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**ESTIMATING SIZE OF SHADOW ECONOMY THROUGH CDA:
THE CASE OF TURKEY**

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MASTER'S THESIS

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MASTER'S THESIS

Submitted to the Graduate School of Social Sciences of Kadir Has University in partial fulfillment of the requirements for the degree of Master's in the Discipline Area of Business Administration under the Program of MA in Banking and Finance

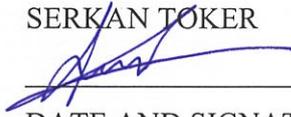
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APPENDIX 3: DISCLAIMER PAGE

I, SERKAN TOKER;

Hereby declare that this Master's Thesis is my own original work and that due references have been appropriately provided on all supporting literature and resources.

SERKAN TOKER



DATE AND SIGNATURE

06/06/2017

APPENDIX 4 ACCEPTANCE AND APPROVAL PAGE

ACCEPTANCE AND APPROVAL

This work entitled **ESTIMATING SIZE OF SHADOW ECONOMY THROUGH CDA: THE CASE OF TURKEY** prepared by **SERKAN TOKER** has been judged to be successful at the defense exam held on **06/06/2017** and accepted by our jury as **MASTER'S THESIS**.

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ABSTRACT

TOKER, SERKAN. *ESTIMATING SIZE OF SHADOW ECONOMY THROUGH CDA: THE CASE OF TURKEY*, MASTER'S THESIS, Istanbul, 2017.

This paper estimates the size of the shadow economy for the 26 NUTS-2 regions of Turkey. It is the first research that attempts at the NUTS-2 level for Turkey in the literature. The estimation used yearly data covering 2011-2014 and applies the modified currency demand approach by Ardizzi et al. (2014) with several updates.

The size of the shadow economy is found as between 6.23% and 7.09% of official GDP of Turkey for the years 2011 to 2014. Results are just an indication of its base value. Because we do not have available data of cash in circulation for each NUTS-2 area, we assume cash flow in circulation is approximately equal to demand deposit flow. However, when the movements of the monetary aggregates variable at the country level are examined, they demonstrate the similar trend. Thus, this paper also present reliable distribution of the shadow economy among 26 Turkish areas.

Results indicate that shadow economy has an upward trend over these specified years and the size of it in metropolitan areas like Istanbul, Ankara, and Izmir is bigger than in other areas. Also, the magnitude of it is decreasing when moving from the western areas to the eastern areas of Turkey.

Keywords: Underground Economy, Shadow Economy, Currency Demand Approach, Illegal Economy

EK 5 ÖZET SAYFASI

ÖZET

TOKER, SERKAN. *GÖLGE EKONOMİNİN BOYUTUNUN PARA TALEBİ YAKLAŞIMI İLE TAHMİN EDİLMESİ: TÜRKİYE ÖRNEĞİ*, MASTER TEZİ, İstanbul, 2017.

Bu çalışmada, Türkiye'nin 26 NUTS-2 bölgesi için gölge ekonomisinin büyüklüğünü tahmin etmektedir. Literatürde Türkiye için NUTS-2 düzeyinde çalışılan ilk araştırmadır. 2011-2014 yıllarını kapsayan yıllık verileri kullanılarak ve Ardizzi vd. (2014) tarafından modifiye edilmiş para talebi yaklaşımında değişiklikler yapılarak gölge ekonominin tahmininde bulunuldu.

Türkiye gölge ekonomisinin boyutu, 2011-2014 yılları arasında resmi GSYH'nin %6.23'ü ile % 7.09'u arasında bulunmuştur. Sonuçlar gölge ekonomisinin büyüklüğünün temel değerinin bir göstergesidir. Her NUTS-2 bölgesi için tedavüldeki nakit para verisi bulunmadığı için nakit para akışı ile mevduat akışını yaklaşık olarak aynı olduğu varsayımında bulunduk. Fakat ülke düzeyindeki parasal büyüklüklerin değişimleri incelendiğinde, benzer hareketler izlemektedirler. Bu nedenle, bu çalışma ayrıca gölge ekonomisinin Türkiye'nin 26 bölgesindeki dağılımı hakkında da bilgi vermektedir.

Sonuçlar, gölge ekonomisinin bu belirtilen yıllar boyunca yükseliş eğilimi içinde olduğunu ve İstanbul, Ankara ve İzmir gibi metropol alanlarda gölge ekonomisinin diğer bölgelere göre daha büyük olduğunu göstermiştir. Ayrıca, gölge ekonomisinin büyüklüğü Türkiye'nin batı bölgelerinden doğu bölgelerine doğru giderken azalmaktadır.

Anahtar Sözcükler: Yeraltı Ekonomisi, Gölge Ekonomisi, Para Talebi Yaklaşımı, Yasadışı Ekonomisi

1. INTRODUCTION

Shadow economy is one of the biggest problems faced by developing countries in particular and it is also becoming an international problem. Shadow economy has the multi-dimensional structure with its consequences, results, and functions, when both Turkey and other countries' experiences are examined (Us 2004).

There are various reasons of the shadow economy, although they are not identical for every country. The size of the shadow economy is affected by economic structure and economic problems of the country. These problems could be high inflation, high unemployment rate, availability of job opportunities, unstable and underdeveloped economy, and so on. The size of the shadow economy and economic problems of the country are highly correlated because every kind of problems economies faces directly affect economic agents namely citizens of the country. These problems could create reasons for people for being unregistered. For instance, increasing in unemployment level entails declining bargaining power of employees. As Us (2004) mentioned it will force employees to involve shadow economy by accepting to work below the minimum wages and without social security.

High burden and strict regulations of governments on economic agents which are the tax burden, social security contribution, minimum wage standards, high retirement ages, licenses requirements, and so on are significant reasons of the shadow economy. These regulations, standards, rules, and 'extra' costs force people and businesses under the competitive market condition to find a way out from these enforcements (Johnson, Kaufmann, and Zoido-Lobaton 1998). One of them is preferring to work in shadow economy rather than working in the registered economy. As Schneider and Enste stated that "Shadow economy can be seen as the reaction of individuals who feel overburdened by the state and who choose the 'exit option' rather than the 'voice option'" (2013: 2). In addition to this, also influences of political and social factors on the size of shadow economy cannot be ignored. These factors could be tax moral, tax awareness, corruption, and so on (Ucok 2015). If trust of citizens in the government and in the justice of taxation system decreases, it might direct them to do shadow economy activities. Because they

know that money they paid as tax is not used properly and they do not get adequate services from government. When citizens get high quality of public service, it encourages them to have more tax awareness (Schneider 2014).

Although there are a lot of reasons of the shadow economy, governments try to find out ways to fight it. However, it is not possible to combat something that is unknown since agents involved in the shadow economy activities try to hide from authorities Schneider and Enste (2013). Consequently, there are various methods that are devised to estimate the size of it.

