two of them are below (Taraktas 2010).

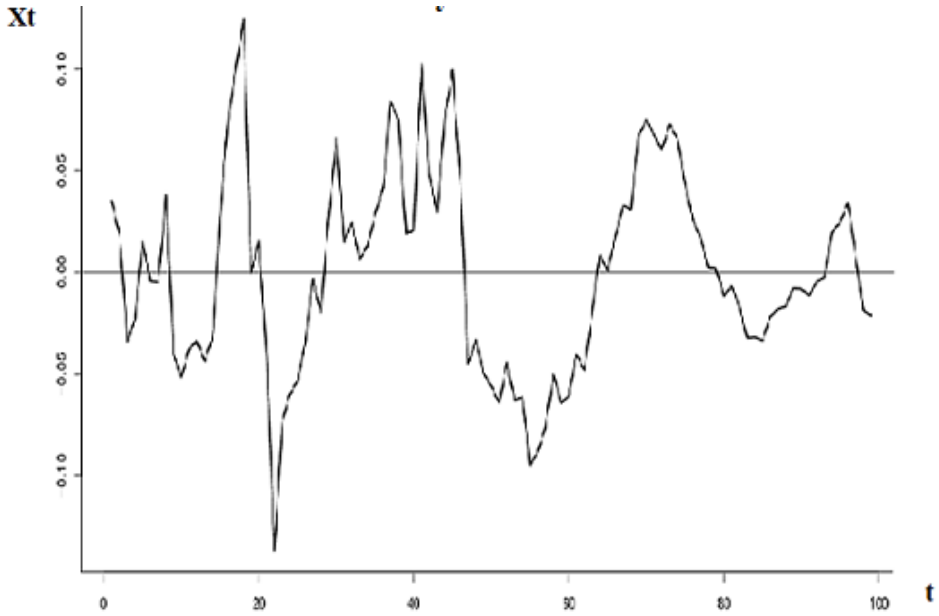
1. Relying on subjective judgements made on time series chart (graph).
2. Applying unit root tests on data

Graph 3.1: Non-stationary Trend Condition Graph



Source: Taraktaş 2010.

Graph 3.2: Stationary Trend Condition Graph



Source: Taraktaş 2010.

As is seen above, Graph 3.1 show permanent increasing or decreasing trend in a given time period and these graphs are given as a sample to the non-stationary series. However, Graph 3.2 shows scatter along a horizontal axis over time. Such similar plots are given as a sample to the stationary series. After ensuring stationary of the variables, correlation analysis will be conducted in order to measure the correlation between selected variables. Later, optimum lag length will be determined to be able to test Granger Causality Test. Lastly, causal relationship between the variables will be revealed.

3.2.1. Unit Root Test

We apply unit root test to check whether there is stationary of a time series. In practice, there are many unit root tests used in the literature.

The most widely used methods are respectively Dickey&Fuller test (1979), Augmented Dickey&Fuller test (1981), Philips&Perron (PP)-(1988) test and Kwiatkowski&Phillips&Schmidt&Shin KPSS (1992) test (Taraktas 2010).

In this study, the Augmented Dickey&Fuller (ADF) test is obtained in order to determine whether there is a unit root in variables used in this study. The model of ADF unit root test is as follows:

$$\Delta y_{t} = ß_0 + ß_1 + \partial y_{t-1} + \sum_{i=1}^{n} \alpha i \Delta y_{t-1} + \varepsilon_t \qquad (2)$$

In the model, ∂yt-1 indicates first difference of dependant variable, εt indicates the constant term among the variables, ß0 and ß1 show the trend variables and $\sum \alpha_i \Delta y_{t-1}$ indicates the lagged values of Δy_t in the model. $\sum \alpha_i \Delta y_{t-1}$ term was inserted to the model in order to solve the autocorrelation problem (Yesilyurt 2011). Autocorrelation problem is arise when there is similarity between specified time series and its lagged value over consecutive time intervals (Filis 2014).

Time series data are generally assumed to be non-stationary. If time series data is not stationary, results of the analysis will be spurious. For this reasons, data used in the analysis should be converted to a stationary time series. In the ADF test, Akaike (AIC) and Schwardz (SC) information criteria is employed in order to clarify appropriate lag length in determining how many previous period values of Δy_t variable will be included in the model (Yesilyurt 2011). In this study, ADF tests the null hypothesis against the alternative hypothesis.

H_0 indicates that each variables used in this study has a unit root (non-stationary)

H_1: indicates that each variables used in this study does not have a unit root (stationary)

3.2.2. Correlation Analysis

There are many ways in order to measure the relationship between two or more variables. Two of the most applied methods are scatter plot and correlation analysis. Scatter plot figures the relationship between the variables for two data series (Botsvadae 2012). As for correlation analysis, this reveals the relationship between two variables by using a single number. In other words, the main aim of correlation analysis is to measure the strength or degree of linear relationship between two variables (Agung and Gusti 2009). Correlation is defined as the relationship of dependency between two variables. The severity of this relationship is determined by the correlation coefficient. Covariance constitutes the basis of the correlation coefficient. Variance is a measure of the distribution around the arithmetic mean a series. In a combined series of two variables, covariance is used to determine the distribution of the arithmetic mean of the series around together (Uygur 2013). The formula for computing the sample correlation coefficient is as follows:

$$\rho = \frac{Cov\ (X, Y)}{\partial x \partial y}$$

In the formula above;

ρ signifies the sample correlation coefficient

Cov (X, Y) is the sample of covariance X and Y

∂x and ∂y are the sample standard deviation of X and Y

The correlation coefficient is indicated by the symbol ρ and range between -1 and +1. The closer the coefficient is to (+) 1, the stronger the positive linear correlation between the two variables. Similarly, the closer the coefficient is to (-) 1, the stronger negative linear correlation between the two variables. The correlation coefficient of 0 indicates no linear relationship between the two variables (Botsvadae 2012).

3.2.3. Co-integration Test

Granger in 1981 firstly introduced the concept of co-integration and Engle and Granger (1987) defined the co-integration as a theory and alleged that the linear

combination of non-stationary series were stationary (Susam 2013). Co-integration is the necessary criteria for stationary among non-stationary variables. Therefore, testing the co-integration of series is very important in order to understand whether the model is statistically meaningful. In other words, co-intergation has improved as a technique in order to examine the correlation between the two non-stationary time series because most econometric techniques are based on stationarity of series. If two or more time series have a long term relation, the series are deemed to be co-integrated (Darrat and Sarkar).

Technically, this method is used the following conditions. Suppose that there are two time series X and Y. These series are non-stationary in level. However, when difference of X and Y series are taken, if X and Y is stationary, it is said that there is long-run relationship (co-integration) between the series. Taking differences of series leads to move the disappearance of long-run relationship between series. However, co-integration method allow making analysis with level for which series are non-stationary in level but stationary in same order differenced. After co-integration test result, if co-integration is not detected between series, it is continued to work with series in differences. However, if co-integration is detected between series, Toda Yamamoto procedure may implemented for co-integrated variables to test Granger Causality between them.

3.2.4. Vector Autoregressive (VAR) Models and Granger Causality Analysis

Systems of simultaneous equations are produced as a method to describe complex relationship and events which cannot be described by a single equation and the complex relationship. The basis of VAR models are based on systems of simultaneous equations. The concept of systems of simultaneous equations refer the simultaneous bi-directional influence of two variables such as X and Y and refers the dual response of variables from each other. VAR analysis results can be obtained in three ways. These are respectively F tests which shows the Granger causality and variance decomposition which shows the interaction between variables and impulse-response functions.

First, stationary condition of series should be ensured in order to conduct VAR analysis. One of the significant point for VAR analysis is to determine the optimum

lag length of the series. Optimum lag length is expressed as the condition that there is no correlation between the error terms and lag length which is a minimum sum of error terms. In case of incorrect determination of the optimum length of the lag, inconsistent results may arise in the impulse-response analysis and variance decomposition stages. (Uygur 2013).

First study on causality was conducted by Granger in 1969. Causality test between Granger variables is based on time series data. While there is relationship between two variables depending on the time delay, Granger test tries to determine the direction of causality statistically.

Granger causality is available to test causality only between two variables For instance, suppose that there is two time series denoted x_t and y_t and let's assume that causality between them exist. In this case, there are three possible situations: either x_t is the cause of y_t, or y_t, is the cause of x_t or each one is the cause of the other. (Zhang and Yao 2015). That is to say, three different cases respectively unidirectional causality, bi-directional causality or no causality relationship between the variable may occur.

In Granger causality test firstly, following equations are estimated:

$$X = \sum_{i=1}^{n} \propto i Y_{t-1} + \sum_{j=1}^{n} \beta j X_{t-j} + u_{1t} \quad (3)$$

$$Y = \sum_{i=1}^{m} \partial i Y_{t-1} + \sum_{j=1}^{m} \delta j X_{t-j} + u_{2t} \quad (4)$$

In the equation above, X and Y are time series variables, α, ß, ∂ and δ are coefficients. u_1 and u_2 denote disturbance terms. According to the simple equations above, if $\sum \alpha i \neq 0$ and $\sum \delta j = 0$, it is concluded that there is unidirectional causality from Y to X. if $\sum \delta j \neq 0$ and $\sum \alpha i = 0$, it is concluded that there is unidirectional causality from X to Y. if $\sum \alpha i \neq 0$, $\sum \delta j \neq 0$, $\sum ß_j \neq 0$ and $\sum \partial_I \neq 0$, it is concluded that there is bi-directional (X↔Y) relationship between them (Zhang and Yao 2015).

3.2.5. Toda Yamamoto Procedure

As mentioned before, Granger Causality test proposed by Granger (1969) is the common way to test the causal relationship between two variables. However, traditional Granger Causality test has some limitations. First and foremost, time series data should be stationary and have normal distribution. Therefore, testing causality of any non-stationary series with traditional Granger Causality give spurious results (Şoltan 2009).

