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An attempt to estimate the Algerian Non Observed Economy

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Motto

“The inconsistency between the predictions of conventional macroeconomic theories and the ‘facts’ of economic life have led to a re-examination of both the theories and facts”

- Edgar L. FEIGE -

DEDICATION

First, thank God for the wisdom and perseverance that He has been bestowed upon me during this research and through my life.

I dedicate this work to my parents for their unconditional love and support;

To my grandmother;

To my brothers;

To my best friends and colleagues, who I love and respect a lot.

Acknowledgements

A research like this is never the work of anyone alone. The contributions of many different people; in their different way; have made this possible. I

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Table of contents

Motto	
Dedications	
Acknowledgements	
List of tables	
List of figures	
General introduction	
Chapter one: Literature review on Economic Behavior and Institutions	
1.1. Introduction	8
1.2. Individuals and interactions	9
1.2.1. The non compliant behavior in developing countries	9
1.2.2. The underground economy	13
1.2.3. The behavioral options by households and firms	19
1.3. New Institutional Economics and Informality	21
1.3.1. Background on New Institutional Economics	21
1.3.2. Underground economy and institutional change in developing countries ..	25
1.4. Conclusion	34
Chapter two: Empirical evidences on the Non Observed Economy	
2.1. Introduction	36

2.2 Measurement methods of the size of the Non Observed Economy	37
2.2.1. Direct approaches	37
2.2.2. Indirect approaches	37
2.3. The modeling approaches	44
2.4. The researches into the Non Observed Economy, using the modeling approaches	47
2.5. Conclusion	63

Chapter three: The Underground Economy in Algeria: state, dynamics and policies

3.1. Introduction	65
3.2. A brief literature review on the Algerian Underground Economy	66
3.2.1. Interpretation of this phenomenon	68
3.2.2. Empirical evidences on the Algerian Underground Economy	69
3.3. Estimating the size of the Algerian Underground Economy	70
3.3.1. Estimating the UE using the MIMIC model	70
3.3.2. Estimating the UE using the Currency-Demand approach	97
3.4. Conclusion	109
General Conclusion.....	110

References

Appendices

Appendix 1: synopsis of the commonly used variables, both causes and indicators, in the estimation of the Non Observed Economy in different countries

Appendix 2: relationship Underground Economy – Growth rate of GDP

Appendix 3: factors contribute to the increase of Underground Economy

Appendix 4: the used database and the transformation averages.

Appendix 5: Data description

Appendix 6: Residual tests

Appendix 7: (stationarity results)



List of figures:

Figure1: the main subareas of the Non Observed Economy	11
Figure2: the behavioral options by households and firms	20
Figure3: the golden triangle in New institutional economics	22
Figure4: the classification of institutions	23
Figure5: relationship between individual's reaction and the tax rates	27
Figure6: economic and institutional change	29
Figure7: the structure of a MIMIC q-1-p model	46
Figure8: the growth rate of money and quasi money	72
Figure9: the growth rate of the GDP per capita	73
Figure10: the growth rate of tax burden	74
Figure11: unemployment rate as percentage of total labor force	75
Figure12: the growth rate of government expenditures	76
Figure13: crude oil prices (US dollar / barrel)	77
Figure14: the growth rate of minimum wages	78
Figure15: inflation rate, average consumer prices	78
Figure16: the structure of a MIMIC 8-1-2 model of the Algerian UE	79
Figure17: the best MIMIC (4-1-2) model	94
Figure18: The index of the Underground economy	95
Figure19: the size of the Algerian Underground Economy	97
Figure20: the ratio currency to M2, and the growth of the Cash	100

Figure21: the size of the Underground Economy as percentage of GDP	105
Figure22: the comparison between the size of the Underground Economy using the modeling approach and the currency-demand approach	106
Figure23: the illegal demand for currency	107
Figure24: the velocity of currency circulated in the Underground Economy	108

List of tables:

Table1: the interdependences between the formal and the informal sectors	16
Table2: Unit root test results (sample period: 1988- 2009)	84
Table3: Output EViews, Coefficients and Tests	90
Table4: the monetary aggregates estimated by the Currency-demand approach	104

The informal economy became a controversial subject since its discovery in 1970; where researchers, scientists and policy-makers attempt to find different ways to control its rising size and its effects on economic outcomes.

According to F. Schneider, 2007, the average of the size of the informal economy in Africa (in percent of GDP) was 42% for the years 1999/2000, and its size in Algeria, according to our estimation, is about 25.4% over the period 1990- 2009. Hence, it is realized that the size of the underground economy is a pervasive phenomenon that need to be economically and socially analyzed.

For this reason, the measurement of the size of the underground economy is a crucial task for developing countries because of its potential consequences on economic growth and public finance.

Moreover, this effort of measuring the underground economy would help better understanding the functioning of the economy and help elaborating relevant and efficient policies to reduce its size and integrate the informal agents in the official economy.

Before measuring the size of the underground economy, we need to highlight the main causes of its rising size (the costs and benefits of informality). However, our emphasis will be on the impact of institutions; in developing countries; in shaping the incentives that promote the economic agents to conceal their activities. On the other hand, the existence of these hidden activities limits the state capacity to provide strong institutions, and thus curb the expansion of the official sector.

The empirical evidences

Therefore, to realize this daunting task, several empirical measures of the underground economy are undertaken, with the difference in terms of the used estimation methods; which are the direct, indirect and modeling approaches; and the used data. This leads to a variety in the estimation results, where there is an agreement that the modeling approach or the MIMIC model (multiple indicators, multiple causes) is the appropriate method to estimate the size of the underground economy. Consequently, our emphasis will be on the researches that used the MIMIC model in estimating the size of the underground economy in different countries.

General Introduction

It was *Jöreskog and Goldberger (1975)* who named this method, but it is first mentioned by *Zellner (1970)*, *Hauser and Goldberger (1971)* and *Jöreskog (1973)*. The first who used the modeling approach to estimate the size of the underground economy (UE) as ‘Latent variable’ were *Frey and Weck-Hannemann (1984)*. After that, many economists employed this method to measure the underground activities in several countries across the globe, among which:

A. Loayza, 1996, estimated the size of the underground economy of the Latin American countries in the early 1990s, using the MIMIC 3-1-2 model. *Tedds Lindsay, 1998*, estimated the size of the underground economy in Canada over the period 1976-2001 using the MIMIC 11-1-3 model. *Guillermo Vuletin, 2008*, also estimated the size of the informal economy for 32 mainly Latin American and Caribbean countries in the early 2000s (2002 or 2003), using the MIMIC 5-1-3 model. *David Giles, 1999*, also investigates some characteristics of the underground economy in New Zealand, during the period 1968-1994, using the MIMIC 5-1-3 model. *Astrem Prokhorov, 2001*, also applied the MIMIC 8-1-5 to estimate changes in the size of the Russian UE from 1992 to 2000. *Cassar Alan, 2001*, also applied the MIMIC 4-1-3 model to estimate the size of the underground economy in Malta for the years 1971 and 1997. *Dell’Anno, 2003*, also estimated the underground economy in Italy using the MIMIC (6-1-2) model during the period 1962 -2000. *Bajada and Schneider, 2003*, also estimated the size of the underground economy for eighteen (18) countries in the Asia-Pacific region over the period 1990- 2000, using the *currency-demand approach* and the MIMIC 3-1-2 model. *Trevor Breusch, 2005*, also estimating the extent of the underground economy in Canada, using the MIMIC 7-1-2 model over the period 1976 to 1995. *Chaudhuri, Schneider and Chattopadhyay, 2006*, also estimated the size of the underground economy in India, using the MIMIC 3-1-2 model over the period 1960/1961 to 1997/1998. *Roberto Dell’Anno, 2006*, also estimated the underground economy in Portugal from 1977 to 2004, using the MIMIC 6-1-2 model.

More recently, we find: *Friedrich Schneider and Andreas Buehn, 2007*, estimated the underground economy for 120 countries, including developing, Eastern Europe and Central Asian and high income OECD countries over 1999 to 2006, using the MIMIC 7-1-3 model. *Roberto Dell’Anno , Miguel Gómez-Antonio and Angel Alañon-Pardo, 2007*, also estimated the evolution of the underground economy in three Mediterranean countries, namely France, Spain and Greece, using the MIMIC 6-1-3 model . *Andreas Bulm, Friedrich Schneider, 2008*, also developed a MIMIC 4-1-2 model, which estimates the co-integration equilibrium relationship and the error correction short run dynamics, to

estimate the underground economy in France during the period 1981- 2006. *Brambila Macias Jose, 2008*, also used annual data during the period 1970-2006 in order to estimate and investigate the evolution of the underground economy in Mexico. *Vjekoslav Klaric, 2010*, also examined and estimated the size of the underground economy in Croatia, using the MIMIC 4-1-2 model, during the period 1998- 2009. *Ahmed Gulzar, Novaira Junaid, 2010*, also estimated the underground economy in Pakistan, where they applied five approaches namely; simple monetary approach, modified monetary approach using dynamic ordinary least square (DOLS), the MIMIC approach, electricity consumption approach and labor market survey, over the period 1973-2010. Moreover, *Micheal Pickhardt, Jordi Sarda, 2010*, based on the Ahumada et al. (2007) critique, they revise existing estimates of the size of the underground economy in Germany. *Ademola Ariyo and William Bekoe, 2011*, also estimated the underground economy in Nigeria over the period 1975-2010. *Corina Maria and Andrei Stefanescu, 2011*, also estimated the size of the underground economy in Romania, using the MIMIC 7-1-3 model for the period 1990-2009. *Edgar L. Feige and Richard Cebula, 2011*, also employed a modified version of Feige's (1989) general currency ratio model (GCM) to obtain a time series estimate of income tax evasion in the U.S. from 1940- 2008.

The main findings of these papers are that the burden of taxes and government regulations, in addition to bureaucracy and corruption are the main causes of the rising size of the UE (for more details about the researches on the underground economy using the MIMIC model, see the second chapter).

Nevertheless, it is obvious that the establishment of efficient public policies should include the underground economy and its implementations on the official economy.

This is why we will attempt to measure the size of the underground economy in Algeria, and analyze its main causes and its effects on economic outcomes, by providing an overview of the empirical evidences that have attempted to estimate its size, in order to pinpoint their shortages concerning the estimation of the UE using the modeling approach.

Our estimates cover the period between 1990 until 2009, besides using the Currency-demand approach and the MIMIC model, using a set of causal and indicator variables.

General Introduction

Objectives and potential contribution of this research

The purposes of this research are as follows:

- To emphasize the potential causes of informality with special emphasis on the impact of institutions in influencing the economic agent's behavior to go underground.
- To figure out the several measurement methods used in the literature and which one is the adequate for the measuring the Algerian underground economy.
- But our main objective is to give the precise size of the Algerian underground economy basing on a set of causal and indicator variables using the modeling approach, in order to help policy-makers to elaborate efficient economic policies to reduce its rising size.

The subject importance

The underground economy is a controversial item in the literature. Thus, there are many reasons behind the interest of policy makers and researches in this phenomenon.

We can mention some of these reasons, as follows:

- The non-compliant behavior of individuals is the result of the tax burden, government regulations; which may curb the extension of the official economy.
- The underground economy falsifies the economic database; which lead to inefficient policies basing on these erroneous database. Therefore, measuring the size of the underground economy and providing reliable economic indicators is crucial in elaborating efficient economic policies.
- At least two-thirds of the income earned in the shadow economy is immediately spent in the official economy; which promote the economic agents of official economy (F.Shneider and Enste (2000)).
- In this research, we choose this subject because it is not dealt before; regarding the use of the modeling approach; besides it is effects on the economic and social structure of the Algerian economy.

This research addresses the following issues

The question of which come first: is the existence of informality due to the fluctuations of the economic activities and the labor market, or it is related to social capital and history,

General Introduction

which is usually called “path dependence¹”? Or even worse to the existing formal institutions??

- In particular, how do institutions shape the development process?? And how do institutions affect economic behavior, allocation of resources and equilibrium outcomes??
- What drives and motivate economic agents underground and what is the perfect and relevant method to estimate its size?

Hypothesis and prediction procedure

- The more the country is regulated, the greater the incentives to work in the underground economy (where we used the government national consumption expenditure as proxy of the government excessive regulations and the crude oil prices).
- The increasing tax and social security burden, combined with rising state regulation and labor market restrictions (proxied by minimum wages) are the main causes of informality where excessive taxes and regulation force firms out of the official sector.

Description of the research design

In order to estimate the Algerian underground economy, this thesis is organized as follows:

Firstly, in the literature review, we will shed light on the individual’s interaction by given an overview of the non-compliant behavior in developing countries, and in section two we will emphasize the New institutional economics (NIE) and its contribution in explaining the development of the hidden activities.

Secondly, in empirical evidences, we will shed light on the different measurement methods of the underground economy in the section one, but the emphasis will be on the MIMIC

¹ Inhere; we should mention that the underground economy is affected by historical factors, rather than current factors, such as technological progress and preferences.

General Introduction

model in the section two, concluding this chapter by pinpointing the different researches that applied the MIMIC model in measuring the underground economy of several countries across the globe.

Finally, the last chapter will be devoted to the Algerian underground economy. Where, we will give a brief literature review on the Algerian UE in the section one. Thereafter, we will apply the MIMIC model and the Currency-demand approach using a set of variables (well chosen variables) to get the size of the Algerian UE.

Table of contents:

1.1. Introduction

1.2. Individuals and interactions

1.2.1. The non compliant behavior in developing countries

1.2.2. The underground economy

1.2.3. The behavioral options by households and firms

1.3. New Institutional Economics and informality

1.3.1. Background on New Institutional Economics

1.3.2. Underground economy and institutional change in developing countries

1.4. Conclusion

1.1. Introduction

2.1. The informal economy became a controversial subject since its discovery by Keith Hart in 1971; the small socio-economic activities shown in the street are the first introduced to the informal sector; where researchers; scientists and policy-makers attempted to find different ways to control its rising size, because of its potential consequences on economic growth and public finance.

Moreover, the limited economic opportunities and the bad governance are the main causes behind the rising size of the underground economy, and thus, the interest in the role of institutions. On the other hand, large informal economies limit the state capacity to provide strong institutions, which curb the expansion of the formal sector and make the individuals go underground, in addition to the burden of regulation and corruption.

2.2. In this chapter we will treat this phenomenon in a special way; devoted to emphasize its importance and its impact on economic outcomes. The first section emphasizes non compliant behavior or *informality*; where our emphasis will be on the underground economy and its effects on the official one. Besides its definition, its characteristics and the set of activities that it consist will be highlighted and ultimately, stressing *its main causes* (the so-called costs and benefits of informality) that promote the economic agents to conceal their activities.

2.3. As to the second section, we will shed light on the Neo-institutional economics. Where we will give a short overview on institutions and organizations, and their influence on the economic agent's behavior, in the sense of its *informalization*. Our emphasis will be on the impact of institutions on the development of the underground economy in developing countries, in which the legalist approach will be stressed.

1.2. Individuals and interactions

1.2.1. The non compliant behavior in developing countries

2.4. The genesis of informal economy is hard and difficult to find, this is why this research will provide an overview of its beginning over different periods.

In the mid of 1950s, *W. Arthur Lewis* invented a theoretical model of economic development which comprises two sectors traditional (agricultural) that consists of petty traders, small producers and a range of casual jobs; and modern (industrial) sector. This model is based on the assumption that there is excess of labor supply in the traditional sector that will be absorbed to the formal economy, where the industrial sector grew and expand, and thus the traditional sector will disappear. Nevertheless, in the developing countries, there is a slow growth rate to promote the industrial sector; which cannot create sufficient jobs to absorb jobless people.

However, the informal sector grew rapidly and became the standard lifestyle for many individuals and thus it became a part of the economy; in contrast to Lewis who showed that the informal sector was marginal and was not related to the official economy.

Besides its increasing size, it became a pervasive phenomenon in both developed and developing countries that are characterized by the low growth rate and the rural migration towards the urban sector; which give rise to a dualism of two sectors: the high profit/high wage sector versus the low profit/low wage competitive sector. (*Moser, 1978*) (1)

2.5. In 1970s, the first who coined the term “informal sector” is Keith Hart, an anthropologist, to describe the scope of unregistered economic activity operating in Accra, Ghana (2). He noticed marginal urban productive activities of self-employed to satisfy their own needs. At that time, these kinds of activities were ignored by politicians and economic researchers and in national economic accounts; which require their introduction in the development strategy. (*Lisa peattie, 1987*) (3)

Thus, the ILO (International Labor Organization) Kenya report on employment aimed to formulate this concept, in 1972, where the term “informal sector” is used to describe the activities of poor workers who worked very hard to survive and meet their own needs but who were not recorded or regulated by the state authorities, as it will be mentioned later in the following sections.

This report is based on the dualistic view of the link between the formal and informal economy and that the informal economy has positive effects on the official one (labor market and distribution of incomes).

2.6. Hence, this concept became a crucial part of the economy, and attracted the attention of politicians and economic researchers.

Furthermore, basing on the report of Kenya, the ILO undertook several studies on the informal sector (1993, 2002, 2003), where it brought new developments to this field each time. Meanwhile, all the definitions of the informal sector included poverty, marginality and underemployment.

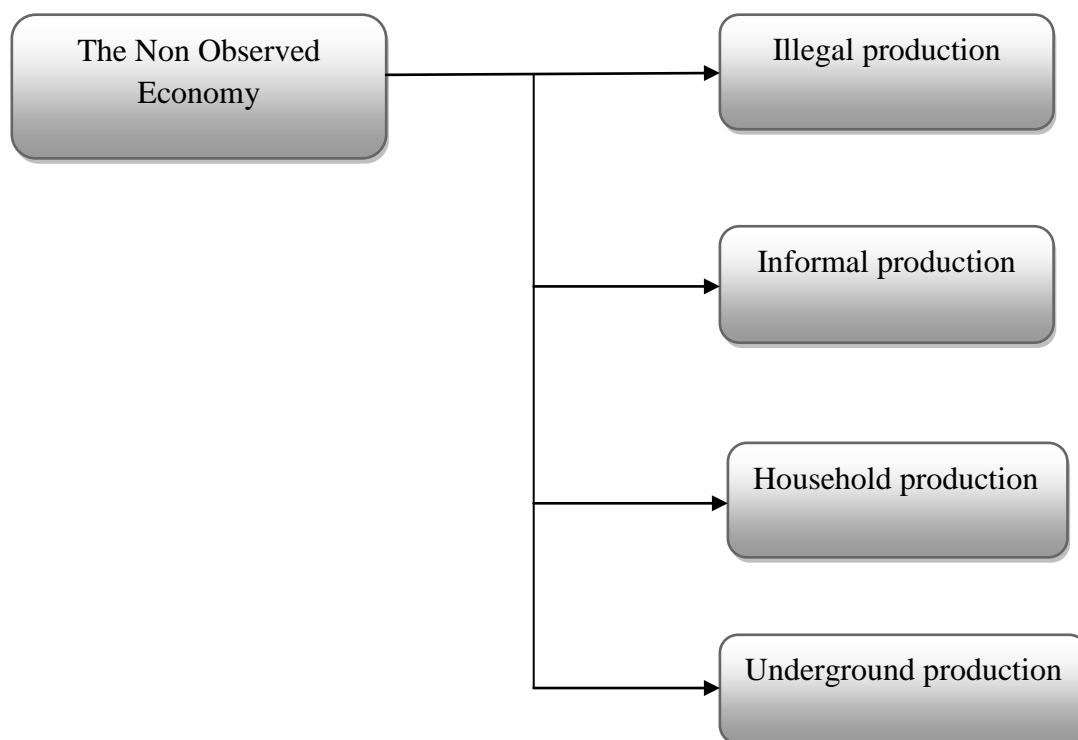
2.7. *The definition of the NOE (Non Observed Economy):*

As it's agreed from the researchers in this field, that is extremely difficult to define the NOE because it differs according to the range, the different economic agents engaged in it, degree of compliance and it depends on the chosen method of measurement. All this clues make finding an appropriate definition hard.

Furthermore, there are many criteria used in the definition of the NOE that it can be summarized in three sub-criteria: political (e.g. government regulation, national statistics, etc), economic (e.g. labor market, tax compliance, size of activity, registration of the activity), and social (social networks, etc).

The heterogeneity of the activities, which encompasses the NOE, gives rise to many interpretations. Thus, the NOE consists of all product activities that are classified into the following sub-areas: illegal production, informal production, household production and underground production, (*OCDE, 2003*) (4), where the magnitude and the impact of each sector vary from one country to another.

Among these different subareas, our emphasis will be on the underground economy and its important implications for the macro-economic outcomes.

Figure1: the main subareas of the NOE

Source: author's construction, based on OECD handbook, 2003.

2.8. Concerning the first subarea; the **illegal economy**; those activities are either prohibited by law, such as the production and sale of illicit drug, prostitution, production and sale of counterfeits, smuggling, concealment of stolen goods, corruption, extortion, money laundering, etc; or are illegal when performed by economic agents who do not have permission, such as the practice of medicine, the organization of gambling or alcohol production without licence, poaching, such as fishing, hunting and felling of trees.

Moreover, the illegal activities are distinguished from the informal activities according to the production of goods and services, where the informal sector generates goods and services whose the production and distribution are legal, whereas the illegal sector does not. Besides this distinction, there is another difference between the illegal activities and the underground activities, where the underground ones are those that do not comply with the administrative rules, while the illegal ones are associated with criminal behaviors.

2.9. As to the second subarea; the **informal economy**; that represents a significant portion of the economy in developing countries; especially the labor market; where those countries are characterized by a demographic growth rate and a high urbanization, thus, the informal sector absorbs the increasing labor force in urban areas.

Basically there are two different points of view concerning the definition of the informal sector, as to the first, it can be defined as those enterprises that do not respect the legal and administrative regulations (i.e. are not registered). As to the second one, it is a specific type of production that is different in its type of organization of its enterprises and the way of running them. Moreover, the 15th ICLS ² adopted these two approaches in defining the informal sector, and they claimed that the difference between the underground economy and the informal economy, is that: the economic agents work in the shadows are deliberately intended to evade payment of taxes and social security contributions or violate labor legislation, whereas the agents who work in the informal economy choose to work illegal in order to reduce the costs of production or seek to survive and meet their own needs.

Thus, this sector can be defined as a set of units that produce goods and services in order to create jobs and generate incomes, with low level of organization, provision of goods in small sizes, no division between labor and capital and it is based on the familial or social relations rather than contracts. Besides this definition, the informal sector is considered as a sub-sector of household sector. **Consequently**, the informal businesses are defined as a subset of **incorporated businesses** owned by households that are defined as production units that are not incorporated and are not independent from the persons to whom they belong, in a way that we cannot distinguish the flows of income and capital of the business from its owners.

Consequently, we can summarize the criterion that the definition of the informal sector based on: legal status of the business, corporate ownership and type of accountancy. Based on these criteria, we can distinguish two types of informal businesses:

(i) Informal businesses of self-employed, which are businesses that do not respect the government regulation (such as industrial or commercial regulations, tax laws and social security, etc) and thus are not registered, with addition of their small size and the lack of complete accountancy.

² These criteria were adopted in the Fifteenth International Conference of Labour Statisticians (15th ICLS), a Resolution concerning statistics of employment in the informal sector (International Labour Organization, in January, 1993). Moreover, the objective of this conference is to help national statistical offices in developing definitions, classifications and methods of collecting data on the informal sector.