Several methods have been applied in Turkey to estimate the size of shadow economy: GNP approach (Temel et al. 1994), Labor approach (Yayla 1995), Monetary approach (Cetintas and Vergil 2003), Electricity approach (US 2004) and Model approach (Schneider and Savasan 2007). However, none of them tries to estimate the unrecorded economy at NUTS-2 level. The main purpose of this research is to estimate the size of the shadow economy for Turkey's 26 NUTS-2 areas. This research is the first attempt to estimate it for Turkey at NUTS-2 level. The time period is 2011 to 2014. This is the most recent period for which complete data is available. We will contribute the literature by closing this gap. By providing shadow economy in 26 Turkish sub-area, we will get information about differences in size of shadow economy across areas. This might be useful for policymakers to take measures to fight it.

We use the currency demand approach. This approach has some drawbacks, that are mentioned by Schneider and Enste (2000, 2002), and which will be explained in literature review part, Ardizzi et al. (2014) has proposed modified CDA that overcomes these drawbacks.

This study applies Ardizzi et al. (2014)'s modified CDA method to Turkey's 26 NUTS-2 level sub-areas. Our application will diverge from Ardizzi's in certain dimensions due to the data limitations. Example our implementations are the introduction of agricultural and service sector as a proxy for irregular work. Including criminal activities accordance with whether they create demand for cash. Lastly, using regional inflation rates.

The structure of paper will be as follows; section 2 consists of the definition of phenomenon and activities included in it. Section 3 explains possible positive and negative effects of shadow economy on official economy. Methods to estimate the size of the shadow economy is clarified in section 4. It is followed by literature review part in section 5 that contains methods in the literature and explanation of evaluation of currency demand approach. After that, there is data and variable explanation in section 6. The next section is giving information about the model and its variables. Section 7 is structured as to explain the application of the model into Turkey and to present empirical results of it. The last section consists of conclusion part of this thesis that includes comments and criticisms about findings and the model.

2. DEFINITION OF SHADOW ECONOMY

Before measuring the size of the shadow economy, it is significant to define it precisely. Shadow economy phenomenon is known with different names in the literature; underground economy, irregular economy, unrecorded economy, unofficial economy, second economy, grey economy, hidden economy, black economy, invisible economy, moonlighting economy, subterranean economy, clandestine economy, informal economy. These names used in the literature either as synonyms or as to show different activities involved in the shadow economy. Like there is no widely accepted term for this phenomenon, also there is still disagreement about the formal definition of it. As stated by Schneider and Enste “Since the term ‘shadow economy’ comprises numerous economic activities, it is difficult to provide a formal definition” (2013: 6). Therefore, it is utmost important to examine the literature to reveal which activities are included in shadow economy when defining it.

As it can be understood from various terms that are used for shadow economy, it contains illegal activities and also, legal but unrecorded activities (Us 2004). In order to define and examine them, classifications of underground economy activities in the literature will be used. One of them is Schneider and Enste (2013) classification which is dividing unrecorded economy to four parts. These are informal sector, household sector, irregular sector and also criminal sector. Schneider and Enste (2013) showed informally and household sector as a legal part of the unrecorded economy and irregular and criminal sector as an illegal part of the unrecorded economy. There will be an explanation of this classification in order to illustrate which activities are in the shadow economy.

The legal part of the unrecorded economy consists legal activities and legal unrecorded income. Generated income from this part of the economy is unrecorded for certain reasons. One of them is that they are not included in GDP due to difficulties in calculating income from unrecorded legal activities (Us 2004). As mentioned before there are two legal parts of the unrecorded economy; informal sector and household sector. Informal sector includes mostly small-scale activities. Small farmers engaged in

agriculture, private tutoring, and production for private consumption can be the example of economic agents in the informal sector. However, activities that are counted in household sector are do-it-yourself work, volunteer actions, and any legal unrecorded activities that do not create income (Schneider and Enste 2013). One of the most significant differences between these two sectors is that informal sector creates monetary transaction but household sector does not include such like monetary transactions.

Illegal part of unrecorded economy contains criminal sector and also irregular sector. Schneider and Enste (2013) showed irregular sector appears in illegal part, although most of the literature accepted it in the legal part of the underground economy however the definition and explanation of irregular sector are same. Schneider and Enste explained irregular sector as “The production and distribution of these goods and services become unlawful either by illegal production or by prohibited trade or in combination with tax evasion” (2013: 13). Main motivations of agents in the informal sector are cost elements. Agents involved in shadow economy want to pay less pay or not pay at all and also want to escape from regulations, social security payments, minimum wage requirements, and other standards generally by illicit work. In addition to this, self-employment and part-time works are also counted as in the irregular sector (Schneider and Enste 2013). Irregular and criminal sector are illegal but output generated from these sectors shows differences. While the output of criminal sector is illegal, the output generated from the irregular sector is legal. The criminal sector comprises unrecorded activities forbidden by laws. The example of it could be drug dealing, theft, extortion, bribery, smuggling, and so on.

While the name of defined sectors and classifications of these activities can change and show differences, these are most of the activities that involve in the unrecorded economy. However, there is still no agreement on which activities should be taken to shadow economy which ones should not. Because activities in shadow economy are not determined on a common frame, this leads to differences in the definition of it. Reason of this situation explained by Fleming, Roman and Farrell “Differences in the definitions of the shadow economy stem from differing research objectives, such as estimating the size of the shadow economy or explaining the motives for shadow economy participation” (2000: 389). For instance, one of the most opinion dissociations happened about the inclusion of criminal sector. These disagreements are about whether

criminal sector should be counted in the shadow economy and if it is, which activities should be included and excluded from shadow economy. Ulus clarified shadow economy as “all economic activities, whether legal or illegal, that contributes to gross national product of the country, but not registered in the national income accounts” (2001: 1). Consequently, value adding is the significant criteria of including activities to the shadow economy. If criminal activities include value adding, it should be included. Also, Pedersen stated that “Illegal transactions such as theft, extortion, etc., should not be included in the national accounts, on the other hand, since the transaction is not voluntary in the sense that it is accepted by both parties” (2003: 15). However, same criteria should apply to the selection of criminal activities, too. If criminal activities create value, it should be included in the shadow economy.

3. THE POSSIBLE EFFECT OF SHADOW ECONOMY

Shadow economy has several positive effects and negative effects on the official economy. This part is structured as an explanation of these possible positive and negative effects of the underground economy.

To begin with, one of the positive effects of the underground economy on the official economy is job creation for the unqualified labor force. Especially in the time of recession, it creates job opportunities. Eilat and Zinnes (2000) found that shadow economy decreases the effect of the recession on the official economy by employing people that may not be able to work in recorded economy. Unqualified workers can work in underground economy because of the cost of firms that escaping from regulation lower than firms in the regulated economy. Although it creates unfair competition among firms, shadow economy creates employment and lower cost for firms Us (2004). Moreover, spending the income generated through the created employment gives rise to reviving the official economy. Also, Ucok (2015) mentioned that about 66% of earned income through shadow economic activities is spent in the official economy which is found by Schneider (2012).