In (1995) Toda and Yamamoto propose a simple procedure requiring the estimation of an augmented VAR which guarantees the asymptotic distribution of the Wald statistic, since the testing procedure is robust to the integration and co-integration properties of the process In other words, If two or more time-series are co-integrated, Granger Causality is tested by Wald Test. To implement this procedure, firstly lag length (m) of the series is determined and maximum order of integration (dmax) is chosen for the series (Alimi and Ofonyelu 2013). Then, set up a VAR model in the level or logarithms (not differenced) regardless of the integration of the various time series. Finally, VAR Granger Causality/Block Exogeneity Wald Test is implemented to variables. In this test, null hypothesis assume that there is no causality between variables. If null hypothesis rejected, there is causal relationship from independent variable to dependant variable. Let's say, from X to Y.

CHAPTER 4

EMPIRICAL ANALYSIS AND FINDINGS

4.1. Descriptive Statistics of the Variables

Basic descriptive statistical data analysis play a vital role in data evaluation, decision making or policy analysis (Agung and Gusti 2009). All of the statistics which illustrated below the summary statistics of seven variables Size of Shadow Economy (SE), Inspector Number (IN), Auditing Number (AN), Tax Burden (TB), Gross Domestic Product per Capita (GDPC), Unemployment Rate (U) and Corruption Index (CO1) employed in this study are presented below the tables. In the analysis, size of shadow economy, tax burden and unemployment rate data is considered as percentage and inspector number, audit number, GDP per Capita and corruption index is considered as numeric value. Mean value signifies the average value of the series. Average of the two middle values of the series signifies mean value when the values are ordered from the smallest to the largest. Maximum shows the maximum value of the series, and minimum shows the minimum values of the series. Standard deviation value is a measure of dispersion or spread in the series. In Table 4.1, descriptive statistics results of raw data of the variables are shown. The analysis period covers the period between 2000 and 2014 with 15 observations. Annual data is employed for this study.

Table 4.1: Descriptive Information (Raw Data)

Series	Size of Shadow Economy	Inspector Number	Auditing Number	Tax Burden	GDP per Capita	Unemployment Rate	Corruption index
Mean	29.693	3765.333	54228.40	20.266	14107.33	9.806	4.020
Median	29.100	3505.000	55284.00	20.300	14466.00	9.700	4.100
Maximum	32.800	5544.000	80091.00	23.400	16947.00	13.100	5.000
Minimum	26.500	2650.000	16267.00	15.900	10883.00	6.500	3.100
Std. Dev.	2.155	859.762	19085.53	2.116	2002.041	1.577	0.618
Skewness	0.071	0.627	-0.664	-0.579	-0.198	0.116	-0.022
Kurtosis	1.546	2.439	2.534	2.877	1.772	3.361	1.804
Jarque-Bera	1.333	1.179	1.239	0.849	1.039	0.115	0.895

Source: Author's calculation

As shown in Table 4.1., the mean value of size of shadow economy is around 29.69 % and standard deviation of the size of shadow economy is around 2 % for the observed period. During the 2000-2014, the size of shadow economy reach a

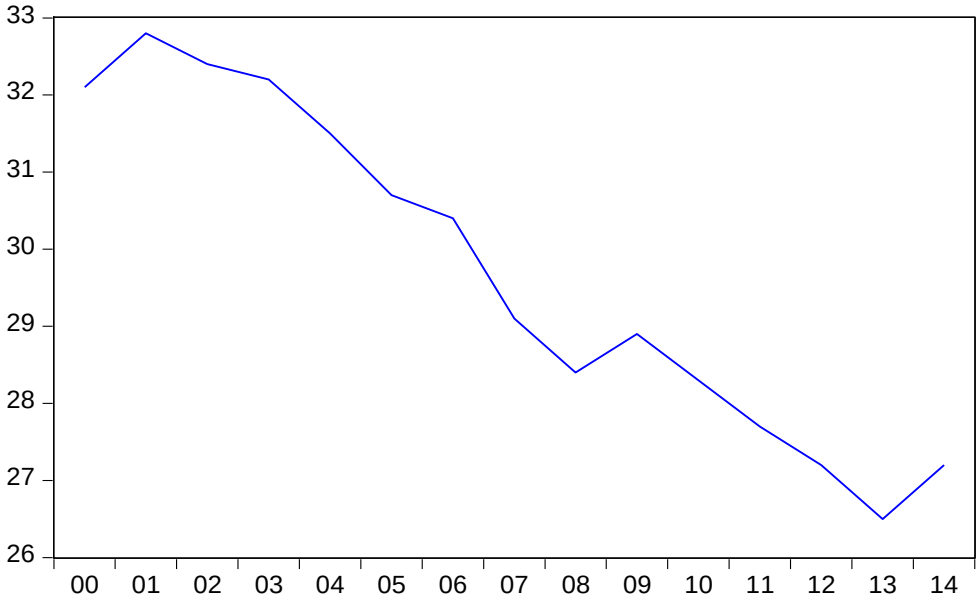
maximum of 32.80 % in 2001, while minimum was 26.50 % in 2013. Low standard deviation signifies that there is no significant changes on the size of shadow economy during the 2000-2014.

As for the inspector number, 3765 person on the average has employed as an inspector in a given period. Maximum and minimum inspector number employed is 5544 and 2650, respectively. High standard deviation (859 inspector) explain the gap between maximum and minimum number of inspector. As regards to auditing number, 54228 taxpayers have been audited as an annual average. Maximum 80091, minimum 16267 tax audit has been conducted by the tax inspectors during the 2000-2014. High standard deviation reflects the high fluctuation at the auditing number.

The average annual tax burden is about 20 % and the highest ratio is 23.40 % in 2003 and the lowest ratio is 15.9 % in 2000. Standard deviation of tax burden is around 2 %. GDP per Capita has been around 14,107- TL during the 2000-2014. GDP per Capita reach a maximum 17,000-TL in 2014, while minimum was 10,833-TL in 2001. High standard deviation confirms the substantial fluctuation at GDP per Capita. The average annual unemployment rate is about 9.80 %. Maximum and minimum unemployment rates has been around 13 and 6.5 %, respectively during the 2000-2014. Standard deviation of the variable is around 1.5 %. Corruption perception index is averagely 4. Maximum value is 5 and minimum value is 3. This values show that corruption perception of Turkish society is rather high.

Graph 4.1 illustrate the trend of size of shadow economy in Turkey between 2000 and 2014.

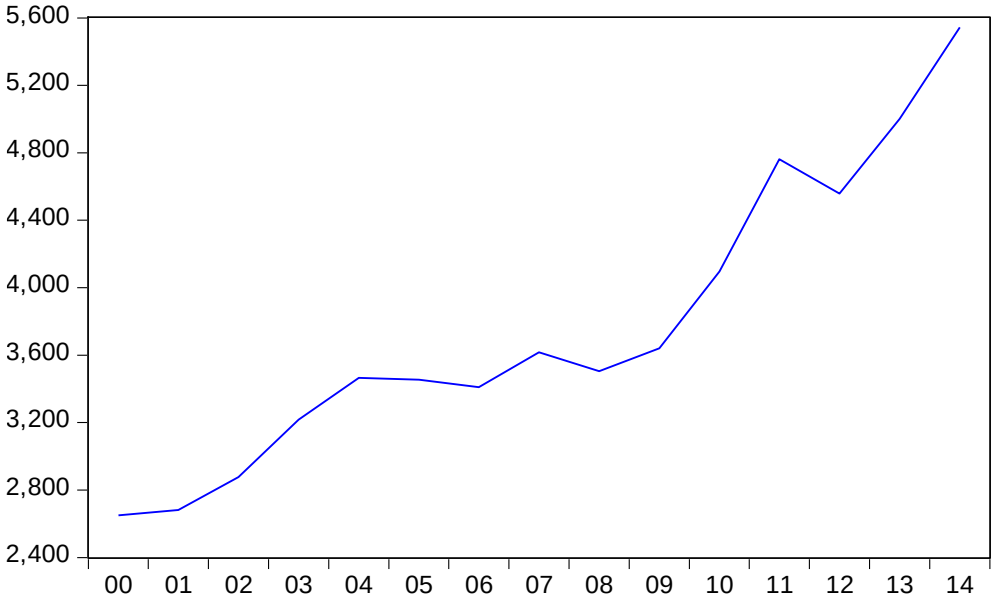
Graph 4.1: Size of Shadow Economy in Turkey, 2000-2014



Given Graph 4.1, the size of shadow economy shows increasing trend between 2000 and 2001. Since 2002, the size of shadow economy shows permanent decreasing trend until 2013. In 2014, the size of shadow economy increase in comparison to 2013. On average, Graph 4.1 shows that shadow economy have declining trend. Economic crisis in 2002 and recession in 2012 may have triggered the shadow economy in Turkey. Schneider et al (2015) indicate the average size of the shadow economy for 28 EU countries dropped from 22.6 percent to 18.6 percent between 2003 – 2014 periods. As regards to Turkey, average size of shadow economy between 2000 – 2014 periods is around 29 percent. Although diminishing trend of the size of shadow economy for Turkey, this ratio is rather high compared to 28 EU countries.

Graph 4.2 illustrate the trend of inspector number employed in Turkey between 2000 and 2014.