(ii) Businesses of informal employers are defined based on the following criteria: the small size of the business, the non-registration of the business and the non-registration of the employees (i.e. the lack of any contracts when hiring the employees). The last criterion is crucial in identifying the informal businesses, and thus a business is an informal business if none of their employees are registered.

2.10. As to the third subarea; **household production**; can be defined as all the goods and services provided by the household members for the own final use, which consists of:

- The agricultural goods provide by households for the own final use, such as crops and breeding or livestock. (these activities are excluded from the production field)
- The services of owner-occupied housing, such rental or hired houses;
- Paid domestic services, such as self-employed (enterprises) providing services to other households.

1.2.2. The underground economy (UE)

2.11. As it was mentioned earlier, our emphasis will be on the underground economy and its effects and implications on the official economy. However, there are many authors who tried to define it. This theoretical review will help us in the elaboration of the empirical model for this study. Among which:

The underground economy *includes*: “*all those economic activities and the income derived from them that circumvent or otherwise elude government regulation, taxation, or observation.*” Feige E.L. (1989) (5)

For Smith (1994) (6) ³this sector is a “*market-based production of goods and services, whether legal or illegal, which escapes detection in the official estimates of GDP*”.

According to Loayza (1996) (7) “*underground economy is unregulated by the institutions of society, in a legal and social environment in which similar activities are regulated*”. As Tanzi (1999) (8) claims that there are at least two definitions. The first, is connected to “*the production (or income) missed in the official statistics*”; the other, refers to “*...revenue not reported to, and not discovered by, the tax authorities*”.

According to Thomas (2001) (9), the UE is: “*those activities which are not recorded in the national income accounts*”. In addition to the definition of Schneider and Enste (2000) (10): “*all economic activities which contribute to the officially calculated (or observed) gross national product*”.

³ Smith (1994) cited in Shneider and Enste (2000).

There are other definitions that emphasize the role of institutional environment in the development of the UE; where these institutions affect behaviors of economic.

Although there are many attempts to define the underground economy, there is no agreement on one common definition. Thus, a common definition is needed to be elaborated. Moreover, we can refer at the System of National Accounts (SNA93) and the European System of National Accounts (ESA95).

Consequently, the **underground economy** can be defined according to the SNA93, as: “*all legal market-based production of goods and services that escapes detection in the official estimates of GDP*”. These activities have legal outputs but employ illicit means and are concealed from public authorities for the following reasons (*Lars P. Feld and Friedrich Schneider, 2010 (11); Schneider, Buehn, and Montenegro, 2010 (12)*):

- To avoid payment of income, value added or other taxes,
- To avoid payment of social security contributions,
- To avoid certain legal labor market standards, such as minimum wages, maximum working hours, safety standards (politicization) , etc., and
- To avoid certain administrative obligations, such as completing statistical questionnaires or other administrative forms.

The analytical framework of ESA95 and Italian National Statistical Institute (Istat) divided the underground activities into: activities that are considered underground because the businesses that exercise them are not registred, and activities that are considered underground because the businesses that exercise them are registered, but they underreport them and some of their workers are unregistred.

Thus, the underground economy is very heterogeneous and includes both legal activities; such as unreported income that would normally be reported in GDP; and illegal activities including smuggling, fraud, and money laundering, in addition to the unproductive activities; such as: small-scale commercial activities, undeclared incomes to tax authorities.

Nevertheless, there are other underground activities that are not observed (i.e. are not included in the estimations of the official national accounts), such as: **Tax evasion** which means unreported income to tax authorities; **Shuttle trade** is when entrepreneurs buy goods abroad and import them to resale them in the local markets or to small shops in

order to avoid paying import duties; **Border purchases** which means buying goods abroad because of lower taxes and import them but for the own use; **Barter** which means exchange a good or an asset for a good or an asset other than cash; and finally, **Capital flows** which means conversion of assets that are denominated in domestic currency to assets that are denominated in foreign currency but this conversion is outside the normal transactions whether in the same country or abroad.

- 2.12. **The literature on the underground economy** includes a large variety of concepts referring to those activities. Some of the former phrasings are: the informal economy (*ILO, 2002*), the bazaar economy, the firm-centered economy, the black market in periods of war. Besides this, we find another terms, such as: underground or shadow (*Feige, 1990, Schneider and Enste, 2000, etc*), hidden (*Bhattacharyya, 1990*) (13), parallel, second, gray, unofficial, irregular, illegitimate, subterranean, invisible, moonlighting, black, occult, elusive, not structured (*Nihan, 1980*) (14), unregistered, not declared, unrecorded, sector of micro enterprises, etc.⁴

In this research, we will use underground, hidden, shadow, parallel, unofficial, informal like synonyms to the underground economy.

- 2.13. Even there are different types and parts of the underground economy; each part is related to the official economy; one way or another; in addition to the differences that distinguish these two economies.

As many researchers claimed, the distinction between the official and underground economy is based on the spheres of organization, technology, relations of enterprises with governments and other institutions such as banks, and the nature of product and market structure, which give rise to the dualism of the economy.

Furthermore, there were another kind of studies that focused on the legal status of the activities, where the UE consists of activities that did not comply with the rules of law and other government regulations that hampered the economic agents to run their businesses formally. (*Feige 1990 (15), North 1990 (16), O. Williamson, 1979, (17)*)

As a result, several schools of thought interpret the relationship and interdependences between the official and the underground economies, which are: the dualist, the structuralist and the legalist one.

The table below describes their main thoughts, as follows:

⁴ For further reading, see the article of Willard (1989) on the different terms used to distinguish the underground activities.

Table1: the interdependences between the formal and the informal economies

Schools of Thought	Characteristics	Authors
Dualist	<p>-The informal economy is comprised of marginal activities, not related to the formal sector, that provide income for the poor and safety in times of crisis.</p> <p>-The persistence of these activities because there not enough modern jobs opportunities to absorb surplus labor, due to slow growth rate and faster rate of population growth.</p>	ILO, 1972 Sethuraman, 1976, Tokman, 1978
Structualist	<p>-The informal sector was seen as subordinated economic units and workers that reduce labor costs and increase the competitiveness of capitalist firms.</p> <p>-The capitalist development lies in the existence and growth of informal production relationships.</p>	Moser, 1978; Castell and Portes, 1989
Legalist	<p>-The underground economy consists of all micro-entrepreneurs who go underground in order to avoid the costs, time, and effort of being registered.</p> <p>-That is because of the heavy and burdensome government regulation.</p> <p>-It is also comprised of illegal and underground activities.</p>	Desoto.H, 1989, Feige, 1990.
Illegalist	<p>-Informal self-employed operate illegally to avoid taxation, commercial regulations and other costs.</p>	

Source: Chen, Martha, Joann Vanek and Marilyn Carr, (2004).(18)

2.14. *Costs and benefits of informality for entrepreneurs:*

After mentioning almost all the different aspects of informality, we will stress the set of determinants and causes that contribute to the raising size of the UE; which are: economic (as macroeconomic policies ...), political (as corruption and rent seeking...) and finally the institutional ones (concerning the governance quality) which are the novel of this research.

Hence, the determinants of the underground economy can be gathered in three categories (*La Porta and Shleifer, 2008*) (19), as follow:

- *Costs of being formal* or entry costs in the official market, which are the resources to fulfill the required procedures to legally start a business.
- *Costs of staying formal* which consist of tax payments and government regulations (as regulation of labor market) and also corruption that increase the incentive to escape to the underground economy.

Individuals go underground because of the cost of legality. That is to say that the law has a cost like everything else, for example: the amount of time and information necessary to comply with these imposed regulations. In developing countries, the transaction costs (or the cost of law) are low; which encourage economic agents to be legal. (*Douglass North, 1990*)

- *Benefits of being formal* (opportunity cost of informality) which encompass access to public goods, such as: infrastructures.
- Finally; for individuals; there is another important element which is *the cost of compliance*, in terms of tax compliance, which refers to the costs that make taxpayers evaded to pay their taxes. *These costs involve keeping accounts, reporting information to the tax authorities, keeping informed about changing tax laws, hiring tax advisers, obtaining tax forms, filling them out, standing in line to make tax payments, and so on.*(Vito Tanzi,1999)

Furthermore, the state should whether increases the benefits of being formal to promote businesses to stay legal, or reduces the transaction and monitoring costs that prevent businesses to comply with the government regulation⁵.

⁵ For a broader reading about the main causes of informality, see the appendix three.

2.15. *The consequences of the underground economy on the official economy:*

The rising size of the underground economy has many implications on the official one.

Although the analysis of those implications is difficult, most of economic researches focused on the impact of the UE on allocation of resources and the loss of revenues for the state, and ignored the crucial role of official institutions, norms and rules.

However, we will stress some effects and consequences of the underground economy on the official economy, as follows:

- The underground economy is considered as an indicator of state failure, in terms of social order and the imposed rules of law, where the UE limits the state capacity to provide public goods and services that promote the economic agents to be legal, because of the financial losses in its revenues and the resulted budget deficits.
- In terms of tax and monetary policies, the existence of underground economy can lead to an overestimation of the economic and monetary indicators, such as unemployment rate, inflation rate and growth rate, etc.
- Given the fact that there are a positive relationship between the growth of the UE and the official economy, an expansionary fiscal policy stimulate both the formal and informal activities; due to very low entry costs into the UE as a result of low probability of enforcement, this is especially in developed countries.
- Underground activities provided many opportunities for the individuals engaged in it, in terms of jobs, goods and services in low prices, basic needs and thus increase the well-being of the informal agents.
- Although a considerable reduction of the underground economy can lead to a significant increase in tax revenues; and thus, to a greater quantity and quality of public goods and services; which can stimulate economic growth; the increase of its size affects growth by reducing public goods and services, this is especially in developing countries.
- The UE is considered as optimal and dynamic entity because it responds to the rising demand for urban services and small-scale manufacturing. While it can create competition that leads to higher efficiency, especially in developed countries

that are market economies; where the UE offers significant contributions to the creation of markets, increase financial resources and enhance entrepreneurship.

- It is found that the earnings and incomes from the underground activities are spent in the official economy, which has positive effects for economic growth and for the indirect tax revenues.
- Finally, the underground economy has a positive effect on consumer expenditures of non-durable goods and services, and an even stronger positive effect on consumer expenditures of durable goods and services because the official economy cannot satisfy the rising demand on those activities. (*Boyen Belev, 2003*)(20)

2.16. **The behavioral options by households and firms**

All the different kinds of costs mentioned above prevent the economic agent to work legally; thus he chooses to work in the UE and conceal his activities, which the economist called “*the exit option*”.

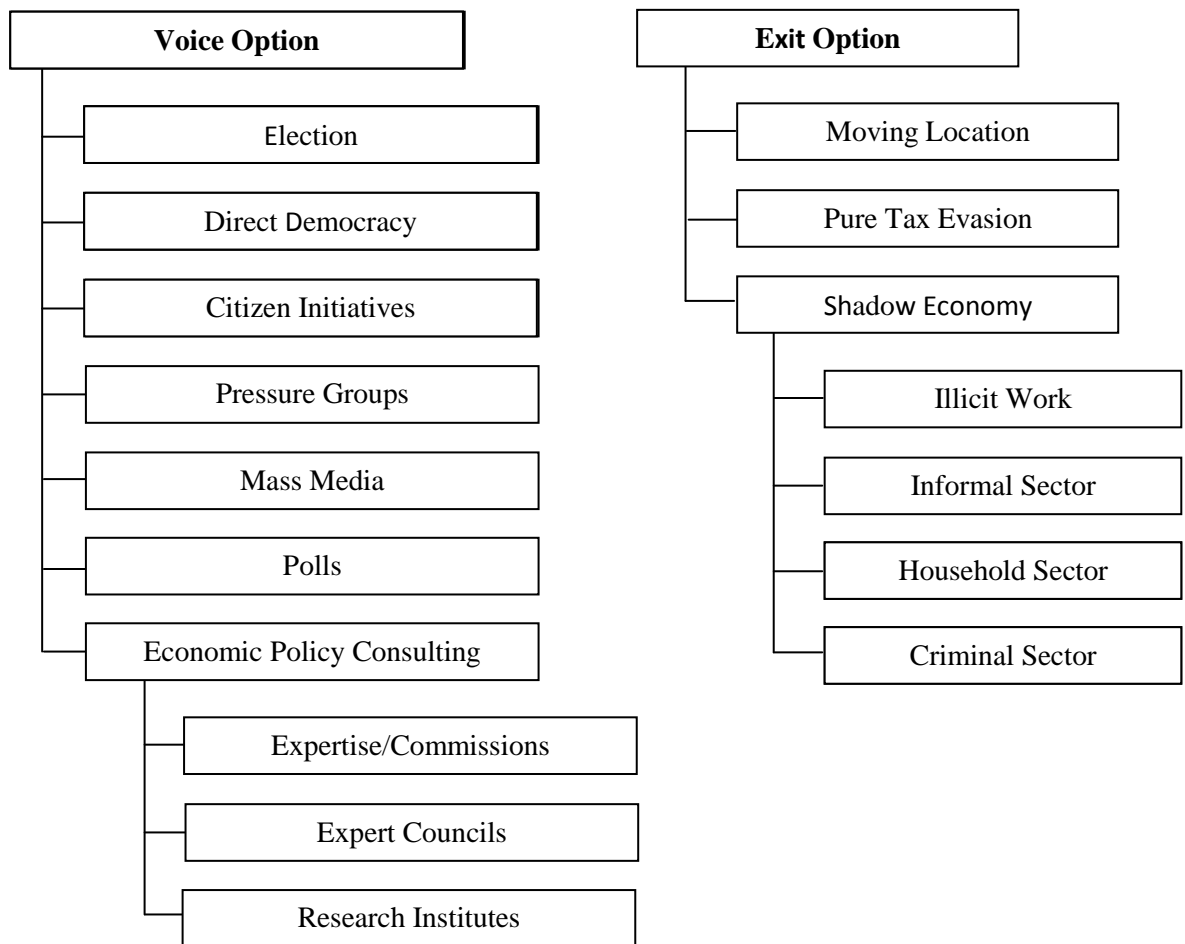
According to *Hirschman, (1974) (21)*, there are two behavioral options that economic agents choose to follow, whether the exit option or the voice option, which compose *the Two Pillar- Strategy*, presented in the figur2. The voice option consists of : elections, direct democracy, citizen initiatives, pressure groups, mass media, polls and economic policy consulting (such as: expertise/ commissions, expert councils and research institutes). And the exit option involves: moving location (migration), pure tax evasion and go underground.

As a result of the overburdened economic and institutional environment, economic agents choose to work illicitly or search for other alternatives. For instance, firms choose the exit option, whether to change location or go underground and tax evasion, as well as to the households who choose to migrate.

Consequently, the state has two ways to solve this issue, whether by decreasing the attractiveness of the exit option, or increasing the efficiency of the voice option. To do so, it should pursue the following procedures: the reduction of the tax rates by simplification of the tax system, adoption of reforms over the social security systems, increasing the efficiency of public administrations by effective monitoring procedures, more protection of property rights, stabilization of the society, etc.

To sum up, all these actions are gathered in an efficient economic and institutional change based on the citizen's preferences and introducing public participation in the political process and democratic decision.

Figure2: the behavioral options by households and firms



Source: Boyan Boley, (2003).

1.3. New Institutional Economics and informality

2.17. Background on New Institutional Economics (NIE)

We should mention that there are two mainstreams of institutionalism, the first are the old intuitionism as Veblen, Commons⁶ and Michael, who are the pioneers of this approach in 1920th. The second was the new institutionalism by *R. Coase* from law, *O. Williamson* from managerial sciences and organizational theory, and *D. North* from political science, cognitive science, and history, who extended the old views to elaborate their new approach, where each one of them add some contributions to the analysis of institutions and its impact on economic behavior, allocation of resources and equilibrium outcomes.

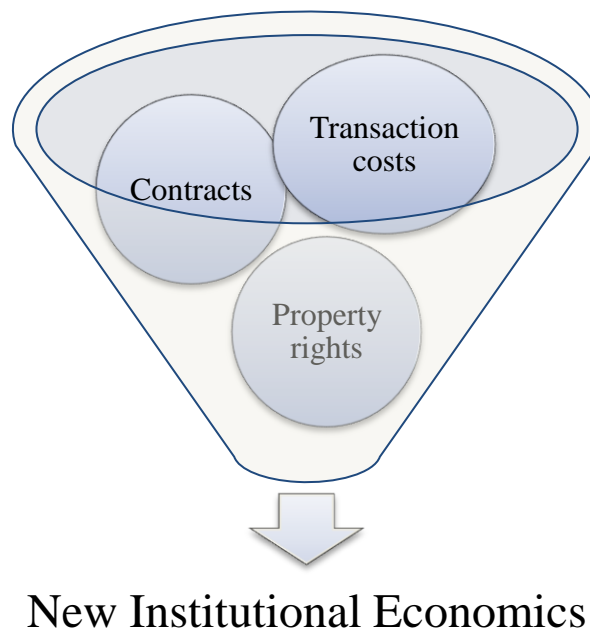
What makes the NIE differs from the new classical approach is that this approach remove the assumptions of the standard neoclassical, such as: perfect information, rationality, stable references, zero transaction costs and equilibrium, and replace them by learning, bounded rationality and evolution with addition of other assumptions.

The emergence of the new-institutional approach was in 1970th, by *R. H. Coase* (1973) (22) in his article titled “*the Nature of the firm*”; *North and Davis* (1971) (23), *North* (1981) (24) and “*Markets and Hierarchies*” by *Williamson* (1975, 1985) (25), besides others, such as: *A. Alchian*, *H. Demsetz* (1967) (26), *Claude Menard* (2005) (27), *Elinor Ostrom* (2009) (28).

2.18. This approach arose to resolve two problems, the first one is related to the organization of the economic activity in firms, markets and other modes of governance which explain the process of *decision making* (i.e. make, buy and look for proper organizational arrangements) and the second is related to the explanation of the status of the countries as poor or rich, which reflect their *economic performance* (*North Douglas, 2000*).

Hence, as response to these issues, two schools of thought emerged. The first school is pioneered by *Coase and Williamson*, who analyzes **property rights** and **contracts** at the firm level. Whereas the second one is invented by *D. North* who analyzes **institutional change** and **the role of the state**, which the following figure emphasize:

⁶ Commons is the first pioneer of the term “Institutional Economics” in 1931.

Figure3: the golden triangle in New institutional economics

Source: author's construction based on: Ménard, Claude; Shirley, Mary M. (2005).

2.19. As we have seen there are several streams that attempted to analyze the firm and the market, among which Transaction costs theory, Property Rights theory (A. Alichian and H.Desmetz in 1967), Agency theory (M. Jensen and W. Meckling in 1976); and Game theory, which they form **the contractual approach**. Whereas, there is another approach which is **the cognitive approach**, among which, theory of competences and the evolutionary theory of organization of the firm.

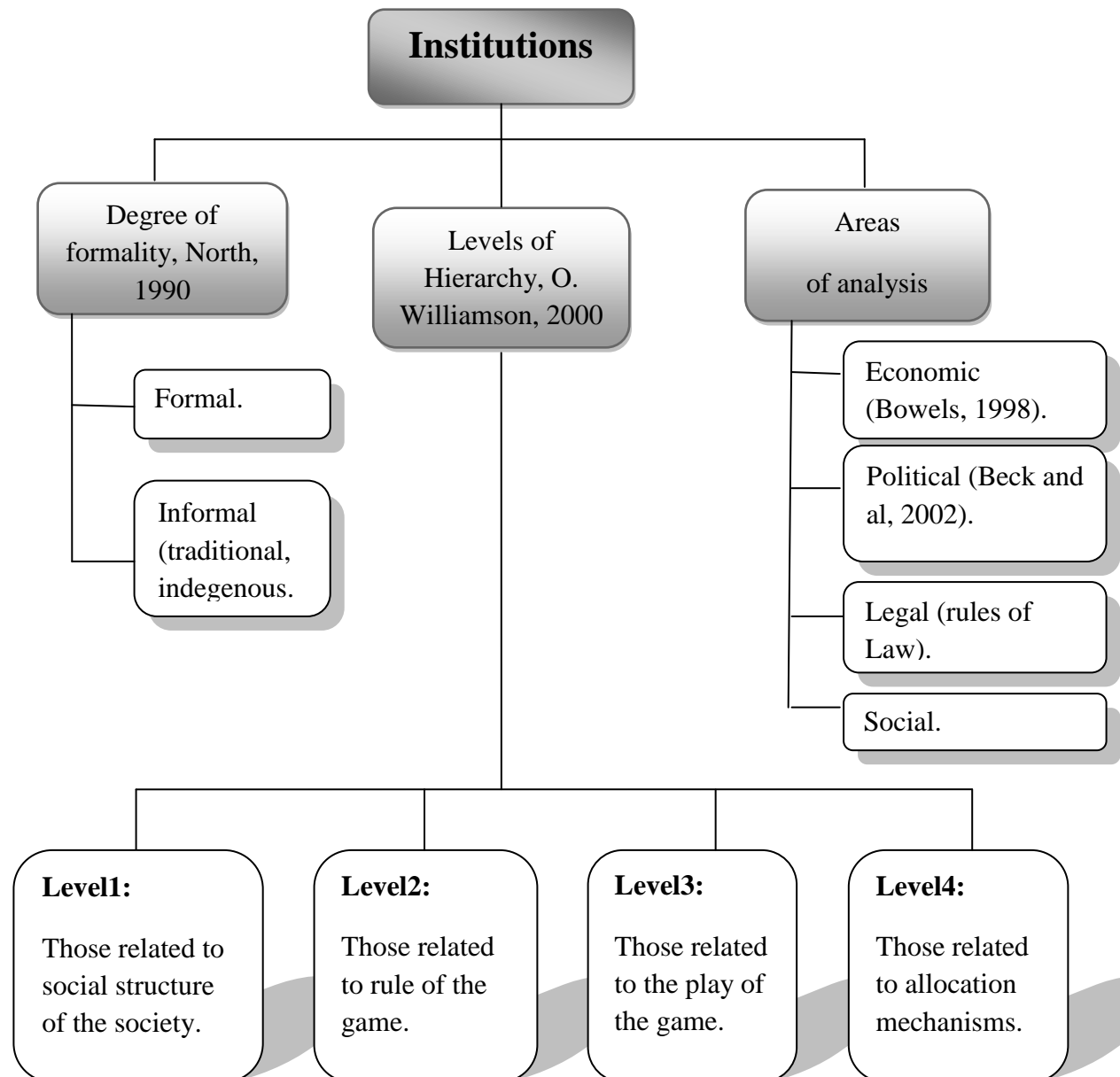
2.20. After given a short overview on the NIE and its main streams, we will give the definition of institutions and emphasize its influence on the economic agents' behaviors and its impact on the rising size of the underground activities.

Institutions are generally defined as the “rules of the game”, or “humanly- devised constraints that shape human political and social interactions”. Since human beings live in an uncertain world, they devise institutions to control their environment, to bring some certainty. (North Douglas, 1990)

Recent researches include in their definition of institutions: organizational entities, procedural devices, and regulatory frameworks (*Williamson, 2000*). Moreover, they are important for reducing transaction costs; that arise while doing business and enforcing contracts, for improving information flows and enforcing property rights. (*North, 1990*)

There are several ways to classify institutions. In this research, institutions are gathered in three categories, which can be represented in the following diagram:

Figure4: the classification of institutions



Source: Johannes Jütting, (2003) (29).