However, negative effects of shadow economy are outweighed than its positive effects. One of the most significant negative effects of the shadow economy is that it causes unreliable economic indicator which leads to misevaluation of the economic situation, wrong economic policies (Guloglu, Korkmaz and Kip 2003). Since underground economic activities are unrecorded, official indicators do not reflect these activities. Policymakers evaluate these indicators to understand economic situation of the country. Because these indicators are missing, that might cause difficulties in defining the problem in the economy by policy makers and might induce taking wrong measurement and actions by policymakers. Moreover, these wrong policies taken by policymakers might lead to reverse effect in the economy and worsen the situation.

Other important negative effects of the shadow economy are that it causes deterioration in the most important financial resource of government which is tax income.

Unrecorded economic activities give rise to the unpaid or incomplete payment of taxes. That induces pressure in budget and force government to take measures for recovering budget. In order to finance budget, the way of increasing tax rate or borrowing method might be chosen by governments. However, both increasing tax rate and choosing borrowing method prepare a ground for shadow economy. If policymakers choose to increase the tax rate, it might strengthen injustice in taxes and also unfair income distribution and that might entail increasing in size of the unregistered economy. If policymakers choose to borrow money, that might engender increasing in interest rates; Increasing in interest rate might decrease investment and that might affect both national income and employment in negative ways. Also, increasing in interest rates leads to increase in the cost of public borrowing so, the budget deficit might get bigger. Thus, these two ways might produce more unrecorded transactions in the economy. These features drag the economy into a vicious cycle (Us 2004).

Moreover, as mentioned partly in the positive effect of the shadow economy, it leads to unfair competition. It affects recorded firms with decreasing their competition level since the unrecorded firm has cost benefit by escaping regulations and taxes and they can sell goods and services at lower prices (Ogunc and Yılmaz 2000). It is like punishment for firms just because being recorded.

The last but not least effect of the shadow economy is leading corruption in the social security system. Due to the large size of illicit work, enough premium cannot be collected and this situation leaves social security institutions with financial difficulties all alone. In addition to this, employees in the irregular sector are destitute of union rights. Also, because employers ignore various standards for work and workplace, it makes possible abuse of employees (Us 2004). Moreover, it should be mentioned that there can be injustice tax system since tax burden of the unrecorded economy might be reflected people who are paying their tax. This situation damages tax moral, shakes confidence in authority and also it might create acts against tax. That could create the social problem and disturb social tranquillity (Guloglu, Korkmaz and Kip 2003).

4. METHODS TO ESTIMATE SIZE OF SHADOW ECONOMY

There are the different type of methods used for estimation of the shadow economy. In the literature, these methods are divided into 3 groups; direct method, indirect method, and models.

4.1. DIRECT METHOD

In this type of measurements made on a micro level, results that are taken from the randomly selected sample are used for making inferences about the population. Questionnaire surveys are one of the most important direct methods which are used for estimation of the size of shadow economy for specified time of period. In order to quantify the size of the shadow economy, questionnaires should be designed to determine the discrepancy between earned income and declared income for tax purpose (Kildiş 2005). After getting the results of the survey, the size of the shadow economy is tried to be estimated according to samples of the survey. The size of shadow economy relies on samples which are the answer of respondents. However, the fact that significant part of the shadow economy activities is illegal gives rise people to have the tendency to hide information (Us 2004). Because samples reflect possible wrong information (especially for criminal activities), the reliability of this method is debatable.

Another direct method is tax auditing approach assumes that with using the tax base differences resulting from detection of undeclared income during selected tax audits, the size of shadow economy could be estimated. By using statistical methods, sample results which are tax base differences applied into the whole economy and it assumes that figures for the size of shadow economy will be got by that way. As it can be estimated, the reliability of methods strongly depends on the effectiveness of auditing system. Also, randomly selection of sample could be biased (Schneider and Enste 2013).

4.2. INDIRECT METHOD

Pedersen expressed that “indirect methods are based on the assumption that the shadow economy leaves a number of clues on the surface, from which it is possible to form an idea of what is going on below” (2003: 21). Therefore, indirect methods use these “clues” in the official sector in order to estimate size shadow economy. In order to do so, economic indicators are used. Because of that, it is also known as indicator method. There are a couple of indirect methods which are; Gross National Product Approach, Labor Force Approach, Electricity Consumption Approach and Monetary Approach.

4.2.1. Gross National Product Approach

Gross National Product (GNP) can be calculated using different methods; expenditure, income, and production. Although the GNP calculated with using these methods are expected to be same, the result of these three methods might give different results (Ogunc and Yilmaz 2000). This approach assumes that differences between results of these three methods are coming from the existence of shadow economy. One of them is the discrepancy between expenditure based GNP and GNP calculated with income method gives the size of the shadow economy. This is called as the discrepancy between national expenditure and income statistics. The main motivation of this idea that although income could be underreported, expenditure cannot be hidden. If especially expenditure could be quantified accurately, results from this model will be quite valuable to assess the size of the shadow economy. However, activities under the name of omissions and errors lead to deterioration of these indicators (Schneider and Enste 2013). The Same point also referred by Temel, Şimşek, and Yazıcı (1994) which is in the period of high tendency to invest in saving instruments such as foreign exchange and gold and presences of fund transfers to abroad, this approach does not give appropriate results.

4.2.2. Labor Force Approach

Labor force model indicates that changing in ‘official’ indicator of participation of labor force is only caused by shadow economy activities. The key assumption of this

approach is that ‘real’ or as it called ‘actual’ participation of labor force is same over the time. Therefore, by subtracting the real number, which can be defined by estimating base year that does not have shadow economy, from the official indicator, information about the size of shadow economy could be gotten. There are lots of weakness of this method. Schneider and Enste 2013 explains them as; there can be other reasons for alterations in the indicator of participation of labor force and also, this indicator does not take into account people work for the second job as shadow economy agent.

4.2.3. Electricity Consumption Approach

Another indirect method of the calculating size of the shadow economy is the approach of electricity consumption. These methods used electricity as a physical indicator, so this approach also called as physical input indicator. There are two methods in this approach; simple electricity consumption method and modified electricity consumption method.

Simple Electricity Consumption Method

Kaufmann and Kaliberda (1996) improved simple electricity method that assumes there is a strong relationship between electricity consumption and development of the economy. The model assumes that if there is increasing in consumption of electricity, it is the sign of growth in the economy. If ‘official’ indicators do not capture and reflect this growth, it is the sign of the existence of shadow economy. Moreover, this model assumes that income elasticity of electricity consumption is exactly equal to 1 which means that the growth in electricity consumption is completely same with the growth in the economy. Consequently, information about the magnitude of shadow economy can be acquired by finding the discrepancy between the official growth of economy and growth of electricity consumption. However, this model has several shortcomings. One of them, electricity consumption does not necessary or need for every business and also, electricity is not the only power supply for economic activities (Medina and Schneider 2017).

Modified Electricity Consumption Method

In this method, it assumed that there can be other variables that could affect consumption of electricity. These factors could be the price of electricity, GDP, value adding of manufacturing industry and so on. The assumption is that the error terms that is obtained from electricity consumption equation with using regression analysis include shadow economy activities. This model also has a couple of drawbacks. Some shortcomings which are identified for simple electricity consumption model are valid for this model. Also, this model requires base year assumption that there is no shadow economy which is unrealistic (Us 2004).