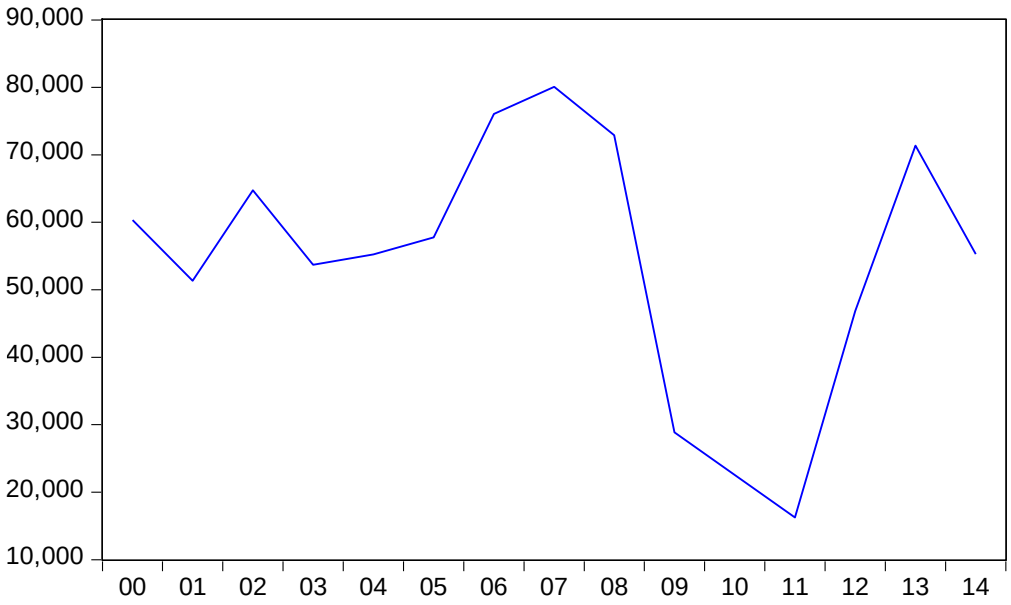
Graph 4.2: Inspector Number in Turkey, 2000-2014



A rising trend is observed in the inspector number employed by Ministry of Finance from 2000 to 2014. In the Graph 4.2, number of inspectors increases sharply from 2009. Recently, Ministry of Finance has issued an action plan to combat the problem of shadow economy in Turkey. Within the framework of the action plan, a large number of new tax inspectors have been employed in order to increase auditing number and hence, decrease the size of shadow economy in Turkey. As seen in Graph 4.2, number of inspectors has increased from around 3200 to 5600 over the last five years.

Graph 4.3 shows the trend of auditing number in Turkey between 2000 and 2014.

Graph 4.3: Auditing Number in Turkey, 2000-2014

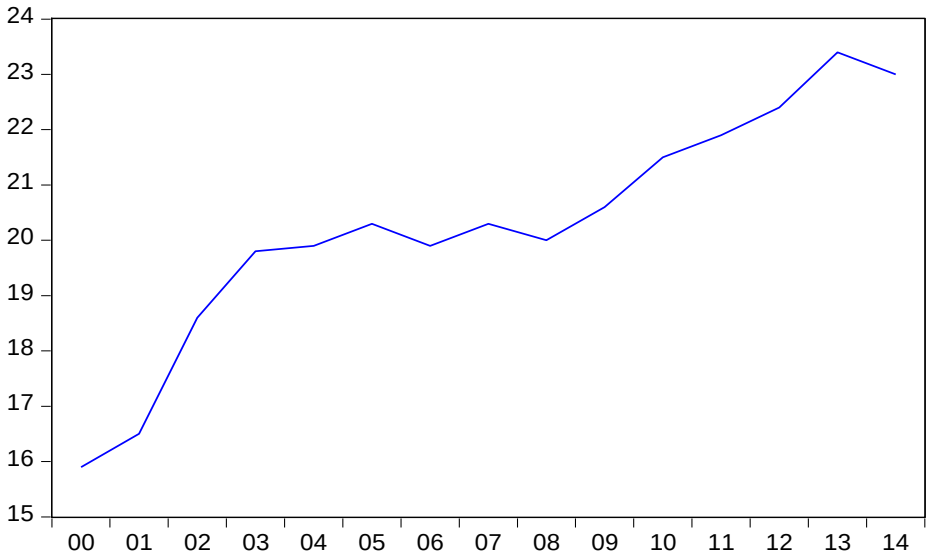


Graph 4.3 shows that auditing number largely fluctuated in the observed period. If we look the auditing number only in 2000 and 2014, we see that there is no change in the number of auditing. Despite minor fluctuations between 2000 and 2005, an increasing trend is observed in the number of audit until the end of 2006. Auditing number in the end of 2006 peaked and reached 80,000, followed by the sharp decline between 2006 and 2011. In 2011, auditing number hit bottom around 16,000. The number of auditing has started to rise again in the last three years and reached around the 60,000 level in the end of 2014.

In 2011, tax administration restructured and four different and independent tax inspection units were combined under the unique tax inspection board. Given increasing trend in auditing number from 2011 till now, it is considered that restructuring in tax administration make a positive contribution to the auditing number. Additionally, the numbers of inspector employed in Turkey has always shown increasing trend as shown in Graph 4.2.

Graph 4.4 illustrate the trend of tax burden in Turkey between 2000 and 2014.

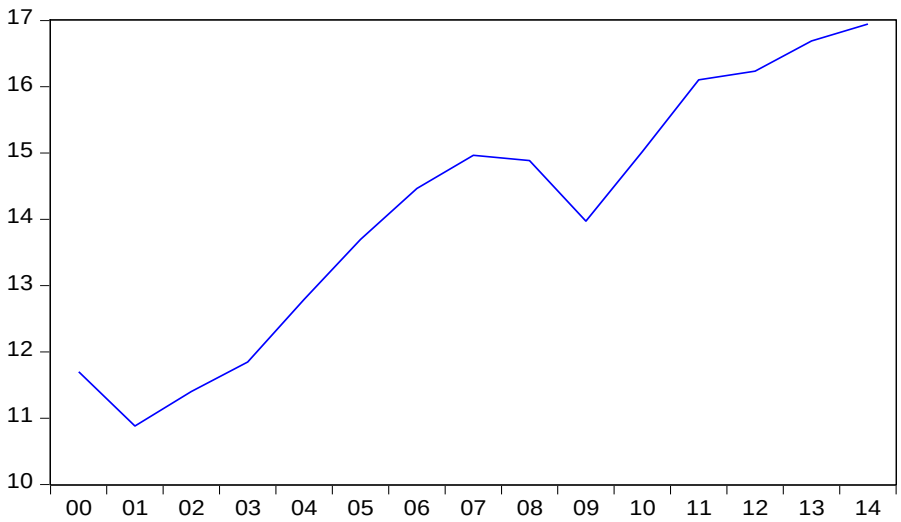
Graph 4.4: Tax Burden in Turkey, 2000-2014



As indicated in Graph 4.4, tax burden in Turkey has shown increasing trend during the observed period. Tax burden was around 16% in 2000 and rose to around 23% in 2014. Tax burden showed sharp increase up to 2004. Between 2004 and 2008, tax burden showed small fluctuations around 20% level. From 2008 to 2013, tax burden showed constant increase and reached around 23 percent in 2013. However, tax burden reduced in 2014.

Graph 4.5 illustrate the trend of GDP per Capita in Turkey between 2000 and 2014.

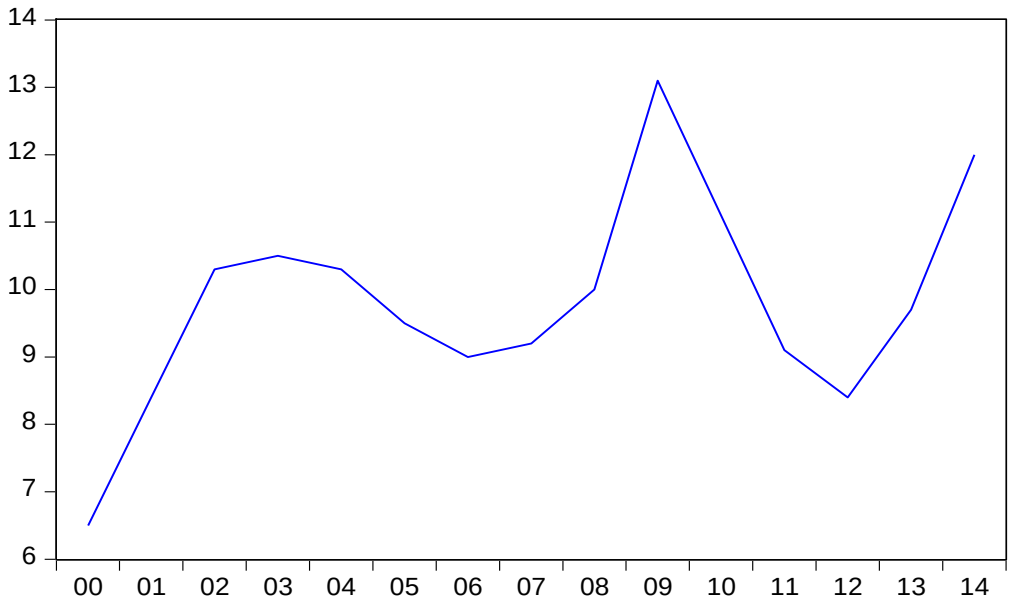
Graph 4.5: GDP per Capita in Turkey, 2000-2014



As shown in Graph 4.5, GDP per capita decreased until the end of 2001. As mentioned before, there was economic crisis in Turkey in that year. In 2000, GDP per capita was the lowest level of around 10.883 TL. Then, Turkish economy has passed the economic recovery period. As is seen Graph 4.5, GDP per capita has increased permanently only having small decline in 2009. This positive trends reveals that Turkish economy has grown steadily over observed period. Considering the size of shadow economy and GDP per capita graphs together, GDP per Capita shows constant increasing trend and the size of shadow economy shows constant decreasing trend although some fluctuations. Accordingly, negative relationship between GDP per capita and the size of shadow economy for Turkish economy confirm the Schneider's (2010) result.