2.21. Among the classification of institutions mentioned in the figure 4, we select the North's division, where he considered *Formal institutions* as the rules engaged in formal structures such as constitutions, political institution and property rights systems, while *Informal institutions* are largely self-enforcing through *mechanisms of obligation*, and they include: socially sanctioned norms of behavior (e.g. attitudes, customs, taboos, conventions and traditions), extensions, elaborations and modifications of formal rules outside the official framework. Besides this, *the enforcement mechanisms* of the informal institutions are:

Self-enforcement mechanisms of obligation, expectations of reciprocity, gossip, shunning, ostracism, boycotting, shaming, threats and the use of violence. (*Indra Soysa and Johannes Jutting (2007)(30)*). North asserted that those institutions are rooted in the Society's structure, and thus are difficult to change over time.

2.22. Concerning the two others classifications, the first one is the classification of *O. Williamson* that is based on four hierarchical levels, which are connected to each other.

The first level comprises all social structures of the society, such as: social norms, customs, traditions, etc.

The second level encompasses the rules of the game that ensure and enforce property rights.

The third level is related to governance or the play of the game; which aims to ensure social and economic order.

The final level is related to allocation mechanisms, and thus to the adjustment of prices and quantities, capital flow controls, trade flow regimes, social security systems, etc.

2.23. The second classification is based on the different areas of analysis (e.g. economic, political, legal and social). As to the **economic area**, it is related to the allocation mechanisms.

The **political area** includes: elections, electoral rules, type of political system, political stability, etc. And the **legal area** encompasses the type of legal system, the enforcement of property rights and legal origin, etc.

Finally, the **social area** includes social institutions, such as access to health and education, social security arrangements, etc.

2.24. Concerning the interaction between the formal institutions and the informal ones, it found four kinds of informal institutions, as follows (*Indra Soysa and Johannes Jutting, 2007*):

As to the first, informal institutions are **complementary** to formal institutions, when both formal and informal institutions have the same enforcement characteristics. This means that there is interaction between social norms and rules of law; which is the optimal situation to promote economic growth.

Second, informal institutions **accommodate** formal institutions, when both formal and informal institutions diverge. This means that there is not interaction between informal and formal institutions, where each one generates different outcomes.

Third, informal institutions **compete** with formal ones that are inefficient. This is especially in countries that are characterized by no enforcement of the rules of law, because of the high costs of enforcement.

Finally, informal institutions can **substitute** inefficient formal institutions, where informal institutions generate outcomes that the formal institutions should generate.

In developing countries, it is found that informal institutions are complementary to formal institutions; where the government should include social norms in the elaboration of their policies.

2.25. **Underground economy and institutional change in developing countries**

As we have seen, there are three major schools of thought that interpret the existence of the underground economy. Our emphasis is on the legalist approach that attributes the existence of informality to burden of the government regulations, in terms of taxes and social services.

The legalist approach is emerged in over the years 80s and 90s, by the book of De Soto in 1989, where he interpreted the existence of the underground economy as a rational optimizing behavior of economic agents who seek for circumventing the burdensome government regulations⁷ (in terms of taxes and bureaucratic regulations). Consequently, the lack of respect for the government regulations is the result of the inadequacy of these regulations. This is why this approach is considered as representative to the NIE, where it pinpoints the role of institutions in the allocation of resources. (*Feige, 1990*)

⁷ De Soto's analysis is based on the idea that all the informal agents are entrepreneurs.

Moreover, the complexity of these regulations leads to more amount of time and legal procedures to comply with them, besides corruption costs. The fact that economic agents go underground is because they are rational, and thus they calculate the costs of formality. However, informality also has costs, such as: the impossibility to access to advertising, bank's credits and public markets, in addition to the costs of corruption to police officers and of rent-seeking bureaucrats). Thus, they will choose whether to stay formal or go underground, and they will choose the later. (*Lautier. B.2004*) (31)

Furthermore, we have seen in the previous sections that there are many causes and determinants of informality, in which we found the institutional change and its effects on the rising size of the underground economy. Institutional design plays a crucial role in shaping the incentives to go underground, where both formal and informal institutions are important in reducing the costs of undertaking economic and social interaction between individuals and raising the level of economic growth and social welfare.

Developing countries are characterized by an inconsistency between formal and informal institutions; which leads to *non-compliant behaviors* such as: tax evasion, circumvention of rules, corruption, rent-seeking, theft of government property, money laundering, etc. All of this gives rise to the following issue: **how do institutions affect the economic behavior and choices of individuals?**

To answer this crucial question, we will refer to the institutional economics field; which emphasize the contributions of institutions in shaping the incentives to go underground and its impact on the evolution of these hidden activities. However, it is argued that the development of underground activities is the consequence of the gap between public policies and the institutional environment, where each part of the underground economy reflects the different violated rules.

Thus, in the following section we will emphasize the role of public finance (tax system, the role of the state, etc), property rights, the rules of law, transaction costs, corruption, political behavior (i.e. rent-seeking).

Public choice and political economy:

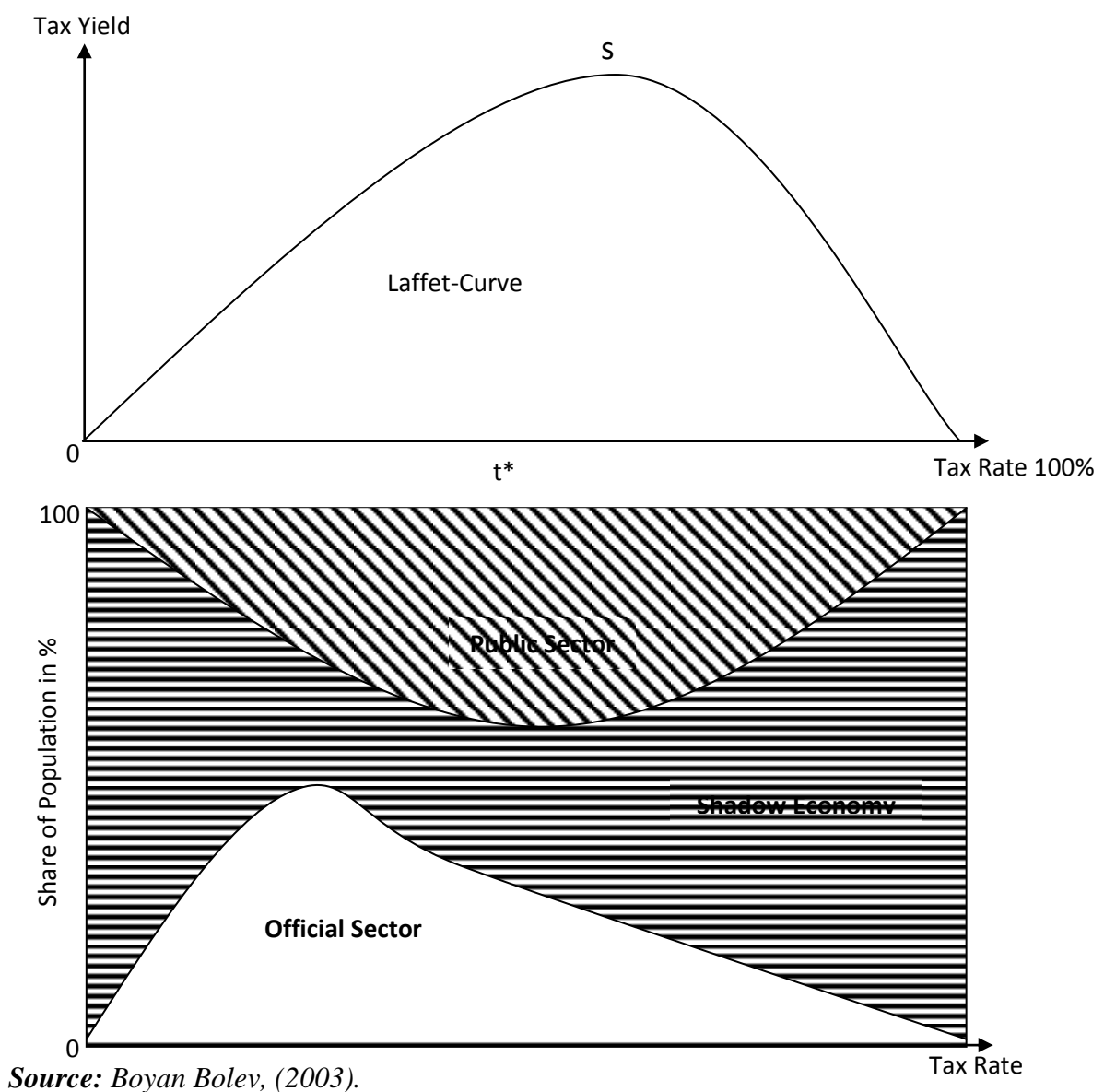
2.26. **First of all**, a growing shadow economy can be seen as the reaction of individuals who feel overburdened by the state and who choose the “exit” option rather than the “voice” option as *Hirschman, 1974*, said. As increase in the size of the underground

economy is caused by a rise in tax and social security burden in addition to the inefficient institutional environment.

As a result, the state cannot provide public goods to promote the official economy, and thus raise the taxes for formal agents, and thus leads to more underground activities to reduce those costs.

The link between individual's behaviors and the tax rates is analyzed by Laffer (1979) who extended his analysis by including the underground economy; which is illustrated in the following graphs:

Figure5: relationship between individual's reaction and the tax rates



We can see from the Laffer curve above that when the government raises the tax rates, this leads to raise its tax yields. When the tax yield achieve a certain point; which is S; it can no longer be increased. Besides, after this point the government tax yields start to decrease and thus the government cannot increase them again; because of what Laffer called it the tax burden that make the taxpayers evade their tax payments.

Moreover, he introduced the underground economy to his analysis as it is showed on the graph above, where the economy includes three sectors: public sector, official and underground economy. At the beginning, the size of the underground economy is high, but when the state (public sector) encourages the official sector by its efficient policies as the provision of public goods and the enforcement of property rights, the size of the UE start to decrease gradually. But in reality, the politicians and bureaucrats seek to maximize their incomes; which leads to the maximization of the public budget by the maximization of tax yields, and thus imposing higher tax rates that curb the growth of official sector.

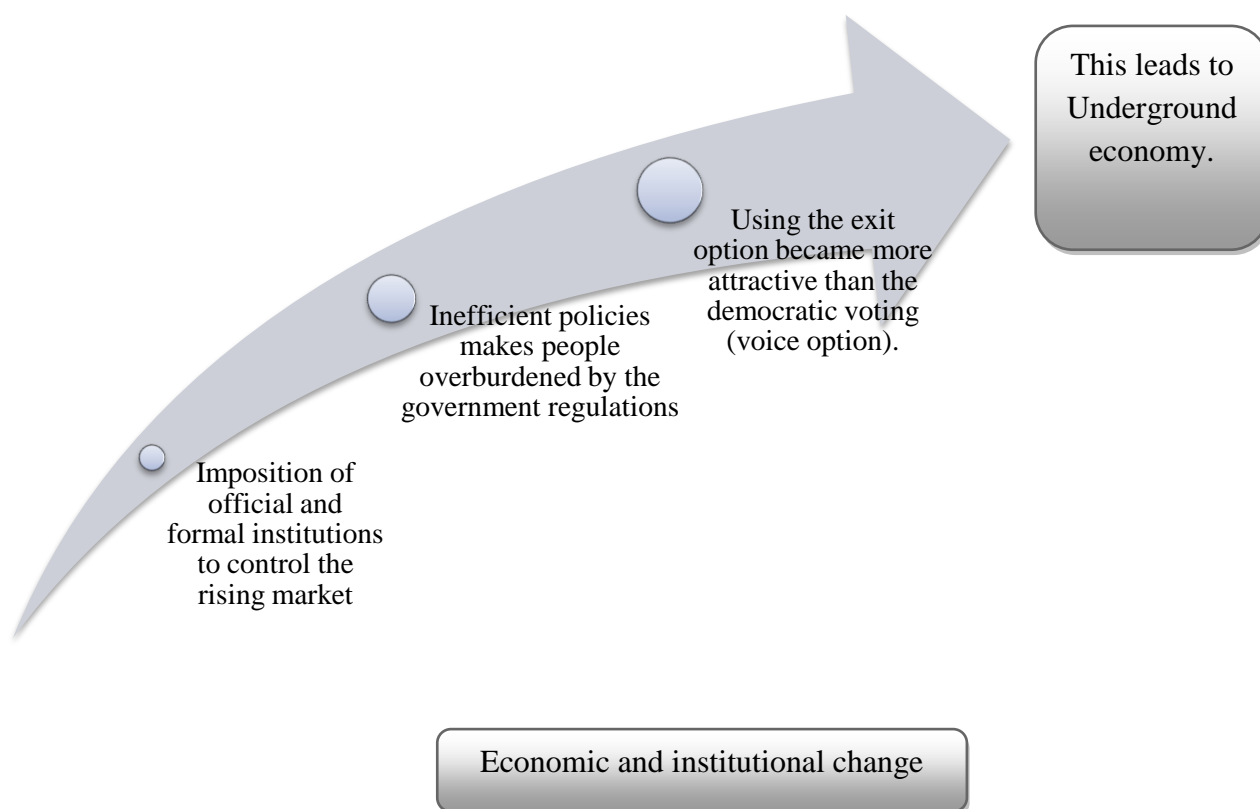
When tax yields achieve its highest, the official sector cannot expand because of the tax burden and government regulations, and thus taxpayers go underground.

All of this shows that the state institutions and policies are a crucial element in the decision whether to go underground or not; which pinpoint the relation between the amount of state's intervention and the underground economy.

2.27. **Besides what is mentioned**, there are two different visions concerning the role of the state. As to the first, the state's intervention including the social security and tax system and other public policies; may improve the social welfare. Whereas the second view ⁸ stresses that it can cause harm to the citizens, especially in developing countries that are characterized by inefficient institutional environment, corruption, a lot of regulations, weak protection of property rights and weak monitoring of bureaucrats (rent-seeking behaviors).

Moreover, all this thoughts accentuate the state's failure in elaborating efficient policies to promote the official sector, due to high tax and regulations burdens that cause hidden activities and tax evasion, etc. The figure 6 pinpoints and gathers these thoughts in the so-called: economic and institutional change, as follows:

⁸ This idea belonged to North, who talked about the predator state and thus reconsidered the neoclassical theory of the state .

Figure6: economic and institutional change

Source: author's construction base on, Boyen Belev, (2003).

2.28. This last vision pinpoints the abuse of the given power to the government officials; the so-called: **rent-seeking behavior of bureaucrats**; which is translated to a predatory market of the privileges given to those officials. For instance, entrepreneurs try to get a subsidy for goods they produce or for being in a particular class of people; by getting a tariff on goods they produce or by getting privileges that prevent their competitors. The result of these kinds of behaviors, usually leads individuals to engage in the underground economy.

Moreover, the government regulations generate two types of costs, in terms of corruption and bribes and compliance procedures, such as: time spent to comply with those regulations. This is usually the state policy to increase the power of bureaucrats.

Rent-seeking is the efforts (i.e. expenditures or costs) to gain a maximum return on a scarce resource, where these activities are unproductive and wasteful of the social welfare. Thus, the government privileges and favors form a predatory market for lobbying by interest groups, and the resources expended in competing for these privileges and favors

are wasted resources. (Tollison, 1982 (32), Tullock, 1989)(33). Besides this, rent seeking behaviors reduce information flows and the enforcement of contracts; which curb the foreign investment and lead to economic stagnation and decline.

There are many definitions of the rent-seeking; where all of them claimed that is a wasteful resource from the society, among which:

According to Tullock, (1989), “rent seeking is used only for cases in which whatever have a negative social impact on the society welfare”. And for Buchanan, 1980,(34) “it describes the behavior in public institutions where individual efforts to maximize their profits cause social waste of resources rather than productive implications”.

Thus, the rent-seeking behaviors (both private and public) are so costly to the economic growth. This is especially in developing countries, where there is a weak protection of property rights; which curbs the productive and innovative sectors. (Kevin M. Murphy et al 2003) (35)

Although, the most important rent-seeking behaviors include *bribery, lobbying, and political violence* in societies with democratic political systems; bureaucratic corruption is the crucial element used to influence the government or affect policy outcomes.

Bureaucratic corruption involves several kinds of activities, such as: accepting bribes from individuals and groups seeking for the government favors, theft or the illegal appropriation of public resources by the civil servant, nepotism, etc.

New economic history, property rights literature and economics of information:

2.29. The first who coined the theory of transaction costs of incomplete information and the variety of socio-cultural constraints, was North (1990).

He found in his book: “*Institutions, Institutional Change, and Economic Performance*”, that the developing countries are poor because of the institutional constraints that did not promote the economic agents; where it depends on the information that the entrepreneurs have and the way to use that information; which is usually incomplete and constrained by the existing institutions and incentives, and thus affect imperfectly the decision-making. (Stigler, 1961 (36), Akerlof, 1970 (37))

Moreover, North by asking: **why are some countries rich and some others poor?** He extended this concept (which is transaction costs) to explain the role of the state and its main characteristics, where he stressed that the economic markets are more efficient than the political markets; because the high cost of the enforcement, the lack of competition

between the economic agents, corruption; which increase the political transaction costs that lead the economic agents to go underground in order to reduce those costs.

Recently, *North and al, (2009)*, (38) found that to be developed economically requires economic organizations, enforcement of property rights and other contractual commitments. Besides, to be developed politically requires efficient rule of law and state control, where institutions; both formal and informal; generate and enforce rules of behavior (which structure incentives and constraints) and rules of procedure (means for modifying the existing rules). All of this pinpoints the need for improving the functioning of law and justice by the enforcement of contracts and the protection of property rights.

Nevertheless, these costs are arisen because of incomplete and imperfectly enforced contracts between different parties, (*O. Williamson, 1981*),(39) which give emergence to the so-called “**opportunism behavior**” that arose when the cost of cooperation between the integrated parties are high.

North et al., 2009, emphasized the role of contracts enforcement and the required institutions for that; where he highlighted the high cost of property protection, *which on one hand, is reduced by the state protection, but on the other hand,* lead to the risk of the state predation or violation of rights. Hence, he combined the property rights with the state protection.

Furthermore, as it is agreed that it is necessary to provide well protected property rights that promote the productivity in the official sector. According to *A. Alchian* in 1965 (40) “property rights” were defined as **permissions** that allow their owners to use, transfer or exploit those properties and also it prevent others from interfering with their actions. These rights are sometimes enforced by law but also are enforced by social customs, and mores of the society. Consequently, the emergence of property rights is a response to the interaction between persons to adjust new benefits and internalize externalities; when the cost of internalization is greater than its gains, (*Demsetz, 1967*).

Moreover, according to *Coase*, what really was the people exchanged is the rights instead of physical commodities, in contrast with the neoclassical economics. Those rights make people act in a certain ways and are enforced by the legal system.

As mentioned above, according to *Williamson* those rights are susceptible to **opportunistic behaviors** which render the legal system more costly to protect them. *North* showed also that the enforcement of those rights affect the development of the societies, which are

protected in developed countries and are poorly protected in the developing countries, which is considered as the main causes of informality.

From an empirical perspective, the key issue is whether the weak institutional quality creates the underground economy or whether the reverse. (*Schneider, Buehn and Montenegro, 2010*). By using a set of variables, exogenous ones that include marginal tax rate, real income per capita, inflation rate, and measures for institutional quality and governance (where the data encompasses six composite indicators⁹), on one hand. On the other hand, the dependent variable is the size of the underground economy. The findings show that the size of the underground economy is influenced mainly by the quality of institutions. Besides this, its size decline as the institutional quality and the rules of law improve, where institutions are the most important determinant of the rising size of the underground economy.

New social economics:

2.30. The backbone of institutional change is the social norms and its role in coordinating the actions of individuals, facilitating transactions and reducing their costs, the so-called **the informal institutions**. Moreover, these social capital could whether promote development policies or hamper them; because of their effects on individuals' behaviors and choices. Thus, institutional change is likely to be **cultural path dependence**, (*North, 2000*). Social capital refers to social connections or networks, norms and trust, all of which can facilitate interactions in a given society, and thus have effects on economic performance.

Moreover, Social capital is included in transaction cost economics as an important element to reduce the costs and uncertainty of market exchange.

To sum up, economic performance relies on both the formal and informal institutions and the compliance with them, so it is important to ensure efficient formal institutions that are complementary with the informal ones, in order to enforce property rights and reduce uncertainty and transaction costs, in order to promote economic growth and technological progress. All of this will specify efficient contracts among firms and their environment,

⁹ These indicators are: voice and accountability, political stability and the absence of violence, government effectiveness, regulatory quality, the rule of law, and control of corruption. Thus, the institutional quality is the average of these six composite indicators.

where there are *strong formal rules*, such as **as courts** to enforce those contracts, and *informal rules*; such as **trust and cooperation**; that are the basis for resolving conflicts.

1.4. Conclusion

2.31. As it is mentioned in this chapter, government faces two major challenges, the first one is linked to the bad governance, and the second is related to encouraging the economic growth and opportunities by promoting economic agents to be legal; which depends on the state's capacity to provide public goods.

Moreover, the large size of hidden activities reduces the state's capacity and makes it raising the tax rates for the formal agents, which in turn restricts the expansion of the formal sector and encourage more hidden activities that make the official statistics incomplete and hamper the establishment of efficient economic policies.

2.32. In other words, it is noticed that transition and developing countries have larger shares of the underground activities than developed countries, and it is obvious that this depends mostly on the quality of institutions and property rights in promoting economic agents to be formal or go underground, as they are rational.

Table of contents:

2.1. Introduction

2.2. Measurement methods of the size of the NOE

2.2.1. Direct approaches

2.2.2. Indirect approaches

2.3. The modeling approaches

2.4. The researches into the NOE, using the modeling approaches

2.5. Conclusion

2.1. Introduction

1.1. Although, the underground economy is a controversial subject, its size should be estimated even it is difficult, because the individuals who go underground leave no trace; in the three different market.

1.2. To realize this daunting task, several empirical measures of the underground economy are undertaken, with the difference in terms of the used methodology, the used data; which leads to a variety in the estimation results. Thus, **the estimation results will be used in elaborating efficient policies.**

In this part, we will give a short but comprehensive overview of the used methods in estimating the size of the underground economy. Three different types of methods are used (direct, indirect and modeling), and each one is briefly discussed and criticized. Our emphasis will be on the modeling approach which is considered as the most appropriate approach for measuring the size of the Underground Economy.

2.2. Methods to Estimate the Size of the NOE

As it is mentioned above, there is a large literature on the used methods to measure the size of the underground economy, among which: surveys, discrepancy between macroeconomics variables, monetary approaches and the modeling approach; where each method has advantages and disadvantages.

2.2.1. Direct Approaches

These are micro approaches that employ both surveys and samples based on voluntary replies, or tax auditing and other compliance methods.

The results of these approaches depend on the respondent's willingness to cooperate, which make it so difficult to assess the amount of undeclared work from a direct questionnaire, and most interviewers hesitate to confess. In addition, the results from these kinds of surveys are very sensitive to the formulation of the questionnaires, which require well designed questionnaires to get reliable data.