4.2.4. Monetary Approach

In this approach, in order to quantify the size of the shadow economy, movements in the monetary aggregates are investigated. The assumption of this approach is the source of these movements stem from shadow economy activities under the assumption of all transaction made in shadow economy used cash and cash equivalents. Agents involved in this economy used cash because of the untraceable feature of cash. Therefore, this approach claims that by tracing demand for cash, information about the size of shadow economy could be obtained (Pedersen 2003).

There are two monetary approaches; The Transactions Approach and Currency Demand Approach.

The Transactions Approach

This approach was proposed by Feige (1979) and he used Fisher quantity theory of money equation which is money supplied multiplied with the velocity of money circulation equals to the value of transactions ($M*V=P*T$). Ahumada, Alvaredo, and Canavese (2008) clarified steps of estimation of the size of shadow economy as follow; first, base year assumption where there is no shadow economy is made. After that, the velocity of official economy is calculated. The next step is, with the assumption of the velocity of official economy is constant over time, total output (official and shadow

economy) is calculated. The last step is subtracting official economy from the total output in order to find the size of the shadow economy. Drawbacks of this model expressed by Medina and Schneider (2017) as; model has unrealistic assumptions like constant velocity and time where there is no shadow economy assumption. Also, development of electronic payments which could affect demand for cash negatively is ignored in this model.

Currency Demand Approach

Agents involved in shadow economy activities want to keep themselves hidden. Because of that, they use cash in their transactions in order to remain untraceable. Even though cash transactions cannot be traced, demand for cash can be inferred. Therefore, this model estimates 'excess' demand for cash that cannot be explained by structural factors like the size and development level of the official economy, the cost of holding non-interest bearing cash, and available payment technology. Total Cash demand includes recorded cash demand and shadow cash demand. In order to calculate the size of the shadow economy, first shadow cash demand should be calculated. In order to do so; first total cash demand should be predicted by the full model. Then, with setting shadow economy components equal to 0, recorded cash demand is calculated with the restricted model. After that subtracting it from total cash demand gives results of shadow cash demand. Then, getting shadow cash demand, velocity should be predicted. In traditional CDA (Tanzi 1983), this is made by using Fisher's quantity theory of money equation and with couple assumptions. First, a base year where the shadow economy is assumed not exist is picked arbitrary. Then for that year, $V = \text{GDP}/M$ the velocity of recorded economy is calculated. Then, one further assumes to estimate the velocity of the shadow economy, the estimated velocity for that base year remains constant across years and also remains valid for both recorded and shadow economies. Thus, multiplying this V by SCD gives the size of the shadow economy.

4.3. MODEL APPROACH

The model approach is also known as multiple indicators and multiple causes (MIMIC) approach was firstly used by Frey and Weck-Hanneman (1984). As it can be understood from the name of MIMIC approach, it estimates unobservable dependent variable by investigating multiple indicators and multiple causes of variables (Baldemir, Özkoç, and İşçi 2013). It is like searching of unobservable by examining its observable effects.

5. LITERATURE REVIEW

5.1. EXISTING WORKS

There are numerous existing works to estimate the size of the shadow economy in literature. This chapter shows several existing works which are using different methods in order to estimate the size of the shadow economy.

Although there is no example of the direct approach in Turkey, there are various examples of it in literature. One of them is Isachsen and Strom (1985). They used surveys as the direct approach to estimating size and growth of the hidden economy in Norway. In surveys, One thousand people were asked to fill in the questionnaire. They estimated by using correction item for unavoidable bias in answers size of the hidden economy in Norway was between 4 and 6 percentage of GDP in 1983 and the size was stable over last few years.

As mentioned before indirect approach includes different type of methods. One of them is the discrepancy between national expenditure and income statistics. O'Higgins (1989) assessed the magnitude of hidden economy in the United Kingdom by using discrepancy approach which examines the discrepancy between income reported to tax authorities and estimated income from national account statistics. He has found that size of the hidden economy is around 5% of GDP and growth of unobserved economy increased in the beginning of 1970s and got stable in mid-1970s.

Another paper which is using different types of indirect method is Us (2003). She tried to demonstrate the size of the shadow economy in Turkey by using different methods; GDP method, labor force method, electricity consumption and also currency demand approach. She found different results with using different methods. She stated that the reliability of the methods was controversial. Although methods gave different results, they demonstrated that shadow economy had an upward trend in years between 1987 and 2003 in Turkey.

Cetintas and Vergil (2003) used currency demand approach to estimate the size of shadow economy as a percentage of official GDP in Turkey between 1971 and 2000. The average size of shadow economy they have found is 24.7%. The figures obtained showed that magnitude of it fluctuates over years. Although this work provided limited estimation in terms of the size of the shadow economy, it showed that shadow economy had reached an important dimension increasingly.

Revised version of CDA which is also applied into Turkey in the research of Halicioglu and Dell'Anno (2009). They adopted Feige (1979) method and eliminated the criticism about base year assumption of the monetary method which was made by Ahumada, Alvaredo, and Canavese (2008) with using autoregressive distributed lag (ARDL). Ahumada, Alvaredo, and Canavese stated that "the only way to avoid ad hoc assumptions about previous values of registered currency is to restrict the measures of the shadow economy size to those based on the long-run estimates of the money demand" (2008: 99). By applying this, they have estimated the size of the unrecorded economy with the range of 10.65% to 18.91% over the period 1987-2007.

Davutyan (2008) applied the expenditure-based approach which is a micro level method because based on the idea that income could be underreported but expenditure cannot be hidden. The research estimates excess food consumption expenditure under the assumption of income is underreported and food expenditure is reported accurately. Shadow economy for the year 2005 had been found as 21% of official GDP in Turkey.

Lastly, the Multiple-Indicators–Multiple-Causes (MIMIC) model which is Model-based approach is applied to Turkey in order to estimate the size of shadow economy by Schneider and Savasan (2007). They have measured it as 31–35% of GDP over years 1999 and 2005. Also, they have found that size of the shadow economy in Turkey is still growing but with slightly at the lower rate.

5.2. EVALUATION OF CURRENCY DEMAND APPROACH: LITERATURE REVIEW

In this section, some of the important works are summarized to show the evolution of currency demand approach. Cagan (1958) is the first one who attempted to use the currency demand model with the core assumptions of CDA which are cash is used in all shadow economy transactions and same velocity for the official economy and shadow economy. Cagan (1958) applied the model to the USA for the years between 1919 and 1955 by measuring the correlation of currency demand and tax pressure which is taken as a proxy for shadow economy.

After that, Gutmann (1977) applied Cagan (1958)'s method but Gutmann interested in the only the currency ratio which is the ratio of cash to demand deposit. One of the key assumptions of Gutmann is that currency ratio is only affected by the change in imposed tax and restrictions of governments. With the assumption of the base year which is there is no shadow economy transaction, Gutmann stated that amount of currency in 'subterranean' economy can be gauged can be found by differences of this currency ratio over years. Lastly, he calculated the size of 'subterranean' economy by multiplying the amount of currency in the unofficial economy with the velocity of the official economy under the assumption of the same velocity for the official economy and shadow economy. Gutmann has found that size of the shadow economy in the USA was 10.4% of official GNP in 1976.