Graph 4.6 illustrate the trend of unemployment rate in Turkey between 2000 and 2014.

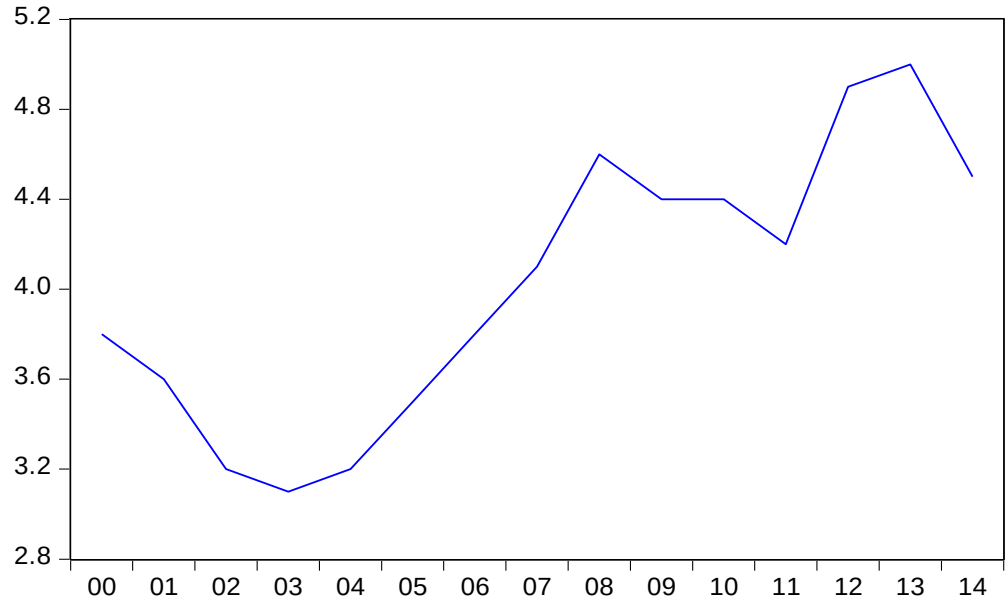
Graph 4.6: Unemployment Rate in Turkey, 2000-2014



Unemployment rate was around 6.5% and this was the lowest unemployment rate for Turkey in 2000. This rate increased sharply until the end of 2003. Then, the trend fluctuated around 9-10% till 2008. As from 2009, trend shows sharp increase and unemployment rate peaked at the end of 2009. Between 2009 and 2012, the trend turned to downward and dipped in 2012 at around 8.4%. After 2012, unemployment rate started to rise again. As mentioned before, economic crisis started in 2001 and economic recession started in 2012. That is, unemployment rate has increased during

the recession and economic crises in Turkey. According to Graph 4.6, unemployment rate has an increasing trend between 2000 and 2014.

Graph 4.7: Corruption Index in Turkey, 2000-2014



As is seen Graph 4.7, corruption perception index exhibits increasing trend between 2002 and 2013. This index decreased from 2000 till 2003, when dipped around 3.1. This index peak at 5 in 2013.After 2013 this showed decreasing trend in Turkey. As mentioned at the second chapter, Dreher and Schneider (2006) found a negative relationship between corruption perception index and the size of shadow economy in high income countries and positive relationship between them in low income countries.

4.2. Stationary Analysis

In this part, ADF test is performed to the logarithmic level variables used in this study in order to determine whether there is unit root problem. As mentioned Chapter 3, ADF tests the H_0 (null) hypothesis as mentioned 3.2.1 and if p value of variable is below 0.05, H_0 hypothesis is rejected. This means that the variable which is tested is stationary. If p value of the variable is above 0.05, H_0 hypothesis cannot be rejected. This means examined series has unit root and is non stationary. In this analysis, Schwardz Info Criterion is used to find appropriate lag length in determining how many previous period values of the variable will be added in the test.

Table 4.2 shows the ADF test result of variables in logarithmic level.

Table 4.2: ADF Test Result

Variables	Probability (p values)	H_0 (Log Level)
LSE	0.0316	Rejected
LIN	0.9987	Not Rejected
LAN	0.1735	Not Rejected
LTB	0.9950	Not Rejected
LGDPC	0.9855	Not Rejected
LU	0.8361	Not Rejected
LC01	0.7980	Not Rejected

Source: Author's calculation, Appendix III

Table 4.2 shows the ADF unit root test results. Logarithmic form of each variables are tested at 5 percentage significance level. Considering the table above, only the LSE variable's ρ value is below the 0.05 significance level. The remaining variables are not significant at 5 % level of significance Therefore, only LSE variable is stationary, i.e. it does not have unit root in levels. However, all other variables are not stationary in levels.

Considering previous results, unit root test is applied to first order differences of variables in order to test the unit roots of the variables.

Table 4.3 shows the ADF Test result of variables in first difference of all logarithmic variables.

Table 4.3: ADF Test Result in first difference of all logarithmic variables

Variables	Probability (ρ values)	H_0 (1^{st} Differentiated)
LSE	0.0190	Rejected
LIN	0.0496	Rejected
LAN	0.0003	Rejected
LTB	0.0444	Rejected
LGDPC	0.0149	Rejected
LU	0.0031	Rejected
LC01	0.0188	Rejected

Source: Author's calculation, Appendix IV

As is seen in Table 4.3, ρ values of all variables are below 0.05, and they are significant at 5 percentage significance level. Hence, H_0 hypothesis is rejected and H_1 hypothesis is accepted. In other words, first difference of series do not have unit root and they are stationary.

4.3. Correlation Results

Table 4.4: Correlation matrix between variables

	DLSE	DLIN	DLAN	DLTB	DLGDPC	DLU	DLC01
DLSE	1.0000	0.0142 ***	-0.4382 **	-0.0419 ***	-0.6364 *	0.6367 *	-0.6078 *
DLIN	0.0142 ***	1.0000	-0.4095	0.3085	0.3879	-0.1226	-0.6684
DLAN	-0.4382 **	-0.4095	1.0000	0.0625	0.2726	-0.2700	0.5463
DLTB	-0.0419 ***	0.3085	0.0625	1.0000	0.0253	0.2138	-0.4703
DLGDPC	-0.6364 *	0.3879	0.2726	0.0253	1.0000	-0.7446	0.1485
DLU	0.6367 *	-0.1226	-0.2700	0.2138	-0.7446	1.0000	-0.4879
DLC01	-0.6078 *	-0.6684	0.5463	-0.4703	0.1485	-0.4879	1.0000

*5% significance level, ** 10% significance level, *** no significance
Source: Author's calculations, Appendix V

Firstly, the correlation matrix shows that there is positive relationship between the size of shadow economy and the number of inspectors. However, positive linear relationship between shadow economy and inspector number is not statistically significance because p value is above 10%. Therefore, we cannot conclude that there is any correlation between the variables. Similarly, there is low but negative correlation between the size of shadow economy and auditing number at the 10 percent significance level. As the auditing number (volume) increases, the size of shadow economy decreases.

We would expect to find that, an increase in the number of inspectors lead to an increase in the number of tax auditing is expected. In other words, it is expected that the increase in the number of tax auditing will have a deterrent effect on the shadow economy. As shown in Table 4.4, there is negative weak relationship between the number of inspector and auditing number. Therefore, this relationship between inspector and auditing number does not ensure abovementioned viewpoint because as the number of inspector employed increases, the number of auditing should have increased.

As for the relationship between the size of shadow economy and tax burden, there no statistically significant linear correlation between shadow economy and tax

burden. As mentioned in Chapter two, Schneider et.al. (2010) reveals that increased tax burden is driving forces of shadow economy. Yıldız (2013) concludes that tax burden is affected by the shadow economy in Turkey. Schneider and William (2013) indicate that there is positive relationship between the shadow economy and tax burden. However, it is not obtained statistically significant relationship between shadow economy and tax burden that confirm the previous studies.

There is strong statistically significant negative correlation between the size of shadow economy and GDP per Capita. In general, the shadow economy is expected to decrease as national income increases. Schneider et.al. (2010) find negative relationship between GDP per capita and size of shadow economy. As Graph A in Appendix 3 show, despite slight fluctuations, shadow economy constantly decreases. However, GDP per Capita exhibits constantly increasing trend. That is to say, correlation result for Turkish economy in the observed period confirm the findings of Schneider et.al. (2010).

Considering the relationship between the size of shadow economy and unemployment rate, statistically significant positive relationship between them is observed. As mentioned Chapter 2, Dobre and Alexandru (2010) found that there is strong causality from unemployment rate to size of shadow economy for USA economy. Moreover, they examined the Romanian shadow economy and revealed the existence of a negative relationship in the short-run and a positive relationship in the long-run between both the unemployment rate and the size of the shadow economy.

Lastly, correlation table illustrates that there is statistically significant negative relationship between corruption index and the size of shadow economy. Many researchers have examined the relationship between the shadow economy and corruption. For instance, Dreher and Schneider (2006) concluded that there is negative relationship between the two high income countries, while the relationship is positive in low income countries. Moreover, Dreher and et.al (2008) reveals that corruption and shadow economy are substitutes. Our finding confirms the Dreher et al (2008)'s result.