2.2.2. Indirect Approaches

These approaches, which are also called "indicator" approaches or macroeconomic approaches, are based on various economic and other indicators that contain information about the development and the size of the underground economy. Currently there are five indicators that leave some "traces" of the shadow economy.

The national accounts:

1.3. The Discrepancy between National Expenditure and Income Statistics :

This approach is based on discrepancies between income and expenditure statistics. In national accounting the income measure of GNP should be equal to the expenditure measure of GNP. Furthermore, the gap or the discrepancy between the expenditure measure and the income measure can be used as an indicator of the extent of the underground economy.

However, this discrepancy can reflect omissions and errors in the national accounts statistics as well as the shadow economy activity. Thus, this method should be carefully used.

1.4. The Discrepancy between the Official and Actual Labor Force:

As unemployment is one of the main causes of underground activities, a decline in participation of the labor force -that causes unemployment - in the official economy can be seen as an indication of increased activity in the shadow economy (with labor force participation is assumed to be constant, in a certain period).

Nevertheless, this method has been criticized because the discrepancy in the rate of participation has other causes. For instance, many people can work in the underground economy and have a second job in the official economy (i.e. Plural-activities).

The monetary approaches:

When using methods basing on these approaches, the authors attempted to exploit the link between the monetary aggregates (demand for currency) and the underground economy.

Moreover, the monetary approach passed through three stages and was developed by *Gutmann 1977, Feige 1979 and Tanzi 1980*, each one of them introduced the monetary factor in explaining the existence of underground economy. According to them the UE is channeled through currency in circulation basing on the assumption that the existence of the UE affects the demand for currency to settle underground transactions.

Ratio of currency to demand deposits:

The first who used the monetary approach is *Gutmann in 1977 (41)*. He used the currency to demand deposits to measure the size of the UE in U. States. Gutmann noticed that the ration of currency stock to demand deposits stayed stable over the period 1937- 1941. This ratio started to decrease after 1941 because most of the transactions were settled in cheques and after that, this ration increased. According to Gutmann, the increase of the ratio of currency to demand deposits is due to the emergence of the underground economy that is neglected before 1941 and thus increases the demand for currency. Furthermore, he assumed that only cash is used in the UE as a method of payment, in addition that only tax burden and government regulations are the main causes of the emergence of UE after the war, which affected the habits of payments of individuals.

Thus, Gutmann estimated the size of currency circulating in the UE using to equations, the first covers the reference period 1937-1941 where there is no UE and the second for 1976, the difference between these two measures is the extra-currency used in the UE. By assuming that the velocity of circulation of money in the UE is the same as M1 in the official economy, he estimated the size of the UE.

Many criticisms are addressed to this method, concerning the assumption that the ratio of currency to demand deposits is stable, in addition to the velocity of currency circulation in the UE that is supposed to be the same as M1 in the official economy.

1.5. The Transactions Approach :

The second author that developed the monetary approach is *Feige in 1979 (42)*. Feige used the link between income (i.e. total nominal GNP that is equal to official GNP plus unofficial GNP) and total transactions basing on the Fisherian quantity equation. His main equation is as follows: $p \cdot T = M \cdot V + M' \cdot V'$.

with M = currency notes, M' = demand deposits, V and V' their velocities, p = prices, and T = total transactions).

Moreover, Feige criticized Gutmann on his assumption that only cash is used in the UE, where he assumed that both cash and demand deposits were used to settled underground transactions.

As Gutmann, he assumed that the ratio of total transactions to income remained constant; he then calculated the values of cheque transactions and of cash transactions. The measure $p \cdot T$ is calculated by dividing the observed income to the GDP ratio to get the size of the UE, where observed income is the product of price index (of newly produced goods) and real income of the economy.

Finally, using these measures, he calculated the ratio of total value of these transactions to observed income, where he attributed the increase in this ratio to the emergence of the UE. This method is criticized because of the choice of a reference year where there is no UE, and that all the changes in the ration of total transactions and official GDP are attributed to UE. in addition that his method required many estimations concerning the velocity of bank notes and the velocity of demand deposits.

1.6. The Currency Demand Approach :

The currency demand approach was first used by *Cagan (1958) (43)* who estimated the UE in the U. States, where he used tax rates (to model the incentives of individuals to go underground), interest rate and income in his equation. Mathematically, his equation is as follows:

$$C = A (1 + F)^\alpha y^\beta \exp^{-\gamma i} .$$

With:

C: currency or cash;

F: is a scale variable that reflects the incentives to go underground;

Y: is the official GDP;

I: is interest rate on savings deposits.

A, α , B and γ are structural coefficients.

The currency demand approach was developed and refined by *Tanzi (1980)* (44) who is based on Cagan's approach. Tanzi combined the previous monetary approaches (the method of ratio of currency to demand deposits and transaction method) and he estimated quantity of money held by people to settle the underground transactions by estimating the changes of the demand for currency. He used the underground transactions associated with tax evasion, and thus excluded the illegal activities (drugs and prostitution).

In contrast to Gutmann who assumed that tax burden and intensity of regulations are the solely factors that affect the size of the UE, Tanzi included other variables. Thus, he used the share of currency stocks (i.e. All bank notes and coins in public circulation) to M2 as dependent variable, and income tax rate, interest rate, inflation rate, per capita income and total wages to GDP as explanatory variables. Mathematically, his **basic regression equation for the currency demand is:**

$$C/M2 = A (1 + F)^\alpha y^\beta \exp^{-\gamma i Inf} .$$

And after introducing natural logarithms, the equation becomes:

$$\ln (C / M_2)_t = \beta_0 + \beta_1 \ln (1 + T)_t + \beta_2 \ln (WS / Y)_t + \beta_3 R_t + \beta_4 \ln (Y / N)_t + \beta_5 Inf + u_t$$

With: $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 < 0$, $\beta_4 > 0$, $\beta_5 > 0$: are structural coefficients.

Where:

\ln denotes natural logarithms,

C / M_2 : is the ratio of cash holdings to M2,

T: is the scale variable that reflects the incentives to go underground; it could be either the proportion of total taxes to GDP or government expenditures (to proxy changes in the size of the underground economy),

WS / Y: is a proportion of wages and salaries in national income (to capture changing payment and money holding patterns),

R: is the interest paid on savings deposits (to capture the opportunity cost of holding cash) and;

Y / N: is the GDP per capita.

Inf: is the inflation rate;

U_t : the error term.

His approach is applied in two stages, the first is estimating the currency-demand regression equation, using econometric methods, that include a scale variable related to cash transactions in the UE and the second is estimating the UE using the quantity theory of money. The first stage is based on the assumption that people use cash in their transactions to leave no traces (makes the transactions more easier and is considered as a confidence factor) and they go underground to avoid the tax burden and the intensity of government regulations, which promote more tax evasion and increase the demand for currency.

Consequently, the demand for cash to settle underground transactions (or the amount of irregular transactions settled in cash) is calculated as the difference between two values, one is estimating using the equation of demand for cash of the full model, and the other one is estimating using the equation by removing the determinants of UE, which means removing the incentives to go underground and thus the demand for currency is motivated only by regular transactions¹⁰.

Hence, using this difference between the two equations, the UE is then calculated using the Fisherian equation, which is using to calculate first the velocity of money in circulation as the ratio of official GDP to the stock of liquid assets M1 (i.e. currency and sight deposits) where it is assumed that the velocity of money circulation is the same in both sectors. Thus, the UE is calculated by multiplying the velocity of money by the estimated “excess demand” for cash (here Tanzi assumed that in the base year there is no transactions, which means that the $UE/ GDP = 0$).

Furthermore, the measured Underground Economy is one component of the total amount of cash payments in the unobserved economy (in cash-based economy) in addition to the illegal component. In other words, the cash determinants are divided in three categories: the structural (economic development proxied by GDP per capita, education level proxied by income, the degree of spatial diffusion of banking proxied by the per capita number of current accounts, the payment technology and interest rate on current or saving deposits), underground (tax burden) and illegal (drug and prostitution offences to total number of crimes).

¹⁰ The equation of the demand for currency of Tanzi includes determinants of cash for regular transactions (wages paid in cash to GDP, interest rate on savings deposits, per capita income) and determinants of cash for underground transactions (tax burden or government expenditures).

In order to isolate the illegal component of the unobserved economy, one should include crime indicators related to drug dealing and prostitution, and thus obtaining a precise estimate of the excess demand for cash associated with tax evasion.

In short, the monetary approaches have been criticized as follows:

- The assumption that there is no UE in the reference year.
- The overestimation of the UE using these monetary approaches which is due to the neglected illegal economy in the estimation.
- Most studies assume the same velocity of money in the official and underground economy, where the velocity of money in the underground economy is even more difficult to estimate, besides, it is high than the velocity of circulation in the official economy.

1.7. The Physical Input (Electricity Consumption) Method:

This method is based on the consumption of some standard commodity such as electricity, which is considered as a physical indicator of the economic activity. This method is first developed by Kaufmann and Kaliberda and was refined later by Lacko.

1.8. The Kaufmann – Kaliberda Method :

They used this method to measure overall economic activity in the economy, basing on the assumption that electricity consumption is used as the best physical indicator, where it is noticed that economic activity and electricity consumption have been observed to move at the same rate (electricity/GDP elasticity usually close to one).

Kaufman and Kaliberda estimated the size of the unofficial GDP by having a proxy measurement of total electricity consumption (of overall economy) and subtracting it from the estimates of official GDP. Consequently, the gap between the rate of the official GDP and the rate of total electricity consumption is contributed to the growth of the Underground economy.

However, this approach was also criticized, mostly by *Lackó (1998)*:

- Not all the underground activities are estimated, because they require in addition to electricity other energy sources, such as: gas, oil, etc.
- Because of the technical progress, electricity is greatly used in both official and unofficial economy. Thus, we cannot contribute all the electricity consumption only to the UE.

1.9. The Lackó Method:

Kaufman and Kalebirda approach was criticized and refined by *Lackó (1998)* (45), who assumed that a part of the underground economy is related to the household consumption of electricity. Lackó approach is related to household economy, such as: do-it-yourself activities, and other non registered production and services.

Furthermore, she assumed that the higher the household consumption of electricity, the higher the part of the underground economy (the part that cannot be measured).

Lackó's approach (1998, p.133) are based on the following two equations:

$$\left\{ \begin{array}{l} \ln E_i = \alpha_1 \ln C_i + \alpha_2 \ln PR_i + \alpha_3 G_i + \alpha_4 Q_i + \alpha_5 H_i + u_i \quad (1) \\ \quad \quad \quad \text{with } \alpha_1 > 0, \alpha_2 < 0, \alpha_3 > 0, \alpha_4 < 0, \alpha_5 > 0 \\ H_i = \beta_1 T_i + \beta_2 (S_i - T_i) + \beta_3 D_i \quad (2) \\ \quad \quad \quad \text{with } \beta_1 > 0, \beta_2 < 0, \beta_3 > 0 \end{array} \right.$$

Where:

i: the number assigned to the country,

E_i : per capita household electricity consumption in country i,

C_i : per capita real consumption of households without the consumption of electricity in country i in US dollars (at purchasing power parity),

PR_i : the real price of consumption of 1 kWh of residential electricity in US dollars (at purchasing power parity),

G_i : the relative frequency of months with the need of heating in houses in country i,

Q_i : the ratio of energy sources other than electricity energy to all energy sources in household energy consumption,

H_i : the per capita output of the underground economy,

T_i : the ratio of the sum of paid personal income, corporate profit and taxes on goods and services to GDP,

S_i : the ratio of public social welfare expenditures to GDP, and

D_i : the sum of dependants over 14 years and of inactive earners, both per 100 active earners.

In a cross country panel study, Lackó econometrically estimates equation (1) substituting H_i by equation (2). The econometric estimation results can then be used to establish an ordering of the countries with respect to electricity use in their respective underground economies.

However, Lackó's method was also criticized:

- There are other energy sources used in the underground economy, besides the electricity.
- Not only the household sector that include the underground activities.

2.3. The MIMIC approach (multiple indicators, multiple causes)

To sum up the previous section, the widely used methods in measuring the size of the UE are the so-called “*macroeconomic modeling*”: (i) the currency-demand approach; (ii) the consumption of some standard commodity such as electricity, and (iii) the Modeling approach (MIMIC model). But, our emphasis is on the MIMIC model and its reliability for the purpose of measuring the shadow economy.

1.10. The model identification:

Estimating the size of the non observed economy **is a challenge and a difficult task**. As a result, many methods are used to undertake this task, and we will test the reliability of the MIMIC (Multiple Indicators Multiple Causes) that is considered as the most appropriate to this aim.

Structural Equation Models (SEM)¹¹ are statistical relationships between latent variable (unobserved) and observed variables. The Multiple Indicators and Multiple Causes (MIMIC model) model is a special case of SEM. In this model, the latent variable is linked to two set of variables on the one hand, to observable indicators that reflect changes in the size of the SE; and to a set of observed causal variables, which are regarded as crucial determinants of the underground economy.

Moreover, it was *Jöreskog and Goldberger (1975)* (46) who named this method, but it is first mentioned by *Zellner (1970)* (47), *Hauser et al (1971)*(48) and *Jöreskog (1973)* (49). The first who used the modeling approach to estimate the size of the UE as ‘Latent variable’ were *Frey and Weck-Hannemann (1984)* (50). After that, many economists

¹¹ It is also called: the « analysis of covariance structures ».

employed this method to measure the underground activities in several countries across the globe.

The advantage of this method is that it combined multiple causes and multiple indicators of the underground economy, instead of using just one indicator (i.e. tax burden) like the other methods.

The equation with the relationships between the latent variable and the causes is called the Structural Model:

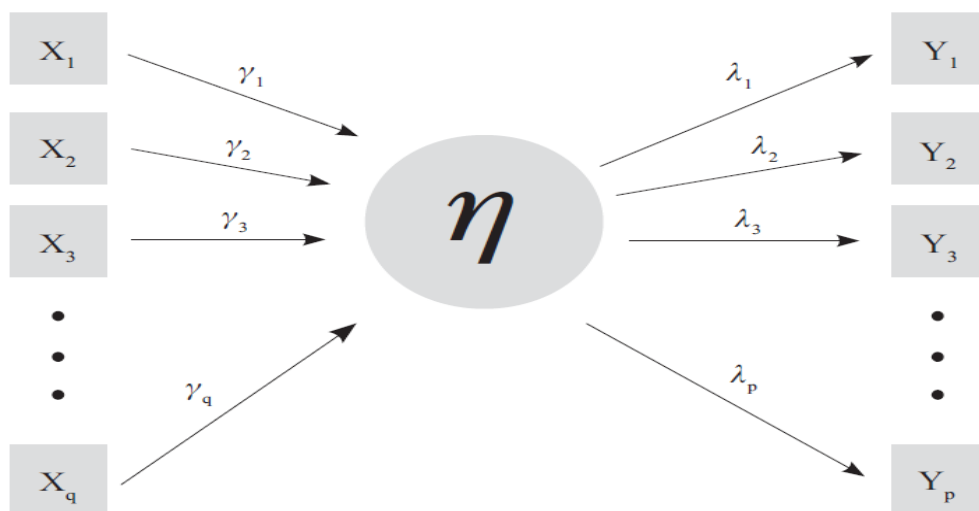
$$\eta_t = \gamma' x_t + \xi_t \dots\dots\dots (1)$$

With : $x_t = [x_{t1}, x_{t2}, \dots \dots, x_{qt}]$ being a $(q \times 1)$ vector of time series variables, each of which is a potential cause of the unobservable time series variable η_t , γ' being a $(1 \times q)$ vector of coefficients describing the causal relationship between x_t and η_t , and ξ_t being an error term.

The equations system that links the indicators and the unobservable variable is the Measurement Model:

$$y_t = \lambda \eta_t + \varepsilon_t \dots\dots\dots (2)$$

With: $Y_t = [y_{1t}, y_{2t}, \dots \dots, y_{pt}]'$ being a $(p \times 1)$ vector of indicators, λ being a $(p \times 1)$ vector of coefficient describing the relationship between η_t and y_t , and ε_t being an error term of the I(0) kind.

Figure7: the structure of a MIMIC q-1-p model

Source: author's construction.

It is important to mention that when using the MIMIC model, the identification is a necessary condition; which states that the MIMIC model should have at least one cause with at least two indicators, in addition that we should assign a scale to the latent variable, η , which the econometricians called “**normalizing procedure**”¹².

In order to estimate the MIMIC model we need to fix a scale variable, that's mean fixing y_1 (Useally the GDP is assigned and fix the M2) to an exogenous value, which can be +1 or -1 and alternatively y_2).

1.11. The model specification:

As it is already mentioned, the MIMIC model combined two set of variables, the causes and the indicators, where the size of the latent variable depends on the chosen causes and indicators. The following section is devoted to shed some light on the most used variables.

1.12. Finally, we should keep in mind that there is no best method to estimate the size of the UE and each approach has its characteristics and give specific results.

As *Helberger and Knepel (1988)* (51) asserted that this approach can be criticized as follows:

¹² For further understanding on the relationship between the underground economy and growth rate of GDP (the official economy), see the appendix 2.

- The difficulty to obtain a common definition of the latent variable; which is the underground economy.
- The coefficients estimated by this method are unstable, especially when the sample changes. As the sample is large and the data is stationary, this instability disappears.
- The difficulty to get reliable data on the used variables.
- Another criticism about the reliability of the MIMIC estimates of the underground economy; which are related to the benchmark method (*Breusch, 2005*) (52). This criticism is revealed when converting the index of the underground economy (estimated by the MIMIC model) into absolute values.
- Besides this, we should state that the SEM is a confirmatory approach; not an explanatory approach to confirm the consistency of the theory with the used data. Thus, there is no theory in which this approach is based on to use the causal and indicator variables.

In econometrics, the main limitations are:

- Use the SEM approach with small sample sizes;
- Using the calibration or benchmarking procedure to convert the index calculated by structural model in actual values of underground economy;
- Test the independence between structural and measurement errors;
- The identification problem when choosing the coefficient of the scale or reference variable, it has effect on the values of the estimated structural coefficients, and thus, on the index of the underground economy.

2.4. The researches on the NOE, using the MIMIC model

As it is already mentioned that the Non Observed economy (NOE) encompasses four different sectors (illegal, informal, underground and household), and each sector consists of several activities that many researchers attempt to measure.

Thus, the empirical measures of the NOE have varied in terms of the methodology employed, the used data; which lead to a disagreement about the used methods and estimation results. Our emphasis herein will be on the research papers that used the MIMIC model in measuring the underground economy.

This section is devoted to these empirical evidences both old and recent ones; which pinpoint the role of institutional quality measures in shaping the underground

incomes; focusing on the most used variables to elaborate a synopsis (see the table in the appendix that summarized the main used variables in each study).

Thus, the main empirical evidences are herein summarized:

- *Tedds Lindsay, 1998, (53)* estimates the size of the Canadian NOE over the period 1976-2001 using the MIMIC 11-1-3 model. As to the choice of the variables, he used the following causes: labor force participation rate, average direct tax rate, average indirect tax rate , average marginal tax rate , average payroll tax rate , dummy variable for the Voluntary Disclosure program (VDP) that equals the marginal tax rate for 1994 and onwards, crime rate , dummy variable for the implementation of the GST that equals 1 in 1991 and onwards, dummy variable for the implementation of the Underground Economy Initiative (UEI) that equals 1 in 1994 and onwards, logarithm of real self-employment income; and flow of federal regulatory transactions by the Governor in Council and individual Ministers. And concerning the indicators are as follows: growth rate of gross domestic product, real currency per capita and ratio of expenditures on goods and services to disposable income.

Finally, he found that underground economy in Canada grew steadily over the period 1976 to 2001, where it grew from about 7.5% of GDP in 1976 to about 15.3% in 2001.

- *Guillermo Vuletin, 2008, (54)* in his paper estimates the size of the informal economy for 32 mainly Latin American and Caribbean countries in the early 2000s (2002 or 2003), using the MIMIC 5-1-3 model. He employed the following causes: tax burden, labor rigidities (minimum wage), the importance of agriculture, the inflation rate and the strength of enforcement system. As for the indicators are: workers contributing to the social security system, the degree of unionization¹³, the gross enrollment ratio for secondary school¹⁴.

¹³ The *degree of unionization*, measured as the percentage of labor force with membership in some labor union, is considered. The larger the informal economy, the weaker the bargaining power of the workers in the formal sector and, therefore, the lower the degree of unionization.

¹⁴ The *gross enrollment ratio for secondary school* is included as an informal economy indicator. However, one of the well-recognized consequences of the informal economy is related to child labor and the effect it has on rates of education enrollment. Thus, the larger the informal economy, the lower the expected enrollment rate.

Following Loayza, 1997, the percentage of the labor force *contributing to the social security system* is included. The larger the informal economy means the lower the expected number of contributors to the social security system.

Finally, he found that a stringent tax system and regulatory environment, higher inflation, and dominance of the agriculture sector are key factors in determining the size of the informal economy. His results also confirm that a higher degree of informality reduces labor unionization, the number of contributors to social security schemes, and enrollment rates in education. Concerning the size of the NOE of his sample, he found that its size ranges between 25 and 70%.

- *David Giles, 1999, (55)* investigates some characteristics of the NO economy in New Zealand, during the period 1968-1994 using the MIMIC 5-1-3 model. In his paper he attempt to measure the size of the NOE using the following causes: the degree of economic regulation, the development of taxation legislation, the tax-bracket "creep", effect of inflation and measures of the "tax burden".

And concerning the indicators: growth rate of GDP per capita, the male labor force participation rate and the proportion of currency to M3.

Finally, he found that the size of the NOE in New Zealand has account for 11.3% of the GDP in 1994.

- *Astrem Prokhorov, 2001, (56)* after his evaluation of various estimation methods, he apply the MIMIC 8-1-5 to estimate changes in the size of the Russian UE from 1992 to 2000, and verify what causes and indicators of the NOE can be of relevance and significance in the settings of the Russian transition. To do so, he used the following causes: tax rates, the share of public sector employees, indicator of quality of regulation, the output decline, inflation, the share of population living below the subsistence level, unemployment rate and labor force participation. As for the indicators: cash on hands, share of M0 in M2, the share of hard currency purchases in personal income; crime rates and the excess of electricity consumption over GDP.

Hence, he found that the share of the NOE of GDP is high in late high in late 96 - early 1997. Besides, the NOE is significantly dependent on tax revenues as share of GDP, a measure of economic decline, and a measure of extensiveness and quality of state regulation. The underground economy is shown to be well-indicated by monetary and physical input aggregates.

Finally, he mentioned the main obstacles that he confronted, as follows: the most difficult problem of the procedure implemented in the paper is the short length of the time series. The period considered here consists of 34 quarterly observations. And he proposed the following solution would be to use longer time series, which however, is problematic in the case of the economies in transitions, in particular, Russia. This problem can be solved as more data on reform become is accumulated.

- *Dell'Anno and Friedrich Schneider 2003, (57)*. The aims of his paper are, to estimate the Italian shadow economy by means of a structural equation approach and to verify the generality of the main criticisms about the reliability of the “MIMIC method” in estimating the size of the UE over the period 1962- 2000. To do so, he employed the following causes: tax Burden, government consumption /GDP, unemployment, self-Employment, index of Efficacy of Justice and index of Illegality. And concerning the indicators: real GDP and currency outside of banks.