Tanzi (1980, 1983) proposed modified version of Cagan (1958) model to gauge the size of the shadow economy in the USA for the period of 1930-1980. Tanzi improved Gutmann (1977) model by introducing new variables and destroying the assumption of the change in currency ratio only depends on the change in tax or restrictions on government. Tanzi stated that there are legal factors like per capita income, the cost of holding currency, the share of wages and salaries and also illegal factors as the cause of shadow economy like tax evasion and criminal activities that drive currency ratio. Because of lack of data Tanzi ignores these illegal factors, just concentrated on the effect of tax evasion and assumed that it is the only motivator of the shadow economy. Again, Tanzi used similar core CDA assumption that cash is used in shadow economy activities because it is hard to trace and it is easy to hide their participation. Moreover, he accepted

income elasticity of demand of currency is equal to 1 which means the same velocity for the regular and irregular economy. Tanzi used this velocity to multiply with estimated cash used in shadow economy transactions to find the size of the shadow economy.

However, several criticisms are made about main weakness of CDA in literature and most of them are related to these assumptions; using same velocity for regular and irregular economy, base year assumption which is determining a period that there is no irregular economy transaction and lastly using only one variable as a determinant which is tax evasion. One of them is Thomas (1999) who defined these assumptions as “heroic” assumptions. For base year assumption, Thomas stated that “was there ever a year in any society when hidden economic activities were not being undertaken? Perhaps in the Garden of Eden, but even there we do not know what else the Serpent got up to!” (1999: 383). Another one is Hill and Kabir (1996), and Klovland (1984) had criticism about using the same velocity in shadow and official economy. Moreover, Ahumada, Alvaredo, and Canavese (2007) showed the way of correction of the size of shadow economy estimation if there is an assumption of making velocity of the irregular and regular economy is same, although income velocity of demand is not equal to one. And last but not least, Schneider and Enste (2000) brought a criticism about using only one variable, tax burden as an indicator of the shadow economy. They stated that there are also other factors that should be considered.

These criticisms on main assumptions of CDA are overcome with ‘modified CDA’ which was introduced by Ardizzi et al. (2014). One of the improvements in Ardizzi et al. (2014) is using flow-based as opposed to stock-based monetary aggregates. This allows to measure $M*V$ directly and avoids. It also allows bypassing the necessity to assume equality of velocity across recorded and shadow economies. Therefore, by that way, there will be no need to make ‘heroic’ assumptions as like base year and same velocity. Another improvement of Ardizzi et al. (2014) is the more general specification of the irregular economy which allows to include regulatory avoidance, tax morale etc. in addition to tax evasion and also including criminal sector. The criminal sector is a component of the shadow economy is ignored in most studies. Also, by doing this, they responded to the criticism about using only one variable, tax burden as an indicator of the shadow economy. This “modified” CDA of Ardizzi et al. (2014) model will be applied Turkey’ sub-areas with several updates and changes which will be explained.

6. DATA

The size of the shadow economy in the years between 2011 and 2014 has been assessed in this thesis for 26 sub-areas of Turkey (NUTS-2 level) on the yearly base. Unfortunately, limited data is available, especially for the sub-area level. Availability of data is considered in the determination of periods and NUTS level of research. When collecting data, several sources are used which are Turkish Statistical Institute (TURKSTAT), The Banks Association of Turkey (BAT), FINTURK, and Central Bank of the Republic of Turkey (CBRT). There will be an explanation of data set and variables which are used in the model.

The value of demand deposit flow relative to the value of non-cash payments (EFTs and Credit card payments) is used as dependent variable in the estimated equation. The value of demand deposit flow (TL thousand) which is gotten from The Banks Association of Turkey (BAT) show the change in the value of demand deposit in 1 year ($\text{Flow}_{2011} = \text{Deposit}_{2011} - \text{Deposit}_{2010}$). FINTURK which is prepared by The Banks Association of Turkey (BAT) provide credit card payments are the individual credit card usage (TL thousand) in the yearly base. Lastly, there is no available data for electronic fund transfers (EFTs) at sub-area level. Because of that, we used a proxy for estimating the value of EFTs at the sub-area level that is EFTs at whole country level (TL thousand) (from Central Bank of the Republic of Turkey (CBRT)) is weighted by active internet banking customer of each area for each year.

Independent variables are structured into three part. These components are the structural component, the irregular component, and the crime component. In structural component, there are four variables which are YPC, URATE, INF, and ELECTRO. YPC (TL) is Gross Domestic Product per capita (TURKSTAT). URATE refers the rate of unemployment at sub-area level (TURKSTAT). ELECTRO is the ratio of the value of payments settled by electronic payments (TL thousand) (again proxy is used) to GDP (TL thousand) at nuts-2 level (TURKSTAT). Lastly, INF present the rate of change in 12 months moving averages in the consumer price index by December (%), $2003=100$ (TURKSTAT). In irregular component, AGR that is employment in agriculture over total

employment with weighted by GDP index (TURKSTAT) and SER employment in service sector over total employment with weighted by GDP index (TURKSTAT) are used. GDP index is the ratio of GDP per capita to the overall mean of GDP. Finally, last part of independent variables is criminal components. It includes two crime variable; CRIME.ND and DRUG. CRIME.ND indicate the ratio of number convicts received into prison by selected criminal activities (theft, extortion, bribery, and smuggling) to the total of number convicts received into prison by criminal activities weighted by GDP index (TURKSTAT). DRUG is the ratio of number convicts received into prison by production and commerce and also use and purchase of drugs criminal activities to the total of number convicts received into prison by criminal activities weighted by GDP index (TURKSTAT).

7. MODEL

‘Modified’ currency demand approach of Ardizzi et al. (2014) is applied as a base model with several updates and changes. When applying the model into Turkey, there was need for changes due to limited data. The first change is using regional inflation rates, as the cost of holding cash whereas Ardizzi uses actual regional interest rates. Also, differently from Ardizzi et al. (2014), rather than using detected cases of tax evasion as the base indicator of the unofficial economy, irregular work proxies from Ardizzi et al. (2012) are replaced. Moreover, selection of crimes criteria is different than Ardizzi et al. (2014)’s model. Whereas Ardizzi et al. (2014) include only those activities that are deemed criminal but are mutually beneficial like (mutually consensual sex or drug trade), we include activities that create demand for cash.

Equation of the model is:

$$\begin{aligned} INCASH_{ti} = & \alpha_0 + \alpha_1 * YPC_{ti} + \alpha_2 * URATE_{ti} + \alpha_3 \\ & * INF_{ti} + \alpha_4 * ELECTRO_{ti} + \alpha_5 * AGR_{ti} \\ & + \alpha_6 * SER_{ti} + \alpha_7 * CRIME.ND_{ti} + \alpha_8 \\ & * DRUG_{ti} + \varepsilon_{ti} \end{aligned} \quad (7.1)$$

A key assumption of this model is only cash is used all of the shadow economy transactions because agents that involved in shadow economic activities want to keep themselves hidden. Due to the nature of cash, there is no or few trace possibly left behind. In order to investigate the relationship between money demand and economic indicators equation (7.1) is set up.