4.4. Co-integration Test Results

After providing stationary of series, co-integration analysis will be conducted to the logarithmic series to measure the long-run (co-integration) relationship between

variables. Co-integration is tested using several tests. Engle and Granger is the first test of co-integration, while Johansen test is the most fundamental test (Sjo 2008). In this study, Johansen Co-integration test will be conducted to test the long-run relationship between series. As mentioned Chapter 3, this test is conducted by using logarithmic data of series. As is seen in the tables below, Johansen Co-integration test derives two tests, namely trace and maximum eigenvalue tests. The difference of two tests result from their hypothesis. The Max test is constructed as

$$\lambda max\ [H1(r-1) \mid H_1\ I] = -T\ log(1-\lambda r), \quad (5)$$

for r = 0, 1, 2.., p – 2, p – 1. The null is that there exists r co-integrating vectors against the alternative of r + 1 vectors. The trace test is

$$\lambda trace[H1I \mid Ho] = -T\ \sum_{i=r+1}^{p} log(1-\lambda i) \quad (6)$$

where the null hypothesis λi = 0, so only the first eigenvalues are non-zero (Sjö 2008). Sjo 2008 revealed that the trace test is more reliable because it appears to be more robust to skewness and excess kurtosis. However, in the following part, the co-integration of series will be tested with both tests to rise the reliability of series. Null hypothesis assume that there is co-integration between series for both trace and maximum eigenvalue test if probability value is below 0.05. If the null hypothesis rejected, it is decided that there is no co-integration between variables. If probability (p) values of series are below 0.05 and both Trace Statistic and Max-Eigen Statistic values are above their 0.05, the null hypothesis is not rejected and it is concluded that the series are co-integrated. Conversely, if p values of series exceeds 0.05 and both Trace Statistic and Max-Eigen Statistic values are below 0.05, it is said that there is no co-integration between series and the null hypothesis is rejected. All co-integration tests below are conducted by using logarithmic data of variables.

Table 4.5 shows the co-integration test result between shadow economy and inspector number.

Table 4.5: Co-integration Test Result for LSE and LIN

Unrestricted Co-integration Rank Test						
	Trace Test			Maximum Eigenvalue Test		
Hypothesized No of Co-integration	Trace Statistic	0.05 Critical Value	Probability (0.05)	Max-Eigen Statistic	0.05 Critical Value	Probability (0.05)
None	21.2231	25.8721	0.1702	17.3896	19.3870	0.0953
At most 1	3.8335	12.5179	0.7661	3.8835	12.5179	0.7661

Source: Author's calculation, Appendix VI/A

According to results in Table 4.5., both Trace and Max-Eigen Statistic reveals that there is no co-integration between LSE and LIN at the 0.05 level.

Table 4.6 shows the co-integration test result between shadow economy and auditing number.

Table 4.6: Co-integration Test Result for LSE and LAN

Unrestricted Co-integration Rank Test						
	Trace Test			Maximum Eigenvalue Test		
Hypothesized No of Co-integration	Trace Statistic	0.05 Critical Value	Probability (0.05)	Max-Eigen Statistic	0.05 Critical Value	Probability (0.05)
None	10.1806	15.4947	0.2671	8.9667	14.2646	0.2889
At most 1	1.2138	3.8414	0.2706	1.2138	3.8414	0.2706

Source: Author's calculation, Appendix VI/B

Given Table 4.6, both Trace and Max-Eigen Statistic shows that there is no co-integration between LSE and LAN at the 0.05 level

Table 4.7 illustrates the co-integration test result between shadow economy and GDP per Capita.

Table 4.7: Co-integration Test Result for LSE and LGDPC

Unrestricted Co-integration Rank Test						
	Trace Test			Maximum Eigenvalue Test		
Hypothesized No of Co-integration	Trace Statistic	0.05 Critical Value	Probability (0.05)	Max-Eigen Statistic	0.05 Critical Value	Probability (0.05)
None	8.7978	15.494	0.3844	8.7027	14.2646	0.3117
At most 1	0.0951	3.8414	0.7577	0.0951	3.8414	0.7577

Source: Author's calculation, Appendix VI/C

Similarly, Table 4.7 shows that there is no co-integration between LSE and LGDPC at 0.05 level given Trace and Max-Eigen tests.

Table 4.8 shows co-integration test result between shadow economy and corruption index.

Table 4.8: Co-integration Test Result for LSE and LC01

Unrestricted Co-integration Rank Test						
	Trace Test			Maximum Eigenvalue Test		
Hypothesized No of Co-integration	Trace Statistic	0.05 Critical Value	Probability (0.05)	Max-Eigen Statistic	0.05 Critical Value	Probability (0.05)
None	9.1523	15.4947	0.3515	8.1396	14.2646	0.3647
At most 1	1.0126	3.8414	0.3143	1.0126	3.8414	0.3143

Source: Author's calculation, Appendix VI/D

According to Table 4.8, it is not detected co-integration between LSE and LC01.

Table 4.9 shows co-integration test result between shadow economy and unemployment rate.

Table 4.9: Co-integration Test Result for LSE and LU

Unrestricted Co-integration Rank Test						
	Trace Test			Maximum Eigenvalue Test		
Hypothesized No of Co-integration	Trace Statistic	0.05 Critical Value	Probability (0.05)	Max-Eigen Statistic	0.05 Critical Value	Probability (0.05)
None	24.8401	25.8721	0.0668	21.5150	19.3870	0.0242*
At most 1	3.3251	12.5179	0.8359	3.3251	12.5179	0.8359

Source: Author's calculation, Appendix VI/E

Co-integration tests indicate no co-integration at the 0.05 level and * denotes rejection of the null hypothesis at the 0.05 level. According to Trace Statistic, it is not detected co-integration between LSE and LU at 0.05 level. However, Maximum-Eigen Statistic found 1 co-integration between LSE and LU because at none p value is under 0.05 and Max- Eigen Statistic value (21.51501>19.38704) exceeds its critical value.

Table 4.10 shows co-integration test result between shadow economy and tax burden.

Table 4.10: Co-integration Test Result for LSE and LTB

Unrestricted Co-integration Rank Test						
	Trace Test			Maximum Eigenvalue Test		
Hypothesized No of Co-integration	Trace Statistic	0.05 Critical Value	Probability (0.05)	Max-Eigen Statistic	0.05 Critical Value	Probability (0.05)
None	30.8317	25.8721	0.0111*	17.2834	19.3870	0.0985
At most 1	13.5483	12.5179	0.0335*	13.5483	12.5179	0.0335*

Source: Author's calculation, Appendix VI/F

Considering Table 4.10, it is clearly observed that there is co-integration between LSE and LTB at 0.05 level. Trace statistics found 2 co-integration, Max-Eigen statistics found at most 1 co-integration between LSE and LTB.

Overall, Co-integration test results reveals that there is co-integration between LSE and LU, LTB. As mentioned Chapter 3, In VAR model, time series analyses are based on stationary of series. Therefore, in order to make causality analysis firstly stationary of series should be ensured. In this study, series have been found non-stationary at level and in order to ensure stationary for series, series were converted in

first difference and thus, stationary is provided for all series. Then, co-integration tests are implemented on logarithmic series because taking first difference of series may cause disappearance of long-run relationship between series and continuing study with series in differences give spurious results. For this reason co-integration test has applied for the series. According to the test results, co-integration problem is detected for unemployment rate and tax burden. Hence, Granger Causality Test is conducted only for DLSE and DLIN, DLAN, DLGDPC, DLC01 as Granger Causality analysis for DLU and DLTB would give spurious results. However, as mention Chapter 3, if two or more time-series are co-integrated, Granger Causality can be tested by Wald Test in level or logarithms. Therefore, causal relationship between the shadow economy and tax burden, unemployment rate will be tested with Wald test.

4.5. Determining Optimum Lag Length

As mentioned above, before commencing Granger Causality test, it is needed to determine the optimum lag length of series. A set of criteria is employed in determining the optimum lag length. Some of the most used criteria are Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), Hannan-Quinn Information Criterion (HQ) and Final Prediction Error (FPE). In VAR model, each variable is run one by one in order to determine optimal lag length. In the Lag Order Selection tables, (*) indicates lag order selected by the criterion such as AIC, FPE. Therefore, lag order which selected by maximum criterion is determined as optimum lag order for variables. After determining optimal lag length, each variable is tested by the Granger Causality test (Yesilyurt 2011). Based on the test results, optimal lag lengths for variables used in the model are determined.

Table 4.11 illustrates the lag order selection for shadow economy and inspector number according to AIC, SC, HQ and FPE criteria.

Table 4.11: Lag Order Selection for dLSE and dLIN

Lag	LR	FPE	AIC	SC	HQ
0	NA*	2.02e-06	-7.436316	-7.363971	-7.481919
1	3.707195	2.71e-06	-7.172443	-6.955409	-7.309252
2	9.034698	1.39e-06*	-7.950953*	-7.589230*	-8.178969*

Source: Author’s calculation, Appendix VII/A

* indicates lag order selected by the criterion, each test is at 5% level. Considering the stars in Table 4.11, second order is selected as optimum lag order because four different criterion determine second order as an optimum lag order. Therefore, second order is employed as lag length for dLSE and dLIN.

Table 4.12 shows the lag order selection for shadow economy and auditing number according to AIC, SC, HQ and FPE criteria.

Table 4.12: Lag Order Selection for dLSE and dLAN

Lag	LR	FPE	AIC	SC	HQ
0	NA*	7.95e-05*	-3.764359*	-3.683542*	-3.794281*
1	1.002493	0.000142	-3.209081	-2.966628	-3.298846
2	2.250286	0.000218	-2.863884	-2.459795	-3.013492

Source: Author's calculation, Appendix VII/B

Optimum lag order is selected as 1 for dLSE and dLAN, because five different criteria select first order as an optimum lag length.

Table 4.13 illustrates the lag order selection for shadow economy and GDP per Capita according to AIC, SC, HQ and FPE criteria.

Table 4.13: Lag Order Selection for dLSE and dLGDPC

Lag	LR	FPE	AIC	SC	HQ
0	NA*	5.44e-07	-8.748597	-8.667779	-8.778518
1	7.666115	4.62e-07	-8.933721	-8.691267	-9.023486
2	8.923135	2.74e-07*	-9.541787*	-9.137699*	-9.691396*

Source: Author's calculation, Appendix VII/C

Given the table above, second lag order is selected for dLSE and dLGDPC because four different criteria select 2. order as an optimum lag length.