Finally, he found that the size of the NOE in Italy amounted to 10.5% in 1980.

And the main outcomes of this paper, in accordance with the conclusions founded by Schneider (1997) and Schneider, Enste (2000) are that a rising of taxes and social security contributions, combined with increasing State regulatory activities, “...are the major driving forces behind the size and growth of the shadow economy”⁶³.

- *Bajada and Schneider, 2003, (58)* in this paper, they provide estimates of the NOE for eighteen (18) countries in the Asia-Pacific region (where Australia is used as a case study to highlight how we go about estimating the NOE and examining the reliability of the estimates) over the period 1990- 2000, in order to know on how such activities have changed during this time.

To do so, they used a well-known technique for estimating the shadow economy, often referred to as the *currency-demand approach* with an alternative and recently introduced methodology into this literature known the MIMIC 3-1-2 model.

Finally, the conclusions that they found is that countries with relatively thin tax compliance initiatives experience great NOE activity when compared to those countries that are more actively involved in limiting such activities.

By using a variant of the monetary approaches of Cagan (1958) and Tanzi (1983), Bajada estimates the size of the Australian cash economy to approximately 13.81% of GDP, and as for the modeling approach is about 13.98% of GDP.

- *Friedrich Schneider and Andreas Buehn, 2008, (59)* estimated the NOE for 120 countries, including developing, Eastern Europe and Central Asian and high income OECD countries over 1999 to 2006, using the MIMIC 7-1-3 model.

They measure its size through using the following causes: share of direct taxation, size of Government, fiscal freedom, economic freedom, business freedom, unemployment rate and GDP per capita, and using the following indicators: growth rate of GDP per capita, employment quota and growth rate of local money per capita.

Their main results that they obtained are as follows: the average size of the NOE (as a percent of “official” GDP) in 2004/05 in 76 developing countries is 35.5%, in 19 Eastern and Central Asian countries 36.7% and in 25 high income OECD countries 15.5%. Besides, they found that the Algerian NOE account for 35.8 % in 2006.

Finally, an increased burden of taxation and social security contributions, combined with labor market regulations are the main causes of the rising size of the NOE. Furthermore, their results show that the NOE reduces corruption in high income countries, but increases corruption in low income countries.

- *Roberto Dell’Anno, 2007, (60)* in this paper, he estimate the Portuguese NOE from 1977 to 2004 and test the statistical relationships between the NOE and other economic variables. In order to carry out the econometric analysis, he used the MIMIC 6-1-2 model. The main causes are: government employment in labor force, tax burden, subsidies, social benefits paid by government and self-employment. And the indicators are: index of real GDP and labor force participation rate.

Finally, he found that the size of the NOE with respect to GDP ranges from 29.6 percent, in 1978, to 17.6 percent of official GDP in 2004.

- *Chaudhuri, Schneider and Chattopadhyay, 2006, (61)*. In this paper, they examine the size of the NOE in India. Given that India has enjoyed democracy for almost sixty years, they tried to make a comparison between the Indian underground economy with other Asian countries.

To do so, they employed the MIMIC 3-1-2 model over the period 1960/1961 to 1997/1998, using the following causes: inflation, the number of persons working in the public sector and the ratio of indirect taxes, direct taxes. As regards to the indicators are: the growth rate of real GDP and the cash to M3 ratio of the economy.

Their analysis has shown an increasing trend of the size of the NOE varying from 8.9% (1960/61) to about 23.19% (1997/98), and their comparison reveals that the shadow economy of India is in the lower end. The average size of the shadow economy of 15 Asian countries in the 1989/90 was 22.6% and in 2000/01 rose to 28%, which means an increase of 5.4 percentage points over these 10 years.

Finally, their paper also demonstrates the importance of mass media, political and institutional factors and government actions in order to curb the size of the hidden economy.

- *Roberto Dell'Anno , Miguel Gómez-Antonio and Angel Alañon-Pardo, 2007, (62).* This paper offers estimations of the evolution of the shadow economy in three Mediterranean countries, namely France, Spain and Greece. To do so, they applied multiple indicators and multiple causes model based on the latent variable structural theory (i.e. the MIMIC 6-1-3 model). Their model includes the tax burden (both as a whole and disaggregated into direct taxes, indirect taxes and social security contributions), a proxy of regulation burden, the unemployment rate and self-employment as causes of the NOE and the GDP growth rate, the labor force participation ratio and the currency in circulation outside banks as indicators of the underground economy.

They found that the size in the France, Spain and Greece is respectively, 9%, 26% and 28%.

Finally, their results confirm that unemployment, the fiscal burden and self-employment are the main causes of the shadow economy in these countries, and confirm that an inverse relationship exists between the official GDP growth rate and that of the unofficial economy.

- *Andreas Bulm, Friedrich Schneider, 2007, (63)* developed a MIMIC 4-1-2 model, which estimates the co-integration equilibrium relationship and the error correction short run dynamics, to estimate the French NOE during the period 1981- 2006. Their aim from this paper is to demonstrate that this approach allows researchers to obtain more accurate estimates about the size and development of the shadow economy compared to other methods.

Their model includes the following causes: tax and social security contributions burden, unemployment rate, regulation and working hours. As to the indicators: the monetary aggregate M1 and GDP volume index.

Finally, they found that the size of the French NOE accounts for 15.9% in 2006.

- *Brambila Macias Jose, 2008, (64)* used annual data for the period 1970-2006 in order to estimate and investigate the evolution of the Mexican underground economy, and the other aim of this study was to provide researchers with a reliable time series that can be used in further analysis of the phenomena and its possible interactions with other important aspects of economic growth.

In order to do so, he modeled the UE as a latent variable and tries to explain it through relationships between possible causes; which are: taxes, inflation, salaries, the size of the public sector (excessive regulation) and unemployment; and indicator variables, which are: GDP and Currency in circulation outside banks.

His main results indicate that the Mexican informal sector at the beginning of the 1970's initially accounted for 40 percent of GDP while slightly decreasing to stabilize around 30 percent of GDP in the late 1980's until 2006, where its size accounted for 27.2% .

Besides, the empirical results confirm in particular the importance of salaries and excessive regulation as causes of the informal economy in Mexico and confirm a positive relation between informality and GDP.

- *Ademola Ariyo and William Bekoe, 2011, (65)* asserted that the existence of a large underground economy in Nigeria is an important consequent of economic and social policy over the period 1975-2010. Thus, this study seeks to identify the determinants of the NOE and estimate both the size of the underground economy and the magnitude of tax evasion in Nigeria during this period. To do so, this study employed the currency demand approach.

The results from their analysis indicated that the size of NOE and magnitude of tax evasion of Nigerian economy ranged between 42.54% –79.32% and 2.09% – 6.75% of GDP respectively. The size of its NOE is about 58.63%, and its tax evasion is about 3.28% in 2010, to be precise.

Besides, their main findings are: tax rate, Inflation, Interest rate, high income inequalities, and the generally low productivity of the Nigerian tax system due to deficiencies in tax administration and tax system, and complex legislation is the driving forces behind the growth in the NOE and tax evasion.

Finally, they claimed that minimization of the size of the NOE is necessary for effectively addressing the problem of tax evasion in the country. Therefore, they recommended that government should evolve perhaps towards monetization of the economy and the evaluation of an optimal tax system.

- *Vjekoslav Klaric, 2010, (66)* examined and estimated the size of the NOE in Croatia, using the MIMIC 4-1-2 model, during the period 1998- 2009. This model includes: tax burden (indirect and direct,), the unemployment rate and social security contributions as causes, and GDP and M1 monetary aggregate.

He found that the size of the Croatian NOE is about 12.1% in 2009.

Finally, he stressed the main concerns that Breusch (2005) expressed looking at the MIMIC approach and its applications, which we mentioned in the previous section devoted to the MIMIC model.

- *Ahmed Gulzar, Novaira Junaid, 2010, (67)* asserted that in Pakistan, it is generally assumed that the NOE contributes about 30% to 50% to the overall GDP. This paper aimed to estimate *more precisely* the size of the NOE with the determination of its potential causes and implications. To do so, they applied five statistical and structural modeling approaches namely; simple monetary approach, modified monetary approach using dynamic ordinary least square (DOLS), multiple-indicators multiple causes (MIMIC) approach, electricity consumption approach and labor market survey, over the period 1973-2010.

We retain here the results from the MIMIC 7-1-4 model, which includes the following causes: Interest Rate, banking Services, financial Development, size of Government, inflation rate, openness, total Electricity Consumption, economics of Freedom Index, corruption Index, literacy Rate: A Proxy of Human Capital, labor Force, unemployment Rate and total Population. And as for the indicators are: GDP and currency in Circulation outside banks.

Finally, their average results show that the size of the informal economy (as % of GDP) remains around 28% over the sample period, and **also** show that tax burden, unemployment rate, economics of freedom, corruption, government size, openness and inflation are significant determinants and play a dominant role in expansion/contraction of the informal economy in Pakistan.

- *Micheal Pickhardt, Jordi Sarda, 2010, (68)*. Based on the Ahumada et al. (2007) critique, they revise existing estimates of the size of the German underground economy. Because that the German policy and law makers have been misguided during the last three decades, they introduce the Modified-Cash-Deposit-Ratio (MCDR) approach and apply it to Germany for the period 1960 to 2008.

Finally, they found that the size of the underground economy in Germany accounted for 15.4% in 2008.

- *Corina Maria and Andrei Stefanescu, 2011, (69)* pinpointed the role of the economic crisis that affected the real economy in Romania, the decline of official GDP by almost 5 percent in 2009 compared with 2008, 1.3 percent in 2010 against the previous year and increase of unemployment too.

Against this background and the extent of the UE in Romania and its development over time, they estimated its size by using the MIMIC 7-1-3 model for the period 1990- 2009. Even that the UE is not a directly observable measure; it is possible to approximate its size, by using measurable causes and indicators. The Romanian underground economy causes consists primarily of taxes: tax burden, corruption index, direct taxes share in GDP, indirect taxes share in GDP, GDP per capita (USD), the official unemployment rate and net investments share in GDP. And as for the indicators are: population activity rate, real GDP index and M1 share in M2.

Finally, they found that the relative size of the underground economy in Romania increased over time, which is about for 35%.

However they suggest that both the size of a country's NOE may serve as an indicator for a country specific economic and social reform agenda, which in turn would allow for constructing a development reform index.

Besides, the scope of the NOE could well serve as a mirror that reflects the type of reforms need in a country, while its relative size and its growth rate would imply how urgent these reforms are.

- *Trevor Breusch, 2005*, replicated the work of David E.A. Giles and Lindsay M. Tedds, who estimated the size of the underground economy in Canada, in their book *Taxes and the Canadian Underground Economy*, especially, the model fitting, prediction, and benchmarking and reveals the origins of their results.

In their book, the authors described their techniques for estimating the extent of the non-observed activity in Canada, by using the MIMIC 7-1-2 model over the period 1976 to 1995. Their model includes: total number of male holders of multiple jobs, income of self-employed persons, real annual disposable income per member of the labor force, nominal Canadian-US exchange rate, ratio of total corporate tax revenue to GDP, ratio of total indirect tax revenue to GDP and unemployment rate, as causes, and currency (notes and coins) in circulation outside of banks and GDP Real gross domestic product, as indicators. They found that an amount of additional income; unobserved by the authorities and untaxed; ranging from a low of 3.46 percent of official GDP in 1976 to a high of 15.64 percent of GDP in 1995.

Finally, he criticized their work, where he showed that the time path of their estimates has little or no connection with underground income as a percentage of GDP and that the overall level of their estimates is a result of numerical accidents. Besides, he found that they didn't mention the transformation of differenced variables into deviations-from-means and scaled to have unit standard deviation, which is unusual in econometrics and they used the transformed data in the estimates of the UE and the original data to interpreting these results, which is inadequate.

- *Norman A. Loayza, 1996*, (70) asserted that informal economies arise when governments impose excessive taxes and regulations that they are unable to enforce.

In this paper he studied the determinants and effects of the informal sector using an endogenous growth model whose production technology depends essentially on congestable public services. In this model, changes (in both policy parameters and the quality of government institutions) that promote an increase in the relative size of the informal economy will also generate a reduction in the rate of economic growth.

Aiming to estimate the size of the NOE of the Latin American countries in the early 1990s,

he applied the MIMIC 3-1-2 model¹⁵. He used the following causes: corporate income tax rate, labor market restrictions and the strength of the enforcement system. As for the indicators: value-added tax evasion rate and fraction of labor force not contributing to social security.

The size of the underground economy is: Chile: 18.2%, Argentina: 21.8%, Costa Rica : 23.3%, Mexico : 27.1%, Venezuela: 30.8%, Ecuador : 31.2%, Colombia: 35.1%, Uruguay: 35.2%, Brazil : 37.8%, Honduras: 46.7%, Guatemala: 50.4%, Peru : 57.9%, Panama: 62.1%, Bolivia : 65.6%.

Finally, he concluded that in economies where the statutory tax burden is larger than optimal and where the enforcement system is too weak, the relative size of the informal sector is negatively correlated with the rate of economic growth; in other words, changes, both in policy parameters and the quality of government institutions, that promote an increase in the relative size of the informal economy will also generate a reduction in the rate of economic growth.

- *Cassar Alan, 2001, (71)* applied the MIMIC 4-1-3 model to estimate the size of the NOE in Malta for the years 1971 and 1997. The model includes the following causes: tax Rate, income Effect on Workers in the Official Economy, unemployment Rate an inflation; and the following indicators: currency Demand, male Participation Rate and productivity in the Recorded Economy.

Finally, he showed that, on average, the underground activity grew by 6.62%, 3.47% and 3.36% in the 70s, 80s and 90s respectively. After calibration, the estimates obtained (% of GNP) show a progression from 8.4% in 1971 to 25% in 1997. Comparing the data for 1994, Malta (23.3%) joins the highest-ranking OECD countries. According to the literature, the main common factor of these countries is a relatively large tax burden.

¹⁵ He justified the choice of this approach for estimating the UE, for the following reasons. First, in the process of estimating the size of the informal sector, we obtain and test the significance of the estimated effects of some causal variables on the informal sector. Second, given that we estimate the size of the informal sector jointly for all countries in the sample, we can make cross-country comparisons and use those estimates to assess their correlation with other variables of interest. Third, we can use the information contained in different alternative or complementary indicators of the informal sector in a single estimation process.

- *Edgar L. Feige and Richard Cebula, 2011, (72)* employed a modified version of Feige's (1989) general currency ratio model (GCM) to obtain a time series estimate of income tax evasion in the U.S. from 1940- 2008.

This study empirically investigates the extent of non compliance with the tax code and the determinants of federal income tax evasion in the U.S.

Finally, they found that 18-19% of total income is not properly reported, giving rise to a "tax gap" approaching \$500 billion dollars, and income tax evasion is an increasing function of the average effective federal income tax rate, the unemployment rate, public dissatisfaction with government, and per capita real GDP (adopted as a measure of income), and a decreasing function of the Tax Reform Act of 1986 (during its first two years of being implemented).

- 1.13.** To summarize all the empirical evidences mentioned above, although the criticism of the MIMIC model, there is an agreement on its use to estimate the underground economy in different countries, in addition to the Currency- Demand approach. Therefore, we can summarize the main explanatory variables and indicator variables as follows:

Explanatory variables:

Tax Burden (share of direct, indirect taxation and social security contributions):

Is the main determinant of tax evasion; where the increase of tax burden makes economic agents go underground. In econometrics, the tax burden is measured as the total share of direct and indirect taxes and social contribution, as a percentage of gross domestic product, (World Bank).

Real Government Consumption (size of government) and public sector services:

The rising size of government expenditures is the main incentive that makes individuals hide their activities in the UE.

Moreover, this variable is a proxy of the burden of the state regulations, bureaucracy and corruption among the politicians.

Which concerns public Sector Services: the rising size of the UE reduces the state revenues that affect the quality of the provided public goods and services. Consequently, this situation leads to more increase in the imposed tax rates; for the economic agents in the

official economy; to satisfy the public needs (such as the public infrastructure¹⁶). This is especially in developing countries that are characterized by higher levels of regulation; leading to a higher degree of bureaucracy and corruption; and higher taxes on official activities; and thus leads to larger underground activities; in addition to the effect of public institutions; the federal political system; on the underground economy that is the result of the failure of state institutions to support the market economy.

Subsidies:

According to *Dell'Anno, 2007*, they are current unrequited payments by the government to enterprises on the basis of their level of production or the quantities or values of the goods or services which they produce, sell or import, (SNA 1993).

It includes **grants, and other social benefits include all unrequited, non-repayable transfers on current account to private and public enterprises; grants to foreign governments, international organizations, and other government units; and social security, social assistance benefits, and employer social benefits in cash and in kind.**

Moreover, these subsidies are considered as distortions to competition and, encourage the firms to go underground; by altering the net tax burden of enterprises; because they are based on the subsidy allocation, rather than market efficiency targets.

Social benefits paid by government:

It includes all current transfers received by households to meet their necessary needs because of such events or circumstances. These social benefits also affect the underground economy by raising the costs of being informal; where workers in the underground economy have no access to unemployment allowances, financial help, etc.

Labor Force Characteristics (or unemployment rate):

There is a positive relationship between the unemployment rate and the underground economy; where the economic agents who enter to this economy seek to raise their revenues to meet their own needs.

The labor force of the underground economy consists of three parts. The first includes unemployed individuals; who are components of the official labor force; and the second part of “hidden” workers is composed by retired people, illegal immigrants, minors or

¹⁶ For further look, see McKinsey Global Institute article, titled: “*Infrastructure productivity: How to save \$1 trillion a year*”, by, Richard Dobbs, James Manyika and Charles Roxborgh, January, 2013.

housewives who are not part of the official work force. Finally, people who an official and unofficial job (*multiple jobs*).

-Besides this, some authors used the share of public sector employees, working hours.

Institutional variables and indices:

In these recent decades, many authors included institutional variables in their analysis, because of the effects of these variables on the rising size of the underground economy, among which:

-Index of efficacy of judicial system: is based on statistical crimes in order to consider the efficacy of the judicial system; where it is assumed that an inefficient judicial system reduces the benefit of being official (access to the legal system), hence, go underground.

- Index of Illegality: is the index of growth rate of the recorded crimes; which is considered as a proxy of the illegality in the society; also; it measures the efficacy of police force.

-Business freedom: is subcomponent of the Economic Freedom Index; when we measure time and effort of business activity. It's ranging from 0 to 100, 0 = least economic freedom, 100 = maximum economic freedom (Heritage Foundation).

-Fiscal freedom: is also a subcomponent of the Economic Freedom Index; when we measure the fiscal burden in an economy (i.e., top tax rates on individual and corporate income). It's ranging from 0 to 100; 0 = least fiscal freedom, 100 = maximum degree of fiscal freedom (Heritage Foundation).

-In addition to other variables, such as: labor market restrictions, strength of the enforcement system, labor rigidities (minimum wages), degree of economic regulations, index of the quality of regulation, openness, corruption index and proxy of human capital (literacy rate).

Tax morale:

The efficiency of public institutions has another effect on the underground economy, the so-called: "tax morale". Individuals; when paying taxes; expect to get valuable public services in return; which promote them to pay more taxes. But, if they receive nothing in return, they feel that they owe nothing to the state. Moreover, it is found that there is a negative link between tax morale and tax evasion.

Moreover, other explanatory variables are used, such as: inflation rate, interest rate, banking services, net investments share in GDP, self-employed incomes and dummy variables.

Indicators:

The variables that are used as indicators of the latent variable are: the real (official) gross domestic product index and the labor force participation rate, to measure the development of the SE, and currency in circulation outside of banks.

Real Gross Domestic Product (variable of scale):

This variable is usually chosen as a reference or scale variable under the identification condition (or *normalization procedure*).

In order to estimate not only the relative size of the structural coefficients, is necessary to fix a scale for the unobserved variable. We fix the coefficient y_1 equal to a nonzero value. The choice of this value can be restricted between two alternatives (+1 or -1), thus, by using a unitary base for normalization, the estimated coefficients are more easily comparable.

In the MIMIC model the vector of structural coefficients is proportional to the coefficient of scale, when the sign of y_1 is changed, the structural parameters y_q of the causes change from positive to negative.

Currency in circulation outside of banks:

The monetary approach to estimate the size of underground activities is based on the assumption that, the irregular transactions, only are paid in cash in order to leave no trace, and thus, circumvent the auditing controls. The underground economy is estimated by comparing the actual demand for cash with the demand that could be expected if there were no shadow economy. In the recent papers, they use the growth rate of currency outside of banks or the ratio between currency and some broader measure of monetary aggregate (M1 or M2).

Labor force participation rate:

The labor force participation rate is calculated as the ratio of the total labor force and the population of working age (15-64 years old). In some papers, they estimate the size of the underground economy from changes in the labor force participation rate, where a decline in this rate over time or a low rate reflect a movement of the workforce from the official economy into the underground economy.

In addition to these main indicator variables, there are other used variables, such as: growth rate of GDP per capita, ration of expenditures on goods and services to real income, crime rates, the excess of electricity- consumption to real GDP.

1.14. Basing on the definition of the underground economy mentioned in the first chapter, we can conclude the following assumptions that will be empirically tested using the MIMIC model, in order to estimate the underground economy in Algeria:

- An increase in direct and indirect taxation increases the underground economy.
- An increase in social security contributions increases the underground economy.
- The more the country is regulated, the greater the incentives to work in the underground economy.
- The lower the quality of state institutions, the higher the incentives to work in the underground economy.
- The lower tax morale, the higher the incentives to work in the underground economy.
- The higher unemployment, the more people engage in underground economy activities.
- The lower GDP per capita in a country, the higher is the incentive to work in the underground economy.
- The size of the underground economy is lower in a federal system than in non-federal ones, *ceteris paribus*.

2.5. Conclusion:

1.15. As it is mentioned above, it is a difficult task to measure the size of the underground economy using any estimation method, where there is no agreement on an accepted method to realize the purpose of measuring its size.

Moreover, we have seen that each estimation method has advantages and disadvantages that limit its use, where the modeling approach (the MIMIC model) is considered as the appropriate method for measuring the size of the underground economy, even the criticisms that we have cited above. Consequently, many authors have used the MIMIC model; which refers to the variety of the used causal and indicator variables, and thus, the estimation results according to the characteristics and specifications of the countries; where it is found that the tax burden, government regulations and unemployment are the main causes of the development of the underground activities.

Furthermore, we should not rely only on the results of the modeling approach; which is regarded as a complementary of other methods; but we should use other estimation methods in order to compare the results and elaborate efficient policies.

1.16. In suggesting the determinants and the assumptions to estimate the underground economy, we will estimate the underground economy in Algeria using two estimation methods: the MIMIC model and the currency-demand approach. However, we should be very caution when applying those two methods.

Table of contents:

- 3.1. Introduction
- 3.2. A brief literature review on the Algerian NOE
 - 3.2.1. Interpretation of this phenomenon
 - 3.2.2. Empirical evidences on the Algerian NOE
- 3.3. Estimating the size of the Algerian NOE
 - 3.3.1. Estimating the UE using the MIMIC model
 - 3.3.2. Estimating the UE using the Currency-Demand approach
- 3.4. Conclusion

3.1. Introduction

1.1. The underground economy is a social and economic phenomenon that one cannot ignore; especially with its effects on the official economy. Consequently, policy makers and academicians have made concerted efforts to estimate its size, and to determine its main causes.