This paper complies similar steps followed by Tanzi (1983) also is followed by Ardizzi et al. (2014) model. With using equation (7.1), there will be a search of ‘excess’ demand that cannot be explained by structural factors. In order to do so, after getting demand for the cash payment from equation (7.1) with using regression model, first, irregular work and criminal components of the demand for cash payment variables make equal to zero separately. After that demand for cash is recalculated with using equation

(7.1), respectively. Then, demand for cash with no irregular work component and with no criminal component subtract from full model, respectively. By that way, the size of two shadow economy component can be demonstrated separately. Independent variable of the equation, INCASH is expressed as the value of demand deposit flow relative to noncash payments (EFTs and credit card payments). Because of that, there will be no need for making base year assumption where there is no shadow economy and also same velocity assumption for shadow economy and official economy. Therefore, the size of the economy which is a sum of irregular work and illegal work can be obtained by multiplying the value getting from difference with the total value of the noncash payment.

7.1. EXPLANATION OF VARIABLES

Tanzi (1980) mentioned separating factors that affect the demand of cash into two categories; legal part (development of the economy, the cost of holding currency) and illegal part (motivators of shadow economy). In Ardizzi et al. (2014) method, similar categorization is followed. Factors that affect the demand for cash examined into three component as legal (structural factors), irregular work and illegal work.

7.1.1. Legal Motivators of the Demand for Cash Payments

There are four variables under the category of legal motivation, which are YPC, URATE, ELECTRO, and INF, that drives demand for demand deposit. Gross domestic product per capita (YPC) and Rate of Unemployment (URATE) is used as an indicator of the level of development of the economy. Expected sign of YPC is negative. The reason of this is as mentioned by Ardizzi et al. (2014) that there are lots of finding that the higher level of income makes decreasing using cash in payments and directing people to use alternative payments (e.g., Schneider and Enste (2000, 2002); Schneider (2011); Buehn and Schneider (2012)). So, increasing in GDP per capita will lead to decreasing in cash demand deposit.

URATE is used as a second possible indicator for the level of development of the economy. In Ardizzi et al. (2014)'s expected the sign of URATE is positive. However, Akin et al. (2012) stated that unemployed people may use the credit card as a credit

instrument to balance and smooth their consumption. Because they are unemployment people, banks may not give them credit to use and they choose to use their credit card in payments. Therefore, the expected sign of URATE should be negative. Thus, expected usage of credit card will increase and that leads to decline in demand for cash in payments.

The third variable of legal motivators is ELECTRO which is a ratio of the amount of payment settled by electronic fund transfers (EFTs) to GDP. It is chosen by Ardizzi et al. (2014) as an indicator of available technology for payments. When there is increasing in available technology in payment that will lead to increasing in using alternative payment methods. Therefore, it will lead to decreasing in the usage of cash, declining in demand of cash. Hence, expected sign of ELECTRO is negative.

The last but not least factor is that inflation rate (INF). It is one of the biggest reason of shadow economy. High and persistent inflation cause injustice in the tax system. Economic agents are taxed in the high-income bracket with increasing in their nominal income due to increasing in general price level. Although their real income did not change, the amount of tax they have to pay is increased. This injustice in tax system caused by inflation leads to increasing in shadow economy (US 2004). We can expect that there will be increasing demand for cash when there is increasing inflation. Because our main assumption was that cash is used in all shadow economic activities. Therefore, increasing in shadow economic activities will increase use of cash. However, because there is high inflation in the economy, people do not want to hold money in their pocket with the fear of declining value of the currency that will affect the demand for money in a negative way. Thus, expected sign of relationship of the inflation rate and demand for cash is unclear.

7.1.2. The Irregular Component of the Demand for Cash Payments

In this component of demand for cash payment. The sectorial composition of the labor force in the economy is used rather than tax evasion variable. The main reason for this selection Ardizzi et al. (2012) mentioned a study of Johnson et al. (2000) that provides information that there is an important effect of the sectorial composition of the labor force in the magnitude of the unregistered economy. Agriculture and service sectors are

selected. The reason for choosing agriculture is that according to data provided by TURKSTAT, the unregistered rate of total employment in agriculture in 2014 is %81.2. For service sector, Guloglu, Korkmaz, and Kip (2003) stated that it is difficult to follow and comply the registration and official documents in service sector due to its nature. Moreover, the concentration of employment in the service sector in marginally inefficient activities prevents transactions from being recorded. Thus, these two sectors have a high presence of irregular workers. In order to measure evasion of income and social security contribution in the irregular sector, these variable are selected (Ardizzi et al. 2012). SER indicated that employment in service sector over total employment with weighted by GDP index and AGR employment in agriculture over total employment with weighted by GDP index. GDP index is a ratio of GDP per capita to the overall mean of GDP. Reason of using GDP index is clarified by Ardizzi et al. that is “standardization allows us to compare provinces characterized by remarkable differences in the level of socio-economic development” (2012: 5)

Expected signs of SER and AGR are positive because they are proxy for irregular work. Increasing in irregular work will lead to rising in demand for cash and greater magnitude of the shadow economy.

7.1.3. The Illegal Component of the Demand for Cash Payments

The last component of demand for cash payment is criminal activities. As mentioned before Ardizzi et al. (2014) brought development in currency demand approach by using criminal variables. Actually, Tanzi (1980) was the first one who was indented to use criminal activities but because of the lack of data, he ignored illegal factors. In this paper, Illegal factors are included but the selection of this criminal factors is different than selection criteria of Ardizzi et al. (2014). Ardizzi search a mutual agreement and voluntary cash payment when choosing criminal types like Pedersen (2003). However, we just consider that whether these criminal activities involved in the monetary transaction or not. Thief, extortion, bribery, smuggling and also drug are selected as criminal activities. These criminal activities are collected under two variable; CRIME.ND and DRUG. CRIME.ND includes thief, extortion, bribery, and smuggling and shows the share of a number of convicts committed these crimes over crimes total

number of convicts weighted with GDP index. DRUG contains production and commerce and also use and purchase of drug and indicate the share of a number of convicts committed production and commerce of drug over crimes total number of convicts weighted with GDP index. The reason for this separation is that drug is creating the biggest part of shadow economy among these criminal activities and also, as like stated in Ardizzi et al. (2014) it is accepted by almost all scholars (e.g., Lippert and Walker (1997)). Lastly, these variables are weighted by GDP index because of the reason mentioned before.