Table 4.11 shows the lag order selection for shadow economy and corruption index according to AIC, SC, HQ and FPE criteria.

Table 4.14: Lag Order Selection for dLSE and dLC01

Lag	LR	FPE	AIC	SC	HQ
0	NA	1.76e-06	-7.574755	-7.502410	-7.620358
1	3.140980	2.53e-06	-7.240105	-7.023071	-7.376914
2	10.39313*	1.04e-06*	-8.245020*	-7.883297*	-8.473036*

Source: Author's calculation, Appendix VII/D

According to Table 4.14, second order is selected as lag order for dLSE and dLCO1.

Table 4.15 illustrates the lag order selection for shadow economy and tax burden according to AIC, SC, HQ and FPE criteria.

Table 4.15: Lag Order Selection for LSE and LTB

Lag	LR	FPE	AIC	SC	HQ
0	NA	4.59e-06	-6.616905	-6.529990	-6.634770
1	32.14439*	3.47e-07	-9.215959	-8.955213	-9.269554
2	8.048348	2.51e-07*	-9.606618*	-9.172042*	-9.695943*

Source: Author's calculation, Appendix VII/E

Two is selected as an optimum lag length order for LSE and LTB considering the criteria. As mentioned Co-integration test result in Chapter 4, co-integration has been detected between LSE and LTB. Therefore, lag length is determined for logarithmic series.

Table 4.16 shows the lag order selection for shadow economy and unemployment according to AIC, SC, HQ and FPE criteria.

Table 4.16: Lag Order Selection for LSE and LU

Lag	LR	FPE	AIC	SC	HQ
0	NA	7.90e-05	-3.770374	-3.683459	-3.788239
1	35.46953	4.28e-06	-6.701943	-6.441197	-6.755538
2	9.752959*	2.50e-06*	-7.305678*	-6.871101*	-7.395003*

Source: Author's calculation, Appendix VII/F

Two is selected as an optimum lag length order for LSE and LU considering the criteria. Selection is determined with logarithmic series because there is co-integration between LSE and LTB.

Table 4.17 summarizes the selected optimum lag orders.

Table 4.17: Summary Table for Lag Orders Selected

Variables	**Optimum Lag Orders**
DLSE and DLIN	2
DLSE and DLAN	1
LSE and LTB	2
DLSE and DLGDPC	2
DLSE and DLCO1	2
LSE and LU	2

Source: Author's calculation

After determining the optimum lag length for variables used in the model, Granger Causality test can be applied in order to reveal the causal relationship between the variables.

4.6. Granger Causality Test Results

At this part of this study firstly it is tested whether the independent variables selected for this study cause the shadow economy. Granger causality test runs based on H_0 and H_1 hypothesis. These hypothesis state as below;

$H_{0:}$ The independent variables do not Granger Cause the size of shadow economy.

$H_{1:}$ The independent variables do Granger Cause the size of shadow economy.

Then, causality from dependent variable to independent variables (the size of shadow economy) is tested. If probability value (p value) is below 0.05 (5%), H_0 hypothesis is rejected and this means that there is causal relationship between variables. Likewise, if p value is above 0.05 (5%), H_0 hypothesis is not rejected, which means there is no causal relationship between variables.

Below, Granger Causality test results are shown as a table considering the optimum lag length determined before for each variables.

The results of the Granger Causality test between shadow economy and inspector number are provided in Table 4.18

Table 4.18: Granger Causality Test results between dLSE and dLIN

Optimum Lag	Null Hypothesis	Probability	Results
2	DLIN does not Granger Cause DLSE	0.6318	H_0 not rejected
2	DLSE does not Granger Cause DLIN	0.0890	H_0 not rejected

Source: Author's calculation, Appendix VIII/A

According to the empirical results table above, p values of two variables are above the 0.05, this indicates that there is no causality between dLSE and dLIN. Before starting this study, it was assumed that there is negative relation between the size of shadow economy and the number of inspectors employed in Turkey. It is expected that an increase in the number of tax inspector will increase the deterrence of inspection on taxpayer and also hamper the growth of the size of shadow economy. However, test result shows no statistically significant causal relation between the variables.

Table 4.19 shows the Granger Causality test result between shadow economy and auditing number.

Table 4.19: Granger Causality Test results between dLSE and dLAN

Optimum Lag	Null Hypothesis	Probability	Results
1	DLAN does not Granger Cause DLSE	0.9427	H_0 not rejected
1	DLSE does not Granger Cause DLAN	0.7135	H_0 not rejected

Source: Author's calculation, Appendix VIII/B

As is indicated in Table 4.14, p values of variables are above 0.005, therefore H_0 hypothesis is not rejected, and this means that there is no causal relationship between dLSE and dLAN. As Cebula (1997) confirmed that there is negative relationship between the size of shadow economy and tax audit rates for USA economy, it is expected the same reason for Turkish economy. However, empirical result shows no causality between the size of shadow economy and auditing number at the given period.

Table 4.20 shows the Granger Causality test result between shadow economy and GDP per Capita.

Table 4.20: Granger Causality Test results between dLSE and dLGDPC

Optimum Lag	Null Hypothesis	Probability	Results
2	DLGDPC does not Granger Cause DLSE	0.0452	Ho **rejected**
2	DLSE does not Granger Cause DLGDPC	0.0101	Ho **rejected**

Source: Author's calculation, Appendix VIII/C

Considering the empirical result in table above, bidirectional causal relationship is observed between shadow economy and GDP per capita, because both variables significance level is below 0, 05. In other words, both GDP per capita is the reason of the size of shadow economy and the size of shadow economy is the reason of GDP per capita. Schneider et al (2010) reveals negative relationship between the size of shadow economy and GDP per Capita. The graphs of series used in this study is attached in Appendix 3. When the graphs of the GDP per Capita and size of shadow economy are examined, GDP per capita has shown increasing trend and the size of shadow economy has shown decreasing trend at the research period. The trends of GDP per capita and the size of shadow economy graphs and correlation result of the variables reveal the strong negative causal relationship between GDP per Capita and size of shadow economy. These results confirm the Yendi's (2011) finding.

Table 4.21 shows the Granger Causality test result between shadow economy and corruption index.

Table 4.21: Granger Causality Test results between dLSE and dLC01

Optimum Lag	Null Hypothesis	Probability	Results
2	DLC01 does not Granger Cause DLSE	0.4068	H_0 not rejected
2	DLSE does not Granger Cause DLC01	0.5631	H_0 not rejected

Source: Author's calculation, Appendix VIII/D

Given the empirical results above the table, there is no Granger causality between corruption index and size of shadow economy. Dreher and Schneider (2006) examined the effect of shadow economy on corruption for countries included their study. Empirical result shows that shadow economy reduces corruption in high income countries, while increases corruption in low income countries. The findings of the study are incompatible with Dreher and Schneider's study.

Overall, Table below summarizes the causal relationship between the size of shadow economy and other variables used in this study. Results are produced at 5per cent significance level.

4.7. VAR Granger Causality/Block Exogeneity Wald Test Results

This test is implemented on logarithmic series of the size of shadow economy, tax burden and unemployment. Before analysing Var Granger Causality Test, firstly lag length of the series (m) is determined according to the lag length criteria previously used. Then, maximum order of integration (dmax) is chosen for the series. Finally, Wald test is implemented to the variables. In this test, null hypothesis assume that there is no causality between variables. If p value is below 0.05, null hypothesis is rejected, this means that there is causal relationship from independent variable to dependant variable. Let's say, from X to Y.

The result of Wald Tests are as follows:

Table 4.22 shows VAR Granger Causality Wald Test result between shadow economy and tax burden.

Table 4.22: VAR Granger Causality/Block Exogeneity Wald Test Results for LSE and LTB

Dependent Variable: LSE		
Excluded	Probability	Results
LTB	0.5151	Ho not rejected

All	0.5151	
Dependent Variable: LTB		
LSE	0.6692	Ho not rejected
All	0.6692	

Source: Author's calculation, Appendix VIII/E

Considering first result of Table 4.22, probability (p) value is above 0.05. Therefore, null hypothesis is not rejected and it is concluded that there is no statistically significant causal relation between tax burden and shadow economy. Neither tax burden nor shadow economy is the cause one another because p value of the result is above 0.05.

Table 4.23 shows VAR Granger Causality Wald Test result between shadow economy and unemployment rate.

Table 4.23: Var Granger Causality/Block Exogeneity Wald Test Results for LSE and LU

Dependent Variable: LSE		
Excluded	Probability	Results
LU	0.7097	Ho not rejected
All	0.7097	
Dependent Variable: LU		
LSE	0.0000	Ho rejected
All	0.0000	

Source: Author's calculation, Appendix VIII/F

The results show there is no statistically significant causal relationship from unemployment to shadow economy, however, there is causal relationship from shadow economy to unemployment

Table 4.24 summarizes the Granger causality and Wald Tests results.

Table 4.24: Summary Result of Granger Causality and Wald Tests

Variables	Results
DLSE ↔ DLGDPC	Bi-directional causal relationship
DLIN → DLSE	No causal relationship
DLSE → DLIN	No causal relationship
DLAN → DLSE	No causal relationship
DLSE → DLAN	No causal relationship
DLC01 → DLSE	No causal relationship
DLSE → DLC01	No causal relationship
LSE → LTB	No causal relationship
LTB → LSE	No causal relationship
LSE → LU	Uni-directional causal relationship

LU → LSE	No causal relationship

Source: Author's calculation

Limitation of the Study

This study analysis the effects of tax audit on the shadow economy and according to our knowledge, similar analysis has not been conducted for Turkish economy. Therefore, the results of this study cannot be compared with the previous studies. Moreover, data about the number of tax inspector and the number of taxpayer audited prior to 2000 could not be collected. Additionally monthly or quarterly data concerning variables which are used in the study is not obtained. For these reasons, time series analysis is performed with 15 observations, which is the main limitation of this study. Considering small number of observation, our findings should be taken with caution.