However, there is a consensus among the policy makers that a better macroeconomic policy elaboration and its true implementation are subject to the proper management of the associated issues of underground economy with suitable policy measures. (*Ahmed Gulzar, Novaira Junaid, 2010*)

1.2. In this section we will attempt to measure the size of the underground economy in Algeria, and analyze its main causes and its effects on economic outcomes. First of all, we will present a brief literature on the Algerian underground economy. After that, we will present an overview of some empirical evidences that have attempted to estimate its size, concluding that there are some shortages concerning the estimation of the UE using the modeling approach. To do so, we collected the data; to determine the development and the size of the Algerian underground economy; over an extended period of time between 1990 and 2009, through examining its main causes and its indicators, by using the MIMIC model and the Currency-demand approach, in order to compare the results of these two approaches.

3.2. A brief literature review on the underground economy in Algeria

1.3. There are many phenomena that are shown in Algeria, among which we notice a significant scope of unrecorded economic activities. Its rising size has been discussed because of the causes, effects and problems that these activities have generated, such as unemployment and financing problems of public expenditures.

In a nutshell, the informal economy in Algeria passed by many periods; in which every period has its specific characteristics.

First, till the 1987, the Algerian economy was state-led economy (**providence state**) where the state was fixed almost everything; such as: the prices, interest rates, exchange rate and even wages. Moreover, the Algerian economy was characterized by a quasi-monopoly of the economic activities by the state, lack in supply in the public market that is filled by goods and services from the underground activities on low prices.

During the 1960s to early 1970s, tax policy in the country was aimed at maximizing revenues to finance public sector programs in order to meet the accelerated economic growth and development programs of the government. The excessive interference from the state in the economy and the overvalued currency in the official foreign exchange market (which give rise to speculation on public exchange rate where people used the differences between the public and parallel exchange rate to make profits) led to favorable conditions for the rapid growth of rent seeking activities and the institutionalization of the underground economy.

Secondly, beginning from mid-1986, the world oil market began to collapse due to the oil's over-abundance and the fall of oil prices, and thus, the Algerian economy has witnessed terrible economic crisis during the 1980s, which caused a widespread increase in the underground activities by individuals in order to survive and meet their own needs.

Moreover, in response to the economic crisis at the time, the government changed from a state-led to market economy. Consequently, the state has changed its role and its nature (**nation or regulatory state**) and could not provide employment opportunities and social services as it did during the oil boom era. This situation, combined with the effects of some public policies led to high unemployment in the economy.

In particular, the adoption of the Structural Adjusted Program (SAP) in 1994, affected the performance of most sectors of the economy, thus forcing most sectors like the industrial sector to downsize. On the other hand, there are no solid institutions to enforce the private sector (the privatization program) coupled with the rationalization of the workforce by various levels of government, to absorb those unemployed people. Besides this, the massive participation of graduates from the tertiary institutions, without corresponding expansion in jobs, has left many of these graduates unemployed.

As a result, most individuals work in the underground economy in order to meet their own needs; because of the unemployment crisis in the official economy; they didn't find a job, or because their revenues didn't satisfy their needs, so they choose this alternative lifestyle. Also, firms or micro-enterprises work illegally in order to reduce the cost of being formal.

In response to the lack of employment opportunities within the formal sector, the underground economy absorbs the "excess labor force". Individuals in this sector mainly engage in activities that are generally small-scale, relying on indigenous resources and skills acquired through informal means and operate outside the administrated market.

Employment opportunities in this sector ranges from street vending, petty trading, food vending, artisan and craft workers, transport, personal services, security services, import-export activities and crime to small-scale businesses.

Furthermore, in these last decades, the underground activities are grown because of the corrupted and inefficient public authorities, coupled with tax burden and excessive government regulations that make economic agent choose not to comply for many reasons both economic and social, and thus lead to more tax evasion and circumvention of public rules.

To sum up, given the fact that a great proportion of economic activities in Algeria are underground, this cannot be just interpreted as the result of the weakness of the state. This gives rise to the following issue: why the state does not impose the missing link with the underground economy and try to integrate it, either the internal organization of economic activities (e.g. regulations of labor), the visibility of these hidden activities (e.g. registration in the public authorities) or the contribution to social expenditures (e.g. paying taxes and social security contributions).

There are two possible interpretations of this confusing situation. **For the first**, the insufficient capacity of the state monitoring in terms of number and quality of their administration officials, because it is a costly procedure, in addition to the non existence of

stable rules of law. Moreover, it is found that the lack of weak control of the state authorities is the effect of the existence of the UE rather than its cause. (Lautier, 2004)

The state tolerance of illegality is the result of its incapacity to take more active role in creating jobs and social service. Thus, the state did not allow the existence of hidden activities only, but it allows also for the existence of parallel police as well as parallel justice.

On the other hand, this incapacity to control hides more evidences, **whether** its incapacity to pay the administration officials, and thus the obligation to tolerate the activities that operate for their own profits, **or** its incapacity to impose the deductions for tax on certain activities.

Secondly, it is because of the burden of the government regulations (tax burden and social security contributions), especially in developing countries, such as Algeria; that did not engage in capitalism correctly, where the established institutions prevent initiatives to be legal and run legal firms. Some regulations are not elaborate for the informal agents, and thus; according to them; any attempt to repress them is illegitimate. According to *De Soto (1989)* (63), the rigidity and burden of those regulations lead to a revolution and chaos in order to engage in the other path, the so-called: the luminous path.

Thus, law is necessary for the functioning of the economy, but what is needed is another kind of law. Under the name deregulation, the law needs to be minimized; which means simplify the government regulations, the reduction if the tax rates and especially extract and dissociate corruption from the law; to promote informal agents to be formal.

3.2.1. The interpretation of this phenomenon

There are many interpretation of the underground economy, in which every author has interpreted this phenomenon using his point of view. Generally, there are four interpretation of this phenomenon in Algeria (*Bellache, 2010*), (74) as follows:

- 1.4. **The first** deals with the phenomenon as "petty commodity production" (PPM) which focuses on the development of small-scale activities and different forms of employment (caregivers, apprentices, work at home and multiple activities).
- 1.5. **The second** focuses on the "parallel economy" in the period of state-led economy, where is includes parallel activities resulting from the inefficiency of the public regulations, such as: production in black market, distribution and import-export, foreign exchange. (Henni, 1991) (75)

1.6. **The third** extended the underground economy to include illegal activities particularly in the period of the transition to market economy, where the legalist approach is introduced to understand the behaviors of illegal economic agents who seek to maximize their profit by the circumvention of the government regulations. (Bounoua, 1999, 2002b) (76)

1.7. **The latter** presents the approach of the OECD, 2003, in terms of the Non Observed Economy (NOE), which is the adopted interpretation in this research. Where the NOE includes four elements: illegal, underground, informal and household sectors, as it is demonstrated in details in the first chapter.

3.2.2. Empirical evidences on the non observed Algerian economy

1.8. We can classify the different researches on the informal economy in Algeria by adopting a classical approach, which consists of arranging them according to the direct and indirect approaches. We have observed that the majority of these researches have privileged questioning and surveys methods, and they have marginalized the quantitative approaches, such as MIMIC model.

And they can be divided in many categories according to: their objectives (production, labor, consumption, etc), the used methods (questioning and surveys on households and private sector, women and gender and modeling approach) and synthesis³².

1.9. According to their objectives:

Among the various researches on the Algerian NOE, there are some surveys on the production, on finance (Adair P., 2002b) (77), on labor or workforce (KEKOUL. M. 1989, Musette M S., Hamouda, 2002 (78) and ISLI M A., 2003, Bellache Y et Adair P., 2012) (79) and on consumption and the multi-criterion approaches (e.g. social security, size of business, the establishment status, form of recording (trade register or communal authority), the mode of taxation (tax payment) and legal sector), etc.

1.10. The used methods:

Questioning and surveys method:

Besides, there are others whom used several estimation methods, such as: the questioning and surveys on households and businesses (**by business**, as micro-enterprise survey covering three

³² For all the papers on the underground economy in Algeria that are not mentioned in the bibliography because of the lack of access, are cited in Adair P., 2002b.

branches: mechanical, textile and restoration from 1990 to 1992, **by sex and by sector**, and private sector (Adair P et Bellache Y., 2008b (80), Bellache, 2010, ONS, 2007, 2008 and 2009, Bouzidi M., 1985, Hamed Y., 2002, Ecotechnics., 1998, Kelkoul M., 1998 (the applied criteria are: administrative recording, fiscal recording, mode of taxation, the place of exercising activity, statement to the social security), Musette M S et Hamouda N E., 2002), surveys on household sector (Attar Abd Elhafid, 2010 (81), FATMA BOUFENIK, 2010 (82), on women (Lakjaa. A, 1996, Musette-Belhouari D., 2006), and gender approach (FATMA BOUFENIK, 2010).

Researches based on the indirect approaches:

Moreover, there are another kinds of researches that are based on quantitative methods, such as: logistic model (Philippe ADAIR et al, 2012), national accounts (Zidouni H., 2002, 2003), and MIMIC model (Bounoua and Bouanani, 2013).

1.11. Synthesis:

Finally, the researches based on synthesis about the NOE, whether definition or characteristics, etc. (Prenant A., 2002, Adair P., 1985, Bounoua C., 1992, 1995, 1998, 1999, 2002a, b, Adair P et Bounoua C., 2003, Benissad H., 1984, 1993a, Boufnik F et Elaidi A., 2002, Henni, 1988, 1989, 1990, 1991, Cherif Aissat, 2012, Prenant A.2002, (83)).

1.12. Because of the lack of data and the costs spent in elaborating such questioning and surveys techniques and the heterogeneity of the activities of this sector, all these researches have argued that it is very difficult to estimate the size of the underground economy, this is why we need more researches in this field.

Besides, the UE estimates are never very stable and absolute, and there is always space for questions, discussion and critiques, (Dell'Anno and Schneider, 2003):

They stated that: *“All the specialists in this field of estimating the shadow economy know quite well, estimating SE is an exercise that does not allow applying well-defined methods and common accepted assumptions. That said it is quite understandable why there are so much replications, and criticisms of the various econometric methods to estimate SE”*.

This is why we will estimate the underground's economy in Algeria using the modeling approach and the currency demand approach, in order to test the reliability of using this approach. Thus, the next section will be devoted to this purpose.

3.3. Estimating the size of the Algerian Underground economy

3.3.1. Estimating the UE using the MIMIC model

Description of variables

1.13. Algeria is like other countries that suffered from the rising scope of hidden activities and their effects on economic outcomes.

In this section we will attempt to measure the size of the Algerian underground economy using the currency- demand approach and the MIMIC model over the period 1990-2009.

Moreover, we employ the currency-demand approach in order to use its results in the benchmarking method that is used to convert the index on the NOE obtained by the MIMIC model into a time series of the UE/ current GDP per capita, which will be discussed later.

To do so; and basing on the previous studies both in Algeria and other countries, we can suggest a set of variables that contribute to the rising UE in Algeria and those who reflect the change in it. We have eight explanatory variables, and two indicators.

For the explanatory variables, we have³³:

- Unemployment rate (percentage),
- Tax burden (direct and indirect taxes, current LCU),
- Social security contributions (current LCU),
- Inflation, consumer prices (annual %),
- General government final consumption expenditure (as % of GDP),
- Crude Oil Prices (US. Dollar per barrel).
- Minimum wage (current LCU).

And for the indicators, we have:

- Gross domestic product per capita (GDP per capita, current US. dollar),
- Money and quasi money (current LCU).

1.14. Indicators

Money and quasi money (M2) (current LCU):

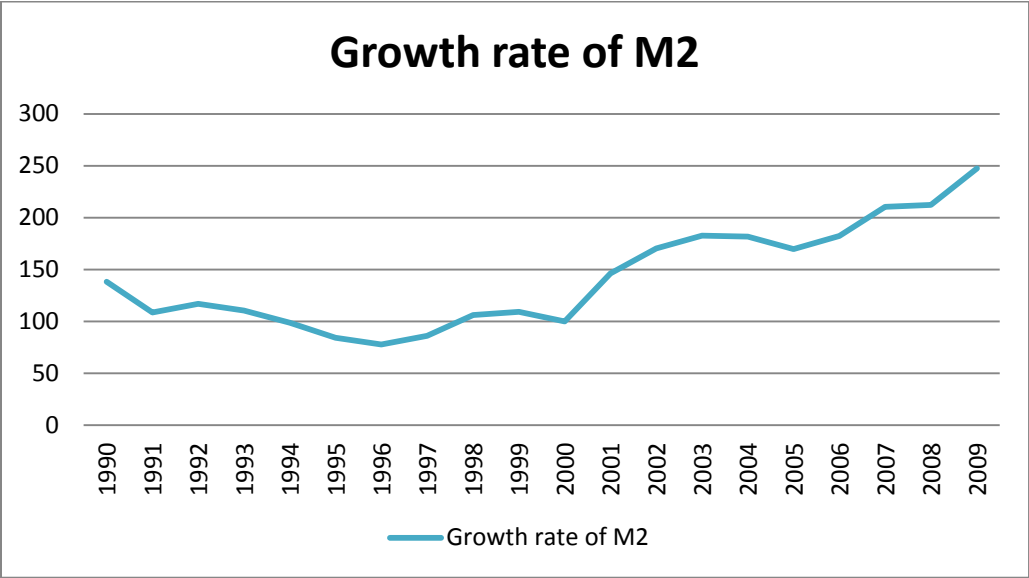
The monetary approach to estimate the size of shadow economic activities is based on the assumption that, the irregular transactions, only are paid in cash in order to circumvent the auditing controls. The shadow economy is estimated by comparing the actual demand for cash with the demand that could be expected if there were no shadow economy.

In the estimated models is not used this ratio as indicator of shadow economy but easily *the growth rate of currency outside of banks.*

³³The description of these variables is obtained from the website of the IMF, expect for the Crude oil prices and minimum wage.

Money and quasi money comprise the sum of *currency outside banks*, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government. This definition of money supply is frequently called M2.

Figure8: the growth rate of money and quasi money

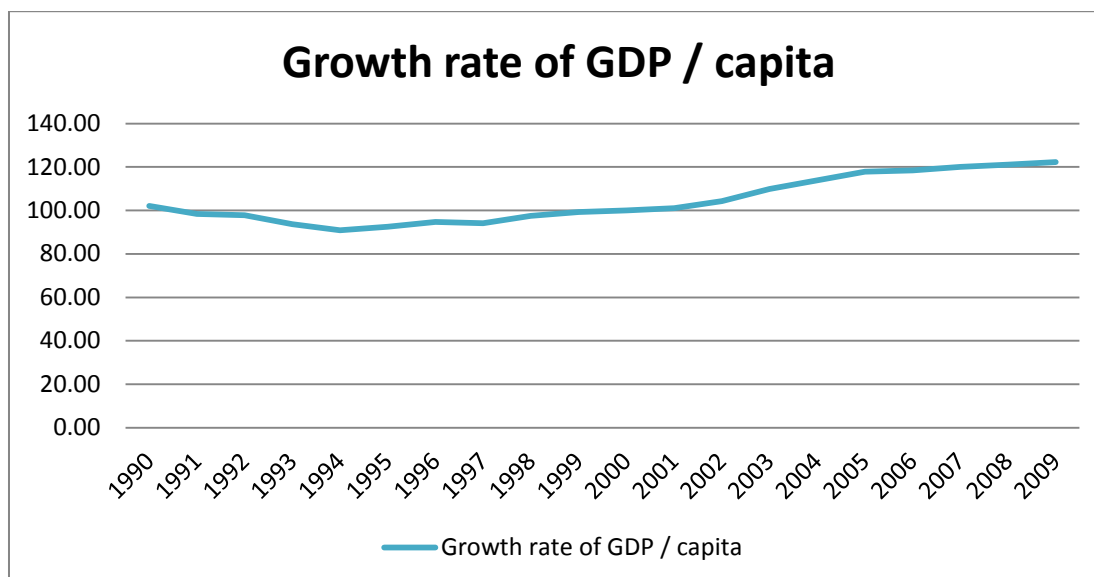


Source: author’s construction based on constant, USD 2000.

GDP per capita (Growth rate):

GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

Figure9: the growth rate of the GDP per capita



Source: author's construction based on constant, USD 2000.

1.15. Causes

Tax burden (share of direct and indirect taxation, and social security contributions, constant USD 2000):

Tax revenues:

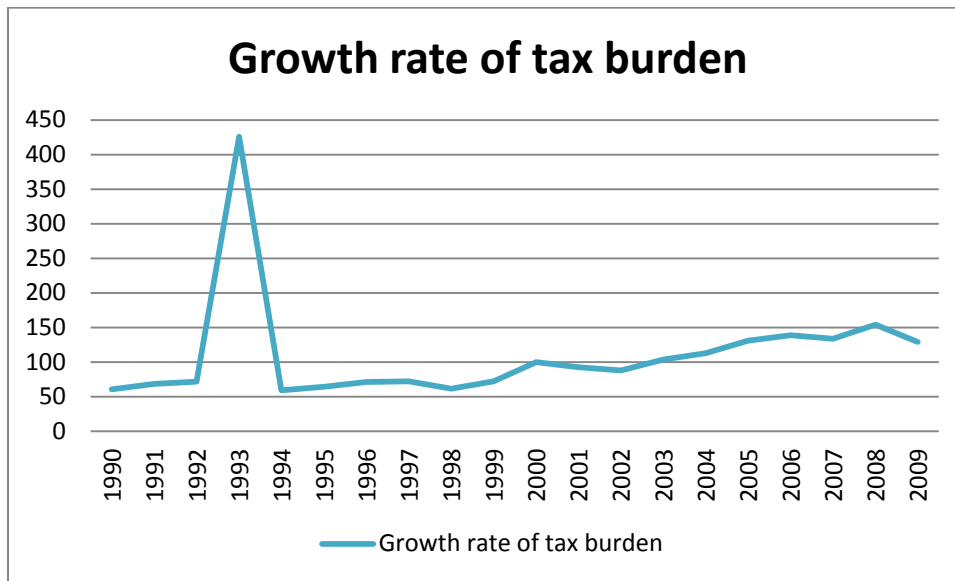
In literature the most popular determinant of tax evasion is tax rates. The common hypothesis is that an increase of tax burden (here we will use direct and indirect taxes) is a strong incentive to work in the unofficial market.

Tax revenue refers to compulsory transfers to the central government for public purposes. Certain compulsory transfers such as fines, penalties, and most social security contributions are excluded. Refunds and corrections of erroneously collected tax revenue are treated as negative revenue.

Social security contributions:

The same assumption of the tax burden is applied on the rising social security contributions burden, for instance, the majority of the firms didn't want to secure their employees because these contributions are considered as costs to work formally. So in order to become more competitive, these firms avoid the payment of social contributions.

Social contributions include social security contributions by employees, employers, and self-employed individuals, and other contributions whose source cannot be determined. They also include actual or imputed contributions to social insurance schemes operated by governments.

Figure10: the growth rate of tax burden

Source: author's construction based on constant, USD 2000.

Unemployment rate (% of total labor force):

It is found that the rising unemployment rate is a crucial factor of the rising size of the hidden activities. Moreover, unemployment and the hours worked per employee in the official economy affect the shadow economy, because the reduction in working hours in the official economy increases hours working in the shadow economy, in order to survive and meet their essential needs.

According to the OECD, unemployment rate gives the number of unemployed persons as a percentage of the labor force (the total number of people employed plus unemployed). (OECD Main Economic Indicators, OECD, monthly)

As defined by the International Labor Organization³⁴, unemployed workers are those who are currently not working but are willing and able to work for pay, currently available to work, and have actively searched for work.

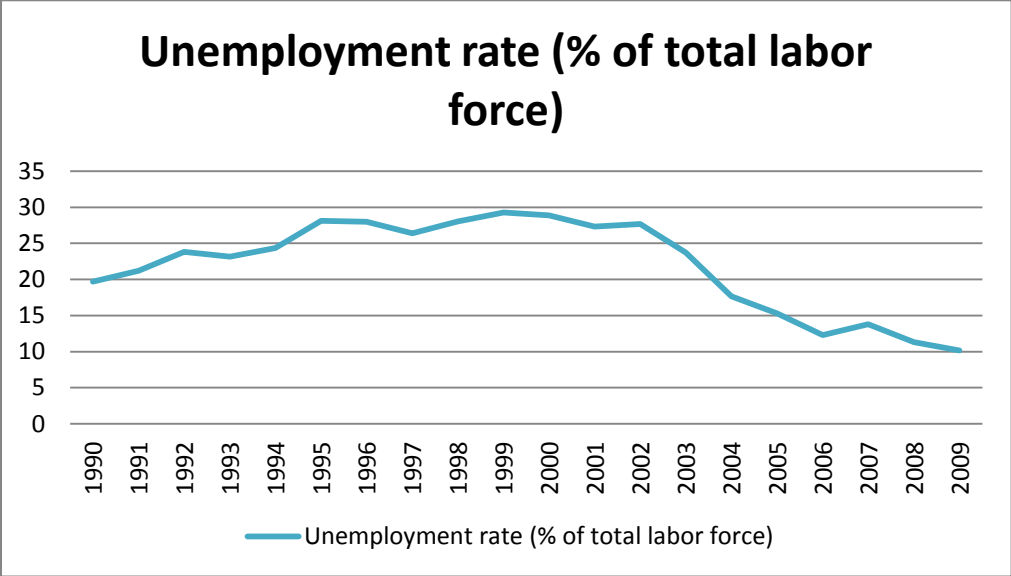
Econometrically, the unemployment variable has positive or negative relationship with underground economy; which depends on income and substitution effect.

Income losses resulting from unemployment decrease the demand in both official and unofficial economy, where unemployed individuals substitute the legal goods for illegal ones

³⁴ For further reading, check the ILO website: <http://www.ilo.org/public/english/bureau/stat/res/index.htm>.

(substitution effect) to compensate their utility losses. Consequently, the relationship is negative if the income effect exceeds the substitution effect, and it is positive if the substitution effect exceeds the income effect.

Figure11: unemployment rate as percentage of total labor force



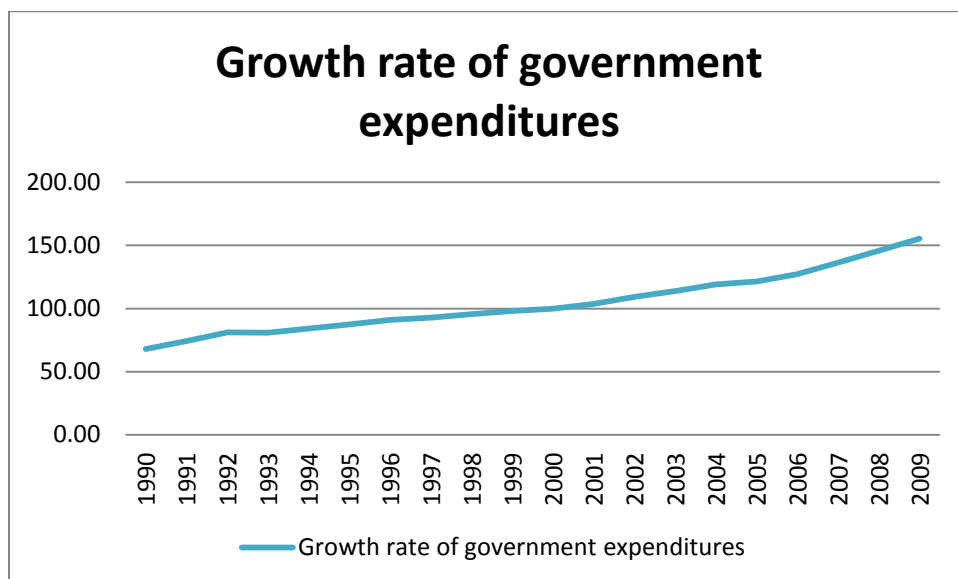
Source: author’s construction.