8. APPLICATION OF MODEL AND EMPIRICAL RESULTS

There is an estimation of the size of the Turkish shadow economy for the years between 2011 and 2014 at sub-area level (NUTS-2) by accepting “modified” currency demand approach model of Ardizzi et al. (2014) as a base model. There is panel data of 26 sub-areas and 104 observations from 2011 to 2014. When applying equation (7.1) into Turkey, Random Effects Tobit model is used because it has overcoming over other panel regression models which are explained by Ardizzi et al. as “to accommodate for the particular distribution of the dependent variable, which is censored at zero and can assume only positive values” (2014: 758)

After collecting data and applying model into Turkey with using equation (7.1), Table 8.1 exhibits results of the econometric model. As expected there is a negative and statistically significant relationship between GDP per capita and demand for cash. If there is 1000 TL increase in GDP per capita, it will decrease relative demand for cash payment for about 0.0000761 unit. The coefficient of URATE with demand for cash payment is also negative and significant. Increasing 1% of unemployment rate decreases about 0.004064 unit for relative demand for cash. Although the expected sign of inflation rate is ambiguous, results indicate that inflation rate and demand for cash are negatively correlated and this relation is strongly significant. The result indicates that if there is 1% increase in inflation rate, it will cause -0.029159 unit declining in relative demand for cash payments. The coefficient of available technology in payment and demand for cash is negative as expected, but this relationship is not statistically significant in the results. If we examine the relationship between variables of the irregular sector, which are the share of service and agriculture sector in total employment, and demand for cash, there are positive and statistically significant relationships. Increasing 1% of service sector share leads to about 0.002054 unit increase in relative demand for cash payments and also increasing 1% of service sector share leads to about 0.001562 unit increase in relative demand for cash payments. Last part of the variables is criminal component of demand for cash. Criminal factors show positive and statistically significant relationships between the demand for cash again as we expected. Although 1% of increasing the share of the

only drug increases 0.002822 unit of relative demand for cash, 1% of increasing the share of other criminal activities increases 0.006002 unit of relative demand for cash.

INCASH	Coef.	Std. Err.	Z	P> z 	[95% Conf.	Interval]
YPC	-0.0000000761	2.4E-08	-3.11	0.002	-1.2E-07	-2.8E-08
URATE	-0.004064	1.5E-03	-2.63	0.009	-7.1E-03	-1.0E-03
INF	-0.02915940	5.5E-03	-5.3	0	-4.0E-02	-1.8E-02
ELECTRO	-0.00000884	1.9E-05	-0.48	0.633	-4.5E-05	2.8E-05
SER	0.00205370	7.4E-04	2.77	0.006	6.0E-04	3.5E-03
AGR	0.00156180	6.4E-04	2.46	0.014	3.2E-04	2.8E-03
CRIME.ND	0.00600170	1.9E-03	3.24	0.001	2.4E-03	9.6E-03
DRUG	0.00282160	1.2E-03	2.32	0.02	4.4E-04	5.2E-03
_cons	0.00309860	8.1E-04	3.82	0	1.5E-03	4.7E-03

Table 8.1 : Econometric results of the model

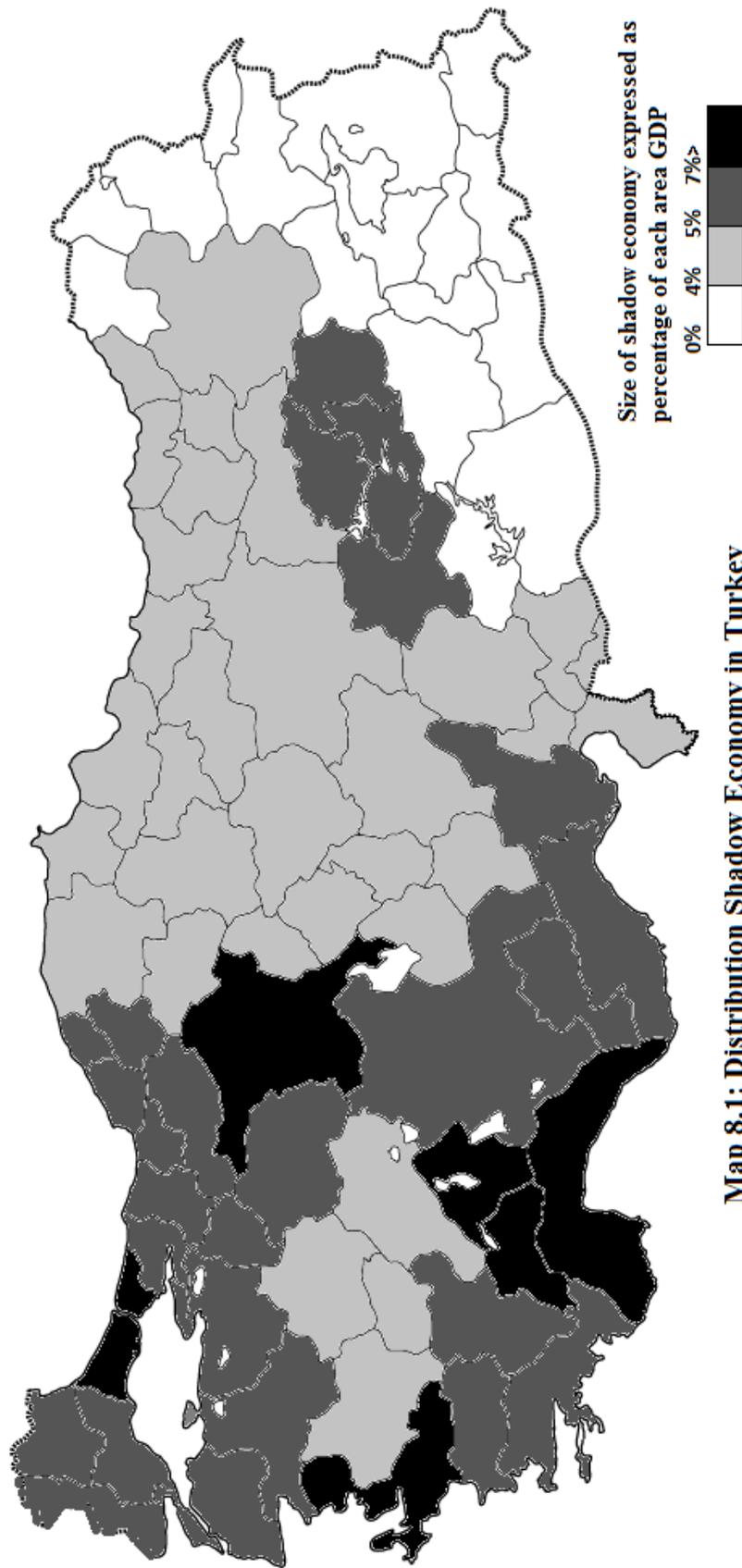
After getting the full model of money demand from equation (7.1), now there will be a search of 'excess' demand that cannot be explained by structural factors. First, irregular work and criminal components of the demand for cash payment variables make equal to zero separately. Therefore, the model which is SER and EMP are made equal to zero called as Model A. Also, the model which is CRIME.ND and DRUG are set equal to zero called as Model B. The next step is recalculating of formula (7.1) for restricted Model A and B. Coefficient from full model are used in restricted models when running the econometric models. The following step is finding differences between the full model and restricted Model A and B to obtain excess demand for cash payment because of the irregular sector and criminal activities. However, results are shown as relative to the total value of non-cash payment because INCASH is expressed as the value of demand deposit flow relative to non-cash payments (EFTs and credit card payments). It requires multiplications of differences with the total value of non-cash payment in order to get cash used in the informal sector and illegal activities separately. Moreover, as a final step to express these value as a percentage of GDP of each area, the size of shadow economy of each sub-area are divided by sub-area GDP.