CONCLUSION

Shadow economy refers to economic activities that cannot be recorded formally. Shadow economy affects the entire economy. One of the most significant consequence is the loss of tax revenues resulting in the public sector. Moreover, negative impacts of shadow economy on the overall economy can be considered as an unfair tax system, waste of resources, corruption on ethical values and disrupting the structure of the economic system. In order to combat the informal economy, it needs a good understanding of its causes because shadow economy consists of various reasons. The most important reason that generate the shadow economy both in Turkey and the other countries is high tax rates (tax burden) and high social security obligations. Apart from this, unfair distribution of income, unfairness of taxation, tax resistance, viewpoint of individuals to public spending, high inflation and unemployment rates, population growth, insufficient auditing and non-deterrent penalties are among the reasons that trigger the shadow economy.

According to Schneider's (2015) study, the average size of shadow economy for 28 EU countries is 18.6 per cent in 2014 and is expected to be 18.3 per cent in 2015. As for Turkey, the size of shadow economy is 27.2 per cent in 2014 and expected to be 27.8 per cent in 2015. Compared to the EU average, the size of the shadow economy in Turkey is very high. In recent years, Turkish government has prepared an action plan in order to combat the shadow economy and to approach the EU average. For this purpose, firstly four different and independent tax inspection units were merged under a single tax inspection board. Then, the number of inspectors employed was increased. In the light of above, in this thesis, firstly the relationship between the size of the shadow economy and deterrence of tax audit is tested. In this sense, the size of shadow economy for Turkey is determined as a dependent variable, the number of inspectors, auditing number and tax burden is determined as an independent variable. Unemployment rate, corruption perception index and GDP per capita are included to model as a control variables. Annual data covering the years between 2000 and 2014 were used in the study. Time series analysis are conducted by using E-views 7.2 statistical program. Before starting analysis, stationarity of the series used in the analysis are tested by using ADF test. After ensuring the stability of series correlation analysis is conducted. Then, Co-integration test is conducted. After that Granger Causality and VAR Granger Causality/Block Exogeneity Wald Tests are conducted in

order to reveal the relationship between the size of shadow economy and other variables which is used in the study.

First, we will explain the results of correlation analysis.

There is no statistically significant linear relationship between the sizes of shadow economy and the number of inspectors. Similarly, there is negative linear relationship between the size of shadow economy and the number of audit at 10% significance level. There is no statistically significant relationship between the size of shadow economy and tax burden. As for the relationship between the size of shadow economy and GDP per capita, there is statistically quite significant negative relation between them. As regards to unemployment, there is statistically significant positive linear relationship between the size of shadow economy and unemployment rate. Lastly, there is statistically significant and negative linear relationship between the size of shadow economy and corruption.

By using Granger Causality analysis, both causality relationship and direction of causality are measured. The results of the analysis are as follows:

Any causal relationship between the size of shadow economy and the number of inspector, number of audit, tax burden have not been determined. As regards to the causal relationship between the size of shadow economy and GDP per capita, bi-directional causal relationship is determined between them. That is, both variables are the cause of each other. A Granger causal link between the size of shadow economy and corruption has not been determined. However, unidirectional causal link has been determined between the size of shadow economy and unemployment rate. The size of shadow economy is found as the reason of the unemployment for Turkish economy, but not vice versa as seen Table 23.

Considering the correlation and Granger causality test results together, there is no statistically significant correlation between the size of shadow economy and inspector number and there is negative correlation between the size of shadow economy and auditing number at 10% significance level. Causal relationship between the size of shadow economy and inspector number, auditing number is not determined. Additionally, given the correlation result between inspector number and auditing number, negative correlation is observed between them. Unexpectedly, increasing trend of inspector number has not led an increase in the number of tax audit in Turkey. Schneider and Williams (2013) revealed that there is positive correlation between tax

burden and the size of shadow economy and stated that tax burden is one of the reasons of the shadow economy. Contrary to Schneider and Williams (2013) result, in this study correlation analysis reveals no statistically significant linear relationship between tax burden and the size of shadow economy. Moreover, Granger causality has not been detected between the size of shadow and tax burden for Turkish economy. As is expected, it is found statistically significant strong negative correlation between GDP per capita and the size of shadow economy. Additionally, bi-directional causal relationship is determined between them. The result obtained for Turkish economy is corresponded to the previous studies. However, direction of the relation is determined from GDP per capita to the size of shadow economy at the previous studies. From the point of Turkish economy, as the GDP per capita increase, the size of shadow economy decrease and as the size of shadow economy increase, the GDP per capita decreases due to the bi-directional relation between the variables. In accordance with the results of previous studies as mentioned previous chapters, there is statistically significant positive correlation between unemployment rate and the size of shadow economy. The results of correlation between the variables confirm the previous results. Moreover, size of shadow economy is found the Granger Causality of unemployment, however, Granger causality from unemployment to shadow economy is not detected. Lastly, although statistically significant negative correlation is determined between the size of shadow economy and corruption, it is not determined a causal relationship between variables.

Unsurprisingly, as unemployment rate decreases and the growth rate (GDP per capita) increases, the size of shadow economy will decrease in Turkey. However, negative correlation between the inspector number and auditing number has created the impression of inefficiency in tax auditing. According to our expectations, as inspector number employed increases, the number of tax auditing should have increased and this should have provided positive contribution in order to decline the size of shadow economy in Turkey. That is, only increase the number of inspector employed by Ministry of Finance is not solely enough in order to increase efficiency in tax auditing. As Rakici (2011) mentioned before, the qualitative capacity of current tax inspectors should be enhanced as well. In the light of above, recommendations below may provide positive contribution to decrease the size of shadow economy in Turkey. In addition to the increase in the number of tax inspector, the number of

taxpayers to be audited should be increased and coordination between tax inspectors should be enabled in order to raise efficiency in tax auditing. Moreover, current tax penalties should be revised and increased to boost deterrence. By reducing tax burden over time, tax base should be extended and inequality in income distribution should be reduced. Additionally, social and psychological factors such as the level consciousness, corruption perception, confidence to the government and public spending perspective is one of the factors that determines the size of the shadow economy.

As mentioned chapter 2, there are many financial, economic, administrative, social, legal reasons of the shadow economy. Accurate determination of the causes of the shadow economy for any economy is great importance in terms of effective and consistent measures being taken to prevent shadow economy. Reducing the size of shadow economy to zero is not possible, however, the objective is to reduce it to the minimum possible level. Measures to be taken in the shadow economy will provide not only economic but also social and legal aspects of the development. Finally, only the long-term studies will provide success in fight against the informal economy.

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APPENDIX

Appendix I: The Raw Data Used in the Analysis

Years	The Size of Shadow economy	Inspector Number	Auditing Number	Tax Burden (percentage)	GDP Per Capita (TL)	Corruption Index	Unemployment (percentage)
2000	32.1	2650	60335	15.9	11.699	3.8	6.5
2001	32.8	2682	51337	16.5	10.883	3.6	8.4
2002	32.4	2877	64760	18.6	11.401	3.2	10.3
2003	32.2	3217	53726	19.8	11.846	3.1	10.5
2004	31.5	3465	55256	19.9	12.793	3.2	10.3
2005	30.7	3454	57768	20.3	13.697	3.5	9.5
2006	30.4	3410	76051	19.9	14.466	3.8	9
2007	29.1	3617	80091	20.3	14.965	4.1	9.2
2008	28.4	3505	72911	20	14.886	4.6	10
2009	28.9	3641	28873	20.6	13.973	4.4	13.1
2010	28.3	4097	22570	21.5	15.023	4.4	11.1
2011	27.7	4761	16267	21.9	16.103	4.2	9.1
2012	27.2	4558	46845	22.4	16.237	4.9	8.4
2013	26.5	5002	71352	23.4	16.691	5	9.7
2014	27.2	5544	55284	23	16.947	4.5	12

Appendix II: Logarithmic Data used in the Analysis

Years	Log size of Shadow Economy	Log inspector number	Log Auditing Number	Log Tax Burden	Log GDP per Capita	Log Corruption Index	Log Unemployment
2000	1.506505032	3.42325	4.780569	1.2014	1.06815	0.579784	0.812913357
2001	1.515873844	3.42846	4.71043	1.21748	1.03675	0.556303	0.924279286
2002	1.51054501	3.45894	4.811307	1.26951	1.05694	0.50515	1.012837225
2003	1.507855872	3.50745	4.730185	1.29667	1.07357	0.491362	1.021189299
2004	1.498310554	3.5397	4.742379	1.29885	1.10697	0.50515	1.012837225
2005	1.487138375	3.53832	4.761687	1.3075	1.13663	0.544068	0.977723605
2006	1.482873584	3.53275	4.881105	1.29885	1.16035	0.579784	0.954242509
2007	1.463892989	3.55835	4.903584	1.3075	1.17508	0.612784	0.963787827
2008	1.45331834	3.54469	4.862793	1.30103	1.17278	0.662758	1
2009	1.460897843	3.56122	4.460492	1.31387	1.14529	0.643453	1.117271296
2010	1.451786436	3.61247	4.353532	1.33244	1.17676	0.643453	1.045322979
2011	1.442479769	3.6777	4.211307	1.34044	1.20691	0.623249	0.959041392
2012	1.434568904	3.65877	4.670663	1.35025	1.21051	0.690196	0.924279286
2013	1.423245874	3.69914	4.853406	1.36922	1.22248	0.69897	0.986771734
2014	1.434568904	3.74382	4.742599	1.36173	1.22909	0.653213	1.079181246