General government final consumption expenditure (constant, USD 2000):

The assumption behind the choice of the general government final consumption is that the much the intervention of state and the state regulation the much the individuals work illegal. In econometrics, *the real government consumption is used as a proxy of all state activities*, (Frey and Weck-Hanneman, 1984, and Giles, Tedds, 2002).

General government final consumption expenditure (formerly general government consumption) includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditure on national defense and security, but excludes government military expenditures that are part of government capital formation.

Figure12: the growth rate of government expenditures



Source: author's construction based on constant, USD 2000.

Crude oil prices (U.S. dollar per barrel):

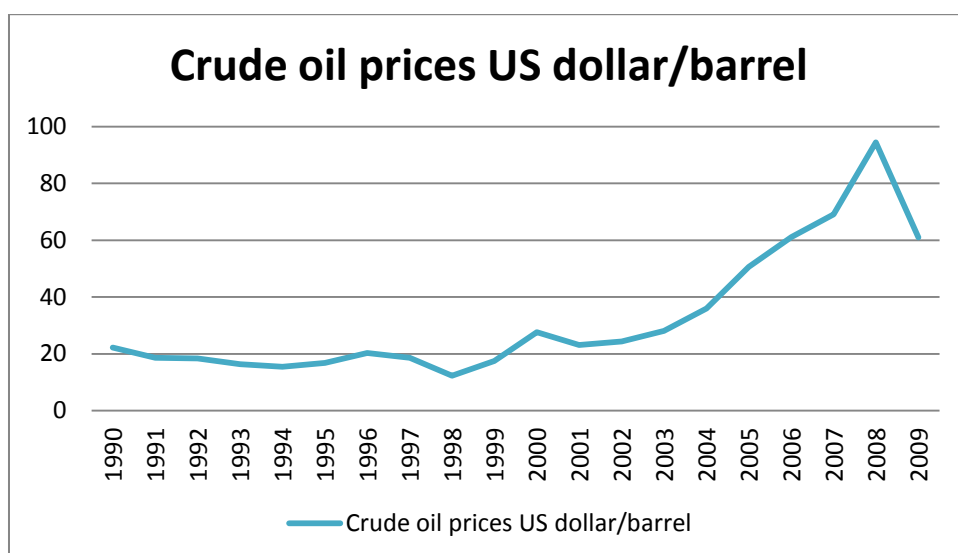
Crude oil is a mixture of hydrocarbons that exists in liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after, through surface separating facilities. Depending upon the characteristics of the crude stream, it may also include³⁵:

- Small amounts of hydrocarbons that exist in gaseous phase in natural underground reservoirs but are liquid at atmospheric pressure after being recovered from oil well (casing head) gas in lease separators and are subsequently commingled with the crude stream without being separately measured. Lease condensate recovered as a liquid from natural gas wells in lease or field separation facilities and later mixed into the crude stream is also included;
- Small amounts of non-hydrocarbons produced with the oil, such as sulfur and various metals;
- Drip gases, and liquid hydrocarbons produced from tar sands, oil sands, gilsonite, and oil shale.

Liquid produced at natural gas processing plants are excluded. Crude oil is refined to produce a wide range of petroleum products, including *heating oils, gasoline, diesel and jet fuels, lubricants, asphalt, ethane, propane, butane* and many other products used for their energy or chemical content.

Figure13: crude oil prices (US dollar / barrel)

³⁵ This definition is obtained from the U.S. Information Administration, on the website: http://www.eia.gov/dnav/pet/pet_pri_spt_s1_a.htm.



Source: author's construction.

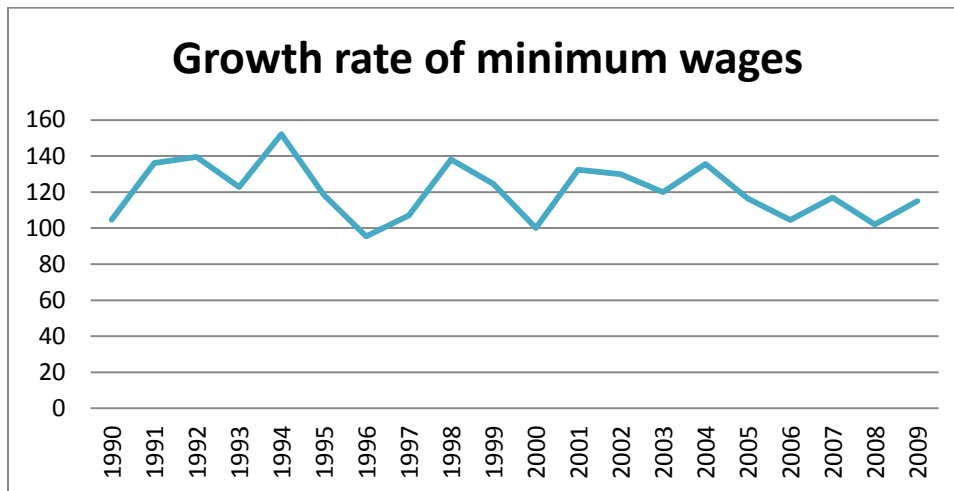
Minimum wages (constant, USD 2000):

The national guaranteed minimum wage ³⁶ applicable in sectors is fixed by decree, after consultation with the trade unions of workers and the most representative employers. To determine the guaranteed minimum wage is taken into account changes in:

- The average national productivity recorded;
- The index of consumer prices;
- General economic conjunction.

The national guaranteed minimum wage comprises basic salary, allowances and premiums, with the exception of compensation paid as repayment of expenses incurred by the worker.

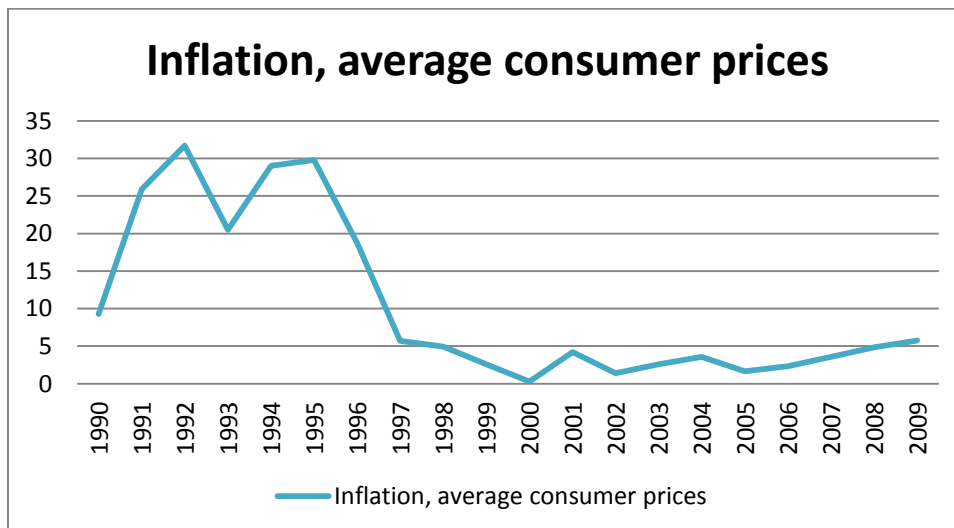
³⁶ This definition is obtained from the Algerian Labor Code 2001- 2002.

Figure14: the growth rate of minimum wages

Source: author's construction based on constant , USD 2000.

Inflation rate, consumer prices (annual %):

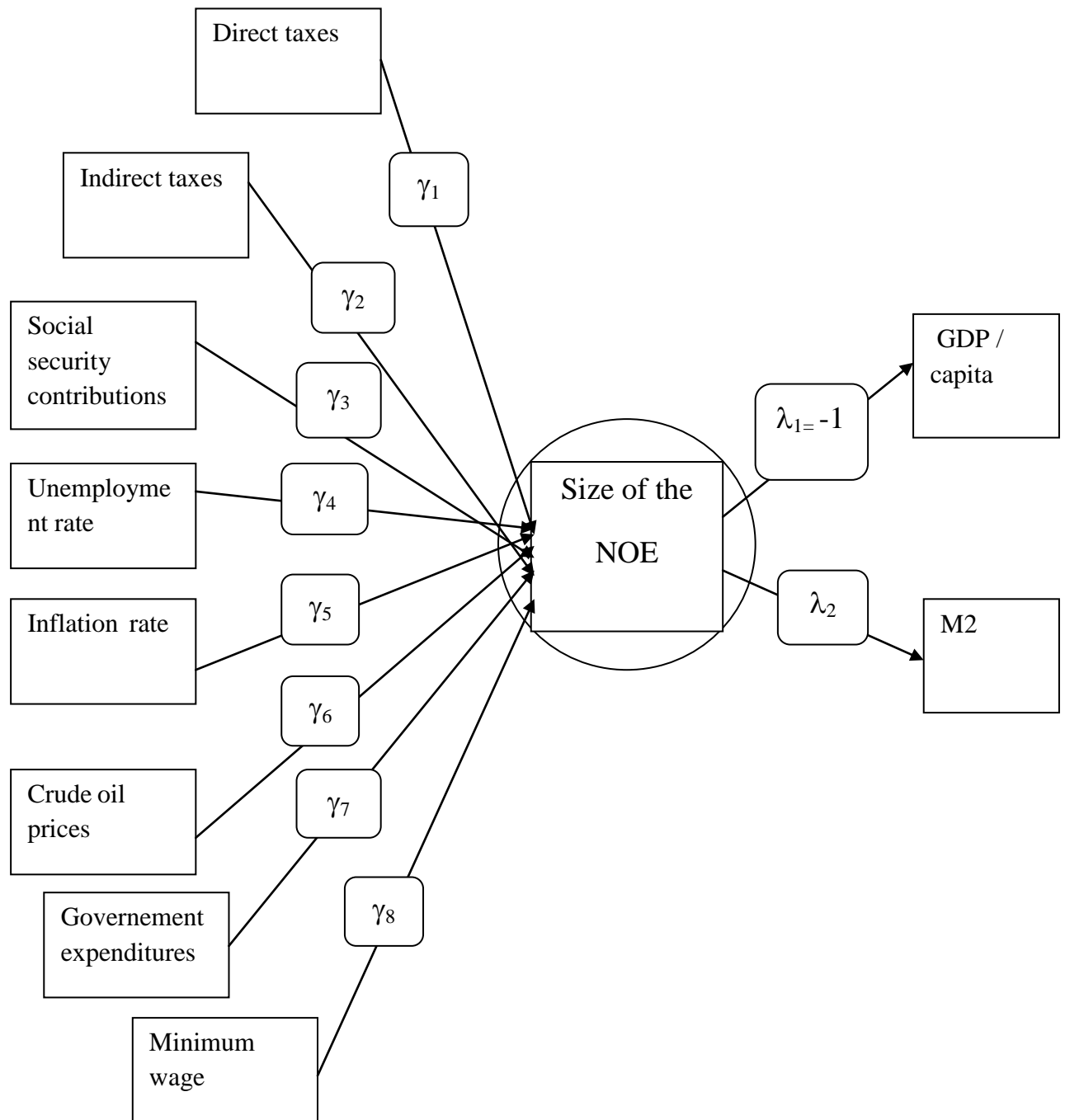
Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used.

Figure15: inflation rate, average consumer prices

Source: author's construction.

Moreover, I include the growth rates of the used variables , in order to compare them with the growth rate of the underground economy that is estimated by the MIMIC model and thus interpret them. The figure 16 illustrates the structure of our MIMIC model, as follows:

Figure16: the structure of a MIMIC 8-1-2 model of the Algerian UE



Source: author's construction.

- 1.16. As it is agreed in econometrics, the time series should be homogeneous, which means that all the variables should have: the same unit whether local or foreign currencies (here we will use US dollar), should be at current or at constant prices and have the same base year (here the base year is 2000). Especially, the series should be used whether as growth rates according to a base year (here, 2000), as percentages of Real GDP or in their quantities.

In this research, the majority of the variables are current LCU. Thus, we need to convert them to constant US dollar to obtain homogeneous time series that lead to reliable estimation results.³⁷

1.17. The resource of the database of all the variables is obtained from the World Bank Indicators, the IMF's world economic outlook database and the ANSO (Algerian Notational Statistical Office).

We will test the results of regressions whether are in conformity with the estimation assumptions, or not:

- An increase in direct and indirect taxation increases the underground economy. Also, the lower tax morale, the higher the incentives to work in the underground economy.
- An increase in social security contributions increases the underground economy.
- The more the country is regulated, the greater the incentives to work in the underground economy (where we used the government national consumption expenditure as proxy of the government excessive regulations and the crude oil prices). Also, the lower the quality of state institutions, the higher the incentives to work in the underground economy.
- The higher unemployment, the more people engage in underground economy activities, in order to survive and meet their own needs.
- The lower GDP per capita in a country, the higher is the incentive to work in the underground economy (GDP per capita, minimum wage).
- The size of the underground economy is lower in a federal system than in non-federal ones.
- The more the inflation rate, the more the tax and social security contributions burdened the economic agents.

The choice of the measurement method

1.18. The MIMIC model is a special case of simultaneous equations models. In the simultaneous equation models, the specification requires writing multiple equations interconnected through several variables included in equations.

This means that, we cannot use OLS (equation by equation) because the equations are dependent on each other; and thus; some variables have dual status: are endogenous in one equation and exogenous in another one; which lead to a bias in the estimation of coefficients

³⁷ See the appendix 04 about the transformation's averages.

when using OLS. In this case, there are several methods specific for the estimation in simultaneous equation models.

1.19. The identification conditions are determined equation by equation, where three cases are distinguished:

- The under-identified model: if the equation is under-identifiable, thus, this model is impossible to solve and must be specified;
- The just-identified model: if the equations are just-identifiable;
- Over-identified model: if the equations are whether just-identifiable or over-identifiable.

1.20. The choice of the estimation methods is based on the identification criterion in a system of simultaneous equations. To understand the order condition of identification, we introduce the following notations: (*Régis Boubonnais, 2011*) (84)

g : the number of the model's endogenous variables (or the number of the model's equations),

g' : the number of the endogenous variables in a given equation;

k : the number of the model's exogenous variables;

k' : the number of the exogenous variables in a given equation.

Hence each equation is identified by the order condition. Therefore, the model as a whole is identified.

If the order condition of identification is³⁸:

$g - 1 > g - g' + k - k' \longrightarrow$ The equation is under-identified, the estimation is impossible;

$g - 1 = g - g' + k - k' \longrightarrow$ The equation is just-identified, we can use whether the indirect least squares (ILS) or the two stage least squares (2SLS);

$g - 1 < g - g' + k - k' \longrightarrow$ The equation is over-identified, we can use the two stage least squares (2SLS).

Turning now to our model, aiming to choose the reliable estimation method, we will calculate the previous formula:

with: $g=2$, $g'=1$, $k=8$, $k'=8$, we find that: $(2 - 1) = (2 - 1 + 8 - 8) \Leftrightarrow 1 = 2$.

Therefore the model is *just-identified* and we will use 2SLS; which is considered as estimator of the method of instrumental variables and the generalized method of moments.

³⁸ These conditions are called: « order condition of identification ».

The two-stage least squares

We should state that when estimating the structural equations model, there are two approaches that are adopted namely, single-equation methods, also known as **limited information methods**, and system methods, also known as **full information methods**.

Although, the OLS method is inappropriate for the estimation of an equation in a system, there is one situation where OLS can be applied appropriately even in the context of simultaneous equations. This is the case of the **recursive** (i.e. OLS can be applied to each equation separately), **triangular** (i.e. when forming the matrix of the coefficients of the endogenous variables of the system, we obtain a triangular matrix³⁹), or **causal** (i.e. each equation exhibits a unilateral causal dependence, which means that y_1 influence y_2 , without, in turn, being influenced by y_2) models. (*Damodar N. Gujarati, 2004*) (85)

Furthermore, recursive models have proved to be useful, most simultaneous equation models do not exhibit such a unilateral cause-and-effect relationship.

Though there are many alternative estimation methods when estimating the simultaneous equations systems, the widely used alternative to OLS is the Two Stage Least Squares (2SLS).

Two- stage least squares (2SLS) is a used method for creating instrumental variables to replace the endogenous variables where they appear as explanatory variables in simultaneous system equations. 2SLS does this by running a regression on the reduced form of the right-side endogenous variables in need of replacement and using the estimated or fitted values from those reduced-form regressions as the instrumental variables. We do so, by forming a linear combination by running a regression for a given endogenous variable as a function of all the exogenous variables- the predicted value of the endogenous variable is the instrument we want. Thus, the 2SLS two-step procedure is *H. Strudenmund, (2005)* (86):

Stage one: Run the OLS on the reduced- form equations for each of the endogenous variables that appear as explanatory variables in the structural equations in the system.

Hence, we obtain the \hat{y}_s ; which are used as instruments in the structural equations.

³⁹ The triangular matrix is shown as follows :

$$\begin{array}{l} \text{Equation 1} \\ \text{Equation 2} \\ \text{Equation 3} \end{array} \begin{bmatrix} & Y_1 & Y_2 & Y_3 \\ 1 & 0 & 0 & \\ \beta_{21} & 1 & 0 & \\ \beta_{31} & \beta_{32} & 1 & \end{bmatrix}$$

Note that the entries above the main diagonal are zeros .

Stage two : Substitute the reduced-form \hat{y}_s for the y_s that appear on the right side (only) of the structural equations, and then estimate these revised structural equations with OLS.

Besides, each reduced- form equation has as explanatory variables every predetermined variable (i.e. exogenous plus lagged endogenous) in the entire system of equations.

The properties of Two-Stage Least Squares:

- 2SLS estimates are still biased in small samples.
- The bias in 2SLS for small samples typically is of the opposite sign of the bias in OLS. Recall that the bias in OLS typically was positive, indicating that a $\hat{\beta}$ produced by OLS for a simultaneous system is likely to be greater than the true β . for 2SLS, the expected bias is negative, and thus a $\hat{\beta}$ produced by 2SLS is likely to be less than the true β . for large sample, there is little bias in 2SLS.

To sum, 2SLS will almost be a better estimator for the coefficients of a simultaneous system than OLS will be.

Estimation and interpretation of the estimation results

After transforming all the data to become constant US dollar, we will proceed as follows:

First of all, we will stationarize the time series; then estimating the size of the NOE using the currency-demand approach and the MIMIC model.

1.21. **Unit root tests :**

Before applying any method of estimation, we need to render the variables stationary in order to avoid any spurious regression.

To do so, we will employ the Augment Dickey-Fuller test, to test for unit roots in each of the series considered in order to get more precise results. Where this test is for testing a null hypothesis of a unit root (i.e. a series is non-stationary) against the alternative hypothesis of a stationary series.

The following table summarizes the main results based on the estimations made by EViews 6 software, where the values differ according to the maximum lags; which equal to four according to the AIC criterion:

Table2: Unit root test results (sample period: 1988- 2009)

		ADF Test			
		The level of significance and tests	Model 3 Trend and intercept	Model 2 Intercept	Model 1 None
Variables	Test critical values	5%	-3.673	-3.029	-1.960
GDP per capita (growth rate)	Level	Unit root	-3.309	0.913	1.874
		Trend	4.805	/	/
		Intercept	3.037	-0.742	/
	1st difference	Unit root	-2.601	-2.666	-2.177
		Trend	0.876	/	/
		Intercept	-0.147	1.519	/
M2 (as % of GDP)	Level	Unit root	-1.757	-1.271	-0.047
		Trend	1.831	/	/
		Intercept	1.346	1.283	/
	1st difference	Unit root	-3.993	-3.863	-3.943
		Trend	1.037	/	/
		Intercept	-0.651	0.688	/
Unemployment (% of total labor force)	Level	Unit root	-1.377	0.281	-0.795
		Trend	-3.254	/	/
		Intercept	2.010	-0.490	/
	1st difference	Unit root	-3.581	-2.805	-2.736
		Trend	-1.922	/	/
		Intercept	1.432	-0.789	/
Government expenditures (constant, USD 2000)	Level	Unit root	-1.665	-1.869	0.781
		Trend	1.520	/	/
		Intercept	1.612	1.886	/
	1st difference	Unit root	-2.332	-2.852	-2.792
		Trend	0.938	/	/
		Intercept	-0.494	0.828	/
Crude oil prices	Level	Unit root	-2.221	-0.752	1.378
		Trend	2.181	/	/

	1st difference	Intercept	-0.179	1.053	/
		Unit root	-4.687	-3.992	-3.734
		Trend	2.234	/	/
		Intercept	-1.388	1.323	/
Inflation rate	Level	Unit root	-0.781	-1.652	-2.158
		Trend	0.058	/	/
		Intercept	0.0032	0.270	/
	1st difference	Unit root	-4.307	-4.525	-4.611
		Trend	3.109	/	/
		Intercept	-3.325	-1.228	/
Tax burden (as % of GDP)	Level	Unit root	-4.596	-4.526	-2.329
		Trend	-0.926	/	/
		Intercept	2.792	3.436	/
Minimum wages (constant, USD 2000)	Level	Unit root	-4.036	-3.476	-0.61
		Trend	-1.667	/	/
		Intercept	3.956	3.432	/
	1st difference	Unit root	-5.857	-6.116	-6.257
		Trend	-0.039	/	/
		Intercept	-0.156	-0.493	/
The ratio C/ M2	Level	Unit root	-1.44	-1.776	-1.624
		Trend	-0.939	/	/
		Intercept	1.271	1.506	/
	1st difference	Unit root	-4.178	-3.93	-3.73
		Trend	1.317	/	/
		Intercept	-1.732	-1.194	/
Interest rate	Level	Unit root	-2.97	-1.201	-1.003
		Trend	-2.995	/	/
		Intercept	3.001	0.826	/
	1st difference	Unit root	-2.589	-2.23	-2.609
		Trend	-0.553	/	/
		Intercept	0.291	-0.616	/

The maximum lags is $p=4$, according to the AIC criterion.

Source: author's construction based on EViews 6 outputs.

According to EViews estimation outputs above, the (t) calculated *is lower than* the critical value 0.05. And by taking the first of the variables, we can see that they are stationary at the first difference I (1) except for the variable tax burden that is stationary at level I(0).

First, **for the GDP per capita**, the estimation of the third model shows that the trend is significant (Prob= 0.0002 < 0.05), and in the second model the intercept is no significant (Prob = 0.468 > 0.05). For the first model, the ADF test is about (1.874); which is greater than the critical value at 5% (-1.960), consequently it is not stationary at level.

Thus, we move to first difference, the estimation of the third model shows that the trend is no significant (Prob = 0.394 > 0.05), besides that the ADF test of the first model is about (-2.177), which is lower than the critical value at 5% (-1.960). Thus, we reject the null hypothesis and thus the variable GDP per capita is stationary in the first difference and is integrated of order one I (1).