In order to express size of the shadow economy in a country (NUTS-2) level; first, the size of shadow economy of 26 sub-area are weighted by their population and these values are summed up. The size of Turkish shadow economy is found as between 6.23% and 7.09% of official GDP of Turkey for the years between 2011 and 2014. The size of irregular work component is 3.90% in 2011. Although it decreases to 3.27% in 2012. It reaches an almost same percentage of official GDP in 2014. Shadow economy has an upward trend over specified years. It increases from 6.23% in 2011 to 7.09% and the biggest part of this growth comes from the criminal part. Criminal component of the shadow economy is 2.32% in 2011 and it increases to 3.24% in 2014.

When we look at the size of the shadow economy in 26 sub-areas of Turkey, almost all value shows increasing trend over years except the irregular work in 2012. The largest size of the shadow economy is in Istanbul which is 13.16% of Istanbul GDP over years. It is followed by Ankara and Izmir which are 11.71% and 9.04% in 2014. The biggest part of shadow economy component in Istanbul is the criminal sector which is peak to almost 8% in 2012 and decline to about 7% in 2014. The composition of the criminal and irregular sector is not same for Ankara and Izmir. Their biggest part of

shadow economy component is irregular work; almost 7% in Ankara, about 4.5% in İzmir. However, there is rapid growth in the illegal component of the shadow economy in İzmir. In İzmir, criminal component caught irregular work and also got bigger than irregular work in 2013. Also, the smallest shadow economy exists in the area of Ağrı, Kars, Iğdır, and Ardahan which is 2.86% in 2014. It is followed by the area of Sanliurfa and Diyarbakir as 3.03% in 2014 and area of Van, Mus, Bitlis, and Hakkari as 3.06% in 2014. In three area, irregular work composes the largest part of shadow economy but shares of two component are close. Thus, we can clearly say that size of the shadow economy is larger in metropolitan areas like Istanbul, Ankara, and İzmir than other areas.

Moreover, composition and distribution of shadow economy among 26 sub-area of Turkey in the years 2011-14 are examined. The magnitude of the shadow economy is decreasing when moving from the western areas to the eastern areas of Turkey. One of the biggest reason of this could be differences in level developments of economy and differences in industrialization level between areas (Ardizzi et al. 2014). Another point, we also need to consider that size of criminal actives is getting bigger in western cities. Glaeser and Sacerdote (1999) stated that financial advantages of the crime are higher in the larger and richer cities. The distribution of the shadow economy is exhibited in the following Map 8.1 of Turkey;

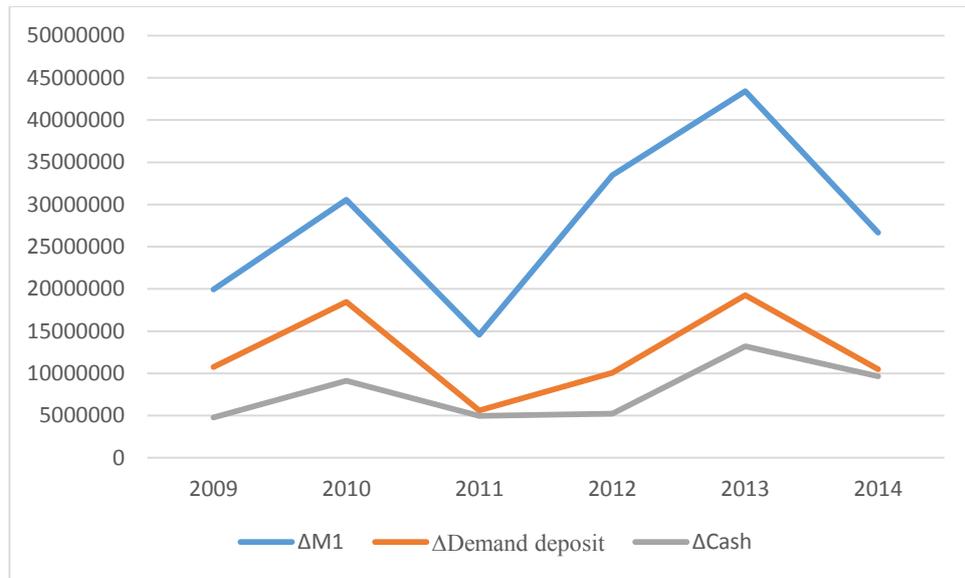


9. CONCLUSION

In this thesis, estimation of the shadow economy is made for 26 sub-areas of Turkey which are NUTS-2 level for the years between 2011 and 2014 with using currency demand approach which is the model of Ardizzi et al. (2014) with several updates. Before doing an estimation, detailed explanation of this phenomenon and analysis of activities that involved in shadow economy took place. After that possible positive and negative effects of the shadow economy on recorded economy examined. Moreover, detailed explanation of methods for estimating the size of the shadow economy and existing works are presented.

This paper gives information not only about the size of shadow economy but also the distribution of it among sub-areas of Turkey. However, it is a hard and difficult task to gauge magnitude of shadow economy with using limited information and present reliable figures which show size of shadow economy precisely. Nevertheless, the best effort is given to this research, it subjects to several limitations. One of the most important limitations of this model is the availability of limited data. For instance, the data of value of M1 at sub-area level is not available. It may be the reason of why we have found aggregated size of the shadow economy is lower than what we expected. When literature is examined, figures we have found are below than the result of the size of shadow economy for Turkey in the literature. For instance, Schneider, Raczkowski, and Mróz (2015) found that size of shadow economy of Turkey for the same years of the research as around 27% of official GDP. As mentioned before, we believe that main reason of this differences using the flow of cash demand deposit rather than using the flow of M1. However, when examining Graph 9.1, it provides information about movements of the value of monetary aggregates in flow based.

Graph 9.1: Movements of Monetary Aggregates-Flow Based



(Data provided by EVDS system of Central Bank of the Republic of Turkey)

The value of the flow of M1 and value of the flow of cash demand deposit are moving together. Thus, we can say that this research gives also accurate information about the distribution of shadow economy among the sub-area of Turkey, although the result of quantifying the size of the shadow economy is a just indication of the base value of its magnitude.

Another pitfall of this model, as in the most studies, could be proxies used in estimation for the unrecorded economy do not include properly all of driving forces of the shadow economy. Some determinants of shadow economy may be hard to measure in practice. As stated in Schneider and Enste criticism “other factors (such as the impact of regulation, the taxpayers’ attitudes toward the state, ‘tax morality’, and so on) are not considered because reliable data for most countries are not available” (2014: 22). The Same argument is also valid for Turkey.

The last shortcoming of the model could be that model is quantifying only transactions that made with Turkish Lira. Especially, as it is known that the biggest part of transactions of drug dealing which is in the illegal component of shadow economy take places as denominated in foreign currency (mostly denominated in the dollar).Therefore, the model cannot measure these type of transactions.

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