Appendix III: Unit Root Test Results in Log Level

A. Unit Root Test Result for LSE

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.196752	0.0316
Test critical values:	1% level	-2.740613	
	5% level	-1.968430	
	10% level	-1.604392	

B. Unit Root Test Result for LIN

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		3.259041	0.9987
Test critical values:	1% level	-2.740613	
	5% level	-1.968430	
	10% level	-1.604392	

C. Unit Root Test Result for LAN

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.277725	0.1735
Test critical values:	1% level	-2.792154	
	5% level	-1.977738	
	10% level	-1.602074	

D. Unit Root Test Result for LTB

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.607863	0.9950
Test critical values:	1% level	-2.740613	
	5% level	-1.968430	
	10% level	-1.604392	

E. Unit Root Test Result for LGDPC

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.063563	0.9855
Test critical values:	1% level	-2.740613	
	5% level	-1.968430	
	10% level	-1.604392	

F. Unit Root Test Result for LU

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.628108	0.8361
Test critical values:	1% level	-2.792154	
	5% level	-1.977738	
	10% level	-1.602074	

G. Unit Root Test Result for LC01

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.450126	0.7980
Test critical values:	1% level	-2.740613	
	5% level	-1.968430	
	10% level	-1.604392	

Appendix IV: Unit Root Test Results in Differenced

A. Unit Root Test Result for dLSE

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.448341	0.0190
Test critical values:	1% level	-2.754993	
	5% level	-1.970978	
	10% level	-1.603693	

B. Unit Root Test Result for dLIN

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.974939	0.0496
Test critical values:	1% level	-2.754993	
	5% level	-1.970978	
	10% level	-1.603693	

C. Unit Root Test Result for dLAN

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.687649	0.0003
Test critical values:	1% level	-2.792154	
	5% level	-1.977738	
	10% level	-1.602074	

D. Unit Root Test Result for dLTB

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.031038	0.0444
Test critical values:	1% level	-2.754993	
	5% level	-1.970978	
	10% level	-1.603693	

E. Unit Root Test Result for dLGDPC

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.564620	0.0149
Test critical values:	1% level	-2.754993	
	5% level	-1.970978	
	10% level	-1.603693	

F. Unit Root Test Result for dLU

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.375730	0.0031
Test critical values:	1% level	-2.792154	
	5% level	-1.977738	
	10% level	-1.602074	

G. Unit Root Test Result for dC01

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.454645	0.0188
Test critical values:	1% level	-2.754993	
	5% level	-1.970978	
	10% level	-1.603693	

Appendix V: Correlation Matrix

Correlation Probability	DLSE	DLIN	DLAN	DLTB	DLGDPC	DLU	DLC01
DLSE	1.000000 -----						
DLIN	0.014260 0.9614	1.000000 -----					
DLAN	-0.438225 0.1170	-0.409597 0.1458	1.000000 -----				
DLTB	-0.041937 0.8868	0.308504 0.2832	0.062531 0.8318	1.000000 -----			
DLGDPC	-0.636438 0.0144	0.387906 0.1705	0.272674 0.3456	0.025334 0.9315	1.000000 -----		
DLU	0.636751 0.0143	-0.122698 0.6760	-0.270072 0.3504	0.213832 0.4629	-0.744612 0.0023	1.000000 -----	
DLC01	-0.607879 0.0211	-0.668452 0.0090	0.546330 0.0432	0.470307 0.0897	0.148510 0.6124	0.487960 0.0767	1.000000 -----

Appendix VI: Co-integration Test Results

A. Co-integration Results for LSE and LIN

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.737542	21.22312	25.87211	0.1702
At most 1	0.255383	3.833502	12.51798	0.7661

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized	Max-Eigen	0.05

No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.737542	17.38962	19.38704	0.0953
At most 1	0.255383	3.833502	12.51798	0.7661

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

B. Co-integration Results for LSE and LAN

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.498298	10.18061	15.49471	0.2671
At most 1	0.089148	1.213870	3.841466	0.2706

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.498298	8.966742	14.26460	0.2889
At most 1	0.089148	1.213870	3.841466	0.2706

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

C. Co-integration Results for LSE and LGDPC

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.488005	8.797856	15.49471	0.3844
At most 1	0.007292	0.095141	3.841466	0.7577

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.488005	8.702714	14.26460	0.3117
At most 1	0.007292	0.095141	3.841466	0.7577

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

D. Co-integration Results for LSE and LC01

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.465343	9.152393	15.49471	0.3515
At most 1	0.074943	1.012695	3.841466	0.3143

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.465343	8.139698	14.26460	0.3647
At most 1	0.074943	1.012695	3.841466	0.3143

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

E. Co-integration Results for LSE and LU

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.808908	24.84012	25.87211	0.0668
At most 1	0.225686	3.325109	12.51798	0.8359

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.808908	21.51501	19.38704	0.0242
At most 1	0.225686	3.325109	12.51798	0.8359

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

F. Co-integration Results for LSE and LTB

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.735388	30.83175	25.87211	0.0111
At most 1 *	0.647315	13.54835	12.51798	0.0335

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

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.735388	17.28340	19.38704	0.0985
At most 1 *	0.647315	13.54835	12.51798	0.0335

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Appendix VII: Lag Order Selection Tables

A. Lag Order for dLSE and dLIN

Lag	LogL	LR	FPE	AIC	SC	HQ
0	42.89974	NA*	2.02e-06	-7.436316	-7.363971	-7.481919
1	45.44843	3.707195	2.71e-06	-7.172443	-6.955409	-7.309252
2	53.73024	9.034698	1.39e-06*	-7.950953*	-7.589230*	-8.178969*
3	54.12592	0.287764	3.69e-06	-7.295621	-6.789209	-7.614843

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)

B. Lag Order Selection for dLSE and dLAN

Lag	LogL	LR	FPE	AIC	SC	HQ
0	24.58616	NA*	7.95e-05*	-3.764359*	-3.683542*	-3.794281*
1	25.25449	1.002493	0.000142	-3.209081	-2.966628	-3.298846
2	27.18330	2.250286	0.000218	-2.863884	-2.459795	-3.013492

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)

C. Lag Order Selection for dLSE and dLGDPC

Lag	LogL	LR	FPE	AIC	SC	HQ
0	54.49158	NA*	5.44e-07	-8.748597	-8.667779	-8.778518
1	59.60232	7.666115	4.62e-07	-8.933721	-8.691267	-9.023486
2	67.25072	8.923135	2.74e-07*	-9.541787*	-9.137699*	-9.691396*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)

D. Lag Order Selection for dLSE and dLC01

Lag	LogL	LR	FPE	AIC	SC	HQ
0	43.66115	NA	1.76e-06	-7.574755	-7.502410	-7.620358
1	45.82058	3.140980	2.53e-06	-7.240105	-7.023071	-7.376914
2	55.34761	10.39313*	1.04e-06*	-8.245020*	-7.883297*	-8.473036*
3	57.32142	1.435500	2.07e-06	-7.876623	-7.370211	-8.195845

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)

E. Lag Order Selection for LSE and LTB

Lag	LogL	LR	FPE	AIC	SC	HQ
0	45.00988	NA	4.59e-06	-6.616905	-6.529990	-6.634770
1	65.90373	32.14439*	3.47e-07	-9.215959	-8.955213	-9.269554
2	72.44302	8.048348	2.51e-07*	-9.606618*	-9.172042*	-9.695943*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)

F. Lag Order Selection for LSE and LU

Lag	LogL	LR	FPE	AIC	SC	HQ
0	26.50743	NA	7.90e-05	-3.770374	-3.683459	-3.788239
1	49.56263	35.46953	4.28e-06	-6.701943	-6.441197	-6.755538
2	57.48691	9.752959*	2.50e-06*	-7.305678*	-6.871101*	-7.395003*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each at 5% level

Appendix VIII: Granger Causality/Wald Test Results

A. Granger Causality/Wald Test Result for dLSE and dLIN

Null Hypothesis:	Obs	F-Statistic	Prob.
DLIN does not Granger Cause DLSE	12	0.49074	0.6318
DLSE does not Granger Cause DLIN		3.48672	0.0890

B. Granger Causality/Wald Test Result for dLSE and dLAN

Null Hypothesis:	Obs	F-Statistic	Prob.
DLAN does not Granger Cause DLSE	13	0.00544	0.9427
DLSE does not Granger Cause DLAN		0.14266	0.7135

C. Granger Causality/Wald Test Result for dLSE and dLGDPC

Null Hypothesis:	Obs	F-Statistic	Prob.
DLGDPC does not Granger Cause DLSE	12	4.97620	0.0452
DLSE does not Granger Cause DLGDPC		9.50274	0.0101

D. Granger Causality/Wald Test Result for dLSE and dLC01

Null Hypothesis:	Obs	F-Statistic	Prob.
DLC01 does not Granger Cause DLSE	12	1.02567	0.4068
DLSE does not Granger Cause DLC01		0.62416	0.5631

E. Granger Causality/Wald Test Result for LSE and dTB

Dependent variable: LSE			
Excluded	Chi-sq	df	Prob.
LTB	1.326756	2	0.5151
All	1.326756	2	0.5151
Dependent variable: LTB			
Excluded	Chi-sq	df	Prob.
LSE	0.803368	2	0.6692
All	0.803368	2	0.6692

F. Granger Causality/Wald Test Result for LSE and LU

Dependent variable: LSE			
Excluded	Chi-sq	df	Prob.
LU	0.685903	2	0.7097
All	0.685903	2	0.7097
Dependent variable: LU			
Excluded	Chi-sq	df	Prob.
LSE	25.63598	2	0.0000
All	25.63598	2	0.0000