For M2, the estimation of the third model shows that the trend is no significant (Prob= 0.08 > 0.05), and in the second model the intercept is no significant (Prob = 0.216 > 0.05). For the first model, the ADF test is about (-0.047); which is greater than the critical value at 5% (-1.960), consequently it is not stationary at level.

Thus, we move to first difference, the estimation of the third model shows that the trend is no significant (Prob = 0.315 > 0.05), besides that the ADF test of the first model is about (-3.943), which is lower than the critical value at 5% (-1.960). Thus, we reject the null hypothesis and thus the variable M2 is stationary in the first difference and is integrated of order one I (1).

For unemployment, the estimation of the third model shows that the trend is no significant (Prob= 0.051 > 0.05), and in the second model the intercept is no significant (Prob = 0.63 > 0.05). For the first model, the ADF test is about (-0.795); which is greater than the critical value at 5% (-1.960), consequently it is not stationary at level.

Thus, we move to first difference, the estimation of the third model shows that the trend is no significant (Prob = 0.073 > 0.05), besides that the ADF test of the first model is about (-2.736), which is lower than the critical value at 5% (-1.960). Thus, we reject the null hypothesis and thus the variable unemployment is stationary in the first difference and is integrated of order one I (1).

For government expenditures, the estimation of the third model shows that the trend is no significant (Prob= 0.150 > 0.05), and in the second model the intercept is no significant (Prob = 0.091 > 0.05). For the first model, the ADF test is about (0.781); which is greater than the critical value at 5% (-1.960), consequently it is not stationary at level.

Thus, we move to first difference, the estimation of the third model shows that the trend is no significant (Prob = 0.073 > 0.05), besides that the ADF test of the first model is about (-2.792), which is lower than the critical value at 5% (-1.960). Thus, we reject the null hypothesis and thus the variable government expenditures is stationary in the first deference and is integrated of order one I (1).

For crude oil prices, the estimation of the third model shows that the trend is significant (Prob= 0.04 < 0.05), and in the second model the intercept is no significant (Prob = 0.306 > 0.05). For the first model, the ADF test is about (1.378); which is greater than the critical value at 5% (-1.960), consequently it is not stationary at level.

Thus, we move to first difference, the estimation of the third model shows that the trend is significant (Prob = 0.041 < 0.05), besides that the ADF test of the first model is about (-3.734), which is lower than the critical value at 5% (-1.960). Thus, we reject the null hypothesis and thus the variable crude oil prices is stationary in the first deference and is integrated of order one I (1); with a trend.

For inflation rate, the estimation of the third model shows that the trend is no significant (Prob= 0.954 > 0.05), and in the second model the intercept is no significant (Prob = 0.791 > 0.05). For the first model, the ADF test is about (-2.158); which is lower than the critical value at 5% (-1.960), consequently it is not stationary at level.

Thus, we move to first difference, the estimation of the third model shows that the trend is significant (Prob = 0.017 < 0.05), besides that the ADF test of the first model is about (-4.611), which is lower than the critical value at 5% (-1.960). Thus, we reject the null hypothesis and thus the variable inflation rate is stationary in the first deference and is integrated of order one I (1); with a trend.

For tax burden, the estimation of the third model shows that the trend is no significant (Prob= 0.367 > 0.05), and in the second model the intercept is significant (Prob = 0.0032 < 0.05). For the first model, the ADF test is about (-2.329); which is lower than the critical value at 5% (-1.960), consequently it is stationary at level, with an intercept.

For minimum wages, the estimation of the third model shows that the trend is no significant (Prob= 0.117 > 0.05), and in the second model the intercept is significant (Prob = 0.003 < 0.05). For the first model, the ADF test is about (-0.61); which is greater than the critical value at 5% (-1.960), consequently it is not stationary at level. Thus, we move to first difference, the estimation of the third model shows that the trend is no significant (Prob = 0.0969 > 0.05), besides that the ADF test of the first model is about (-6.257), which is lower than the critical value at 5% (-1.960). Thus, we reject the null hypothesis and thus the variable minimum wages is stationary in the first deference and is integrated of order one I (1).

For the **ratio of Currency to money supply (C/ M2)**, the estimation of the third model shows that the trend is no significant (Prob= 0.361 > 0.05), and in the second model the intercept is no significant (Prob = 0.15 > 0.05). For the first model, the ADF test is about (-1.624); which is greater than the critical value at 5% (-1.960), consequently it is not stationary at level.

Thus, we move to first difference, the estimation of the third model shows that the trend is no significant (Prob = 0.207 > 0.05), besides that the ADF test of the first model is about (-3.73), which is lower than the critical value at 5% (-1.960). Thus, we reject the null hypothesis and thus the variable the ratio C/ M2 is stationary in the first deference and is integrated of order one I (1).

Finally interest rate, the estimation of the third model shows that the trend is significant (Prob= 0.01 < 0.05), and in the second model the intercept is no significant (Prob = 0.421 > 0.05). For the first model, the ADF test is about (-1.003); which is greater than the critical value at 5% (-1.960), consequently it is not stationary at level.

Thus, we move to first difference, the estimation of the third model shows that the trend is no significant (Prob = 0.588 > 0.05), besides that the ADF test of the first model is about (-2.609), which is lower than the critical value at 5% (-1.960). Thus, we reject the null hypothesis and thus the variable interest rate is stationary in the first deference and is integrated of order one I (1).

1.22. **The model presentation:**

As it is mentioned in the second chapter, the MIMIC model included two set of equations: the structural equation and the measurement equation. Here, we will use the measurement equation to measure the NOE.

The structural equation: $\eta_t = \gamma'x_t + \xi_t$;

The measurement equation: $y_t = \lambda \eta_t + \varepsilon_t$.

1.23. Because we have two indicators that reflect the change of the NOE in the monetary (M2) and the production markets (GDP per capita), our structural model will contain two equations, as follows:

$$\left\{ \begin{array}{l} \eta_t = \gamma_1 Unemp + \gamma_2 DI + \gamma_3 II + \gamma_4 SSC + \gamma_5 GGCE + \gamma_6 COIL + \gamma_7 NGMW + \\ \gamma_8 INF + \xi_t \dots\dots\dots (1) \\ y_t = \lambda \eta_t + \varepsilon_t \dots\dots\dots (2) \end{array} \right.$$

Hence if we substitute (1) in (2), we obtain the two measurement equations are:

$$GDP/capita = \lambda_1 \eta_t + \varepsilon_t \dots\dots\dots (3)$$

$$M2 = \lambda_2 \eta_t + \varepsilon_t \dots\dots\dots (4)$$

With η_t : the size of the non-observed economy as a percentage of the official GDP.

To sum up, our simultaneous system has two structural equations, two endogenous variables and eight exogenous variables.

It is necessary to set a scale for the latent variable, which is; in our case; the GDP per capita. Besides, the choice of the sign of the variable is based on both theoretical and empirical reasons, where there is no final agreement of the effect of the underground economy on economic growth that is proxed by GDP per capita. We will choose the negative sign $\lambda_1 = -1$.⁴⁰

In the first place, we replace the structural equation in the measurement equation, we obtain the following equation:

$$GDP\ per\ capita = \gamma_1 Unemp - \gamma_2 DI - \gamma_3 II - \gamma_4 SSC - \gamma_5 GE - \gamma_6 COIL - \gamma_7 NGMW - \gamma_8 INF - \omega_t ;$$

With:

$\omega_t = \varepsilon_t + \xi_t$; Which represents the error term, which is supposed to be naturally distributed and with mean equal to 0 and stable variance: $(N(0, \sigma^2) \sim \omega_t$.

GDP per capita: Gross domestic product per capita (growth rate);

M2: money and quasi money (as % of GDP).

Unemp: unemployment rate (% of total labor force),

⁴⁰ See the appendix on the relationship between the UE and the GDP, more precisely, the relationship between the official and unofficial economy.

DI: direct taxes (as % of GDP);

II: indirect taxes (as % of GDP);

SSC: social security contributions (as % of GDP);

Inf: inflation, consumer prices (annual %);

GE: general government final consumption expenditure (as % of GDP);

COIL: crude Oil Prices;

MW: minimum wage (as % of GDP).

Secondly, we add to the measurement equation (2), $\lambda_2 (GDP/capita)$, as follows:

With: $\lambda_2 (GDP \text{ per capita}) = -\lambda_2 \eta_t + \lambda_2 \varepsilon_t$;

Thus,

$M2 + \lambda_2 (GDP \text{ per capita}) = \varepsilon_{2t} + \lambda_2 \varepsilon_t$;

Finally, we obtain the second measurement equation as follows:

$LN M2 = -\lambda_2 LN \text{ GDP per capita} + \varphi_t$.

With: $\varphi_t = \varepsilon_{2t} + \lambda_2 \varepsilon_t$.

To sum up the previous stages, we will estimate the two following equations:

$$\left\{ \begin{array}{l} GDP \text{ per capita} = \gamma_1 Unemp - \gamma_2 DI - \gamma_3 II - \gamma_4 SSC - \gamma_5 GE - \gamma_6 COIL - \\ \gamma_7 NGMW - \gamma_8 INF - \omega_t ; \\ M2 = -\lambda_2 \widehat{GDP \text{ per capita}} + \varphi_t . \end{array} \right.$$

1.24. Estimation results for the two structural equations:

First of all, we did an estimation of the full **MIMIC 6-1-2** model with the GDP per capita as dependent variable and the explanatory variables (or the causal variables): indirect taxes, direct taxes, social security contributions, unemployment rate, inflation rate, crude oil prices, government expenditures and minimum wages. The estimation results mentioned in the table below show that only indirect taxes, social security contributions and government expenditures are significant at 5%.

Furthermore, after removing the non-significant variable, we obtain the **MIMIC 4-1-2**, a model that show that only indirect taxes, social security contributions, government expenditures and unemployment rate are significant at level 5%.

Moreover, the coefficients of the variables: unemployment rate (-0.69), indirect taxes (-0.03); government expenditures (-2.85) and social security contributions (0.0056) have the expected signs, which confirm that the raise of unemployment, inflation rate and government expenditures rise the size of the hidden activities.

And basing on the t-statistics, we find that unemployment rate affect greatly the size of the UE by 0.72 per cent, while indirect taxes come in the second place by 0.64 per cent.

After that, we gather the indirect taxes, direct taxes and social security contributions in one variable: tax burden, as it was used in most of the empirical evidences mentioned in the chapter two. The estimation results in the table below of **the MIMIC 4-1-2, b (*)** model illustrate that the tax burden has no effect on the UE, while inflation rate, unemployment rate, government expenditures and minimum wages are significant at level 5% and thus they affect the UE.

Table3: Output EViews, Coefficients and Tests

	MIMIC 8-1-2	MIMIC 4-1-2, a	MIMIC 4-1-2, b(*)
Causal variables (t-statistic)> 2.201			
Unemployment	-0.440 (-1.76)	-0.698 (-6.11)*	-0.97 (-8.56)*
Direct taxes	-6.281E-05 (-1.309)	/	/
Indirect taxes	-0.033 (-2.284)*	-0.03 (-5.054)*	
Social security contributions	0.0059 (4.066)*	0.0056 (4.076)*	
Government expenditure	-3.22 (-2.819)*	-2.855 (-3.274)*	1.46e-08 (3.98)*
Crude oil prices	-0.1878 (-0.532)	/	/
Minimum wage	-0.017 (-0.308)	/	-0.07 (-2.36)*
Inflation rate	7.22 (1.34)	/	-0.42 (-8.84)*
Intercept (C)	150.128 (6.297)*	152.06 (11.79)*	125.74 (36.20)*
Indicator variables			
GDP per capita	-1	-1	-1
M2	/	0.66 (4.336)*	0.63 (4.14)*
Model diagnostics (perfect fit)			
R- squared	0.97	0.96	0.96
Prob (F- statistic)	0.000000	0.000000	0.000000
Durbin- Watson stat.	2.03	2.013	1.77
Multi. Normality of residuals	0.965	0.999	0.954
Breusch-Godfrey Serial Correlation LM Test ¹ (p-value > 0.05)	0.77 0.56	0.957 0.935	0.71 0.60
Heteroskedasticity Test: Breusch-	0.22	0.454	0.43

Pagan-Godfrey ² (p-value > 0.05)	0.21	0.392	0.37
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Notes:
 (*): In this model we regrouped direct taxes, indirect taxes and social security contributions in one variable: tax burden.

In parentheses is the value of t-statistic, it is desirable that the absolute value (t-statistic) > 2.201; fulfillment of this condition is marked with *.

Multi. Normality of residuals test shows the normal distribution of the residuals. In here, we found that the residuals are normally distributed for all the three MIMIC models.

¹we used the Breusch-Godfrey Serial Correlation LM Test, to check if there is a serial correlation among the residuals. The first value expressed the Prob-F, and the second value expressed Chi-squared probability. *: means that these values exceed the critical value 5%, thus we reject H0 that there is a serial correlation problem. †: Means good fitting (p-value > 0.05).

² we used the Heteroskedasticity test of Breusch-Pagan-Godfrey to check the violation of the classical assumption that states that the observations of the error term are drawn from a distribution that has a constant variance. The first value expressed the Prob-F, and the second value expressed Chi-squared probability. *: means that these values exceed the critical value 5%, thus we accept H0 that there is not Heteroskedasticity problem.

³ No perfect multi-co linearity is shown among the explanatory variables, which means that the estimation method (two stages least squares) is appropriate in the estimation of our model.

Source: author's calculation based on EVIEWS 6 software.

Consequently, we have to choose one MIMIC model for estimation the development and size of the UE in Algeria. Basing on the estimation results mentioned in the table above, we choose the MIMIC 4-1-2, b model as the best model for estimating the size of the Algerian underground economy.

- **Estimation results:** for the first measurement equation of the MIMIC 4-1-2, b) (*) model

$$\text{GDP / capita} = 125.74 - 0.42 * \text{inflation rate} - 0.076 * \Delta \text{ minimum wages} + 1.46326348623e-08 * \Delta \text{ gouvernement expenditures} - 0.97 * \text{unemployment} \dots \dots \dots (1)$$

Dependent Variable: PIBCAPITA

Method: Least Squares

Date: 09/14/13 Time: 15:18

Sample (adjusted): 1991 2009

Included observations: 19 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF	-0.429952	0.048618	-8.843551	0.0000
DSNMGSS	-0.076181	0.032155	-2.369157	0.0327
DDPSS	1.46E-08	3.67E-09	3.983332	0.0014
TCH	-0.975966	0.113920	-8.567147	0.0000
C	125.7470	3.473029	36.20673	0.0000
R-squared	0.967642	Mean dependent var		104.6272
Adjusted R-squared	0.958396	S.D. dependent var		10.95968
S.E. of regression	2.235445	Akaike info criterion		4.667692
Sum squared resid	69.96100	Schwarz criterion		4.916228
Log likelihood	-39.34307	Hannan-Quinn criter.		4.709754
F-statistic	104.6634	Durbin-Watson stat		1.775546
Prob(F-statistic)	0.000000			

Source: author's construction using EVIWS 6 outputs.

Concerning the second measurement equation, the estimation results are as follows:

In the second equation, we used the *estimated GDP per capita*; which is calculated as follows:

$$\widehat{\text{GDP per capita}} = \text{GDP per capita} - \varepsilon_t .$$

Thus, $M2 = 46.82 + 0.63 \widehat{GDP\ capita} \dots\dots\dots (2)$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ESTPIBCAPITA1	0.634811	0.153095	4.146526	0.0007
C	46.82478	1.755733	26.66964	0.0000
R-squared	0.502832	Mean dependent var		49.76217
Adjusted R-squared	0.473587	S.D. dependent var		9.651356
S.E. of regression	7.002477	Akaike info criterion		6.829706
Sum squared resid	833.5896	Schwarz criterion		6.929120
Log likelihood	-62.88220	Hannan-Quinn criter.		6.846531
F-statistic	17.19368	Durbin-Watson stat		0.907646
Prob(F-statistic)	0.000675			

Source: author's construction using EVIEWS 6 outputs.

The interpretation of estimation outputs:

Starting from the MIMIC 6-1-2, and deleting all the insignificant explanatory variables, we chose the **MIMIC 4-1-2, b (*)** as the best model. Thus, the main causes of the Algerian non observed economy are: inflation rate, government expenditures, unemployment and minimum wages, which confirm the assumptions that unemployment and minimum wages are the main causes of the hidden activities with the risen burden of the government regulations (proxed by government expenditures).

From the estimation results presented above, the significant explanatory variables have significant effect on the size of the UE since the Prob (F-statistic) is below 0.05 and the R2 (0.96) confirm the good choice of explanatory variables. Moreover, the Durbin-Watson statistic is equal (1.77), which stress that there is no correlation among error terms.

Furthermore, the results showed no significant effect of the variables: crude oil prices and tax burden, which seems strange, because all the empirical evidences showed that tax burden is one of the main causes of the UE. We can interpret this insignificance of the variable tax

burden, is that this variables is a TS variable (trend stationary and it's integrated of order 0, I(0)).

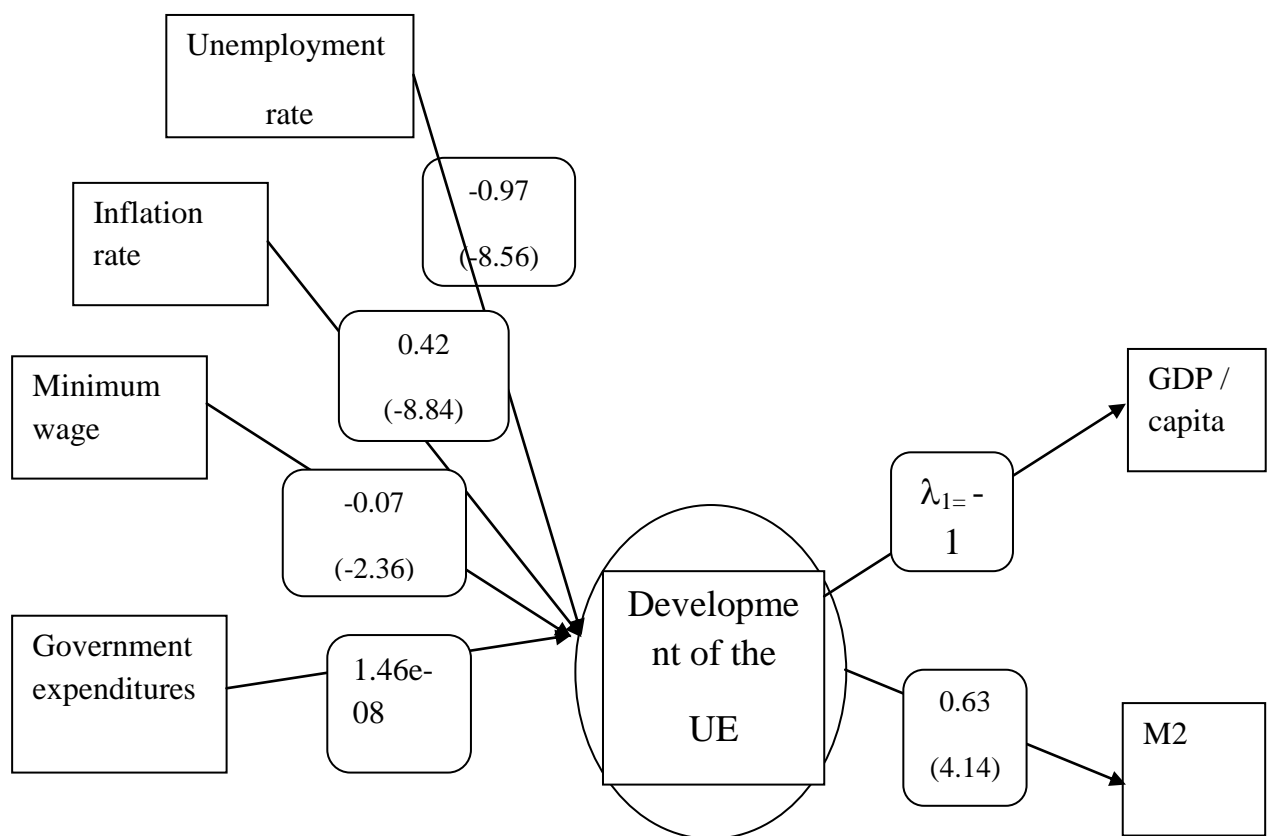
Moreover, the coefficients of the variables: unemployment (0.97), inflation rate (0.42); government expenditures (1.46E-08) and minimum wages (-0.076) have the expected signs, which confirm that the raise of unemployment, inflation rate and government expenditures rise the size of the hidden activities.

Consequently, the raise of inflation rate by one percent implicates a rise of 0.42 percent of the UE and the raise of unemployment by one percent implicates the rise of 0.97 % of the UE.

A raise of government expenditures by one unit implicates a rise of (1.46E-08%) of the UE and the decrease of minimum wages by one unit implicates an increase of 0.07% of the UE.

And basing on the t-statistics, we find that inflation rate affect greatly the size of the UE by 0.84 per cent, while unemployment rate come in the second place by 0.83 per cent⁴¹.

Figure17: the best MIMIC (4-1-2) model



Source: author's construction.

⁴¹ The ratio of inflation rate and unemployment rate are calculated using the partial correlation coefficient, using the following formula: $r^2_{y.xi.(other\ variables)} = \frac{t^2}{t^2 + (n-k-1)}$, with r^2 : partial correlation coefficient and t : t-statistics of the variable that we want to calculate its partial correlation coefficient. (Régis Boubonnais, 2011, p109)

1.25. After the interpretation of the estimation results of the chosen MIMIC 4-1-2, b (*) model, we move now to the estimation of the size and development of the Algerian UE. We **calculate in the first place** the development of the Algerian economy (an index of the evolution of the underground economy) using the following structural equation:

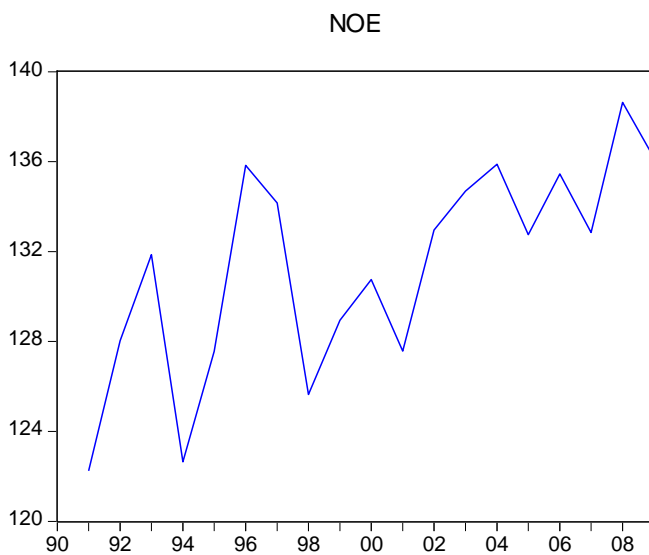
$$\Delta \frac{\hat{\eta}_t}{GDP_t} = \gamma' X_t$$
, with; γ' are the structural coefficients from the equation (1) and X_t are the stationary causal variables in the first difference, and therefore the latent variable (here is the underground economy) is estimated in first differences.

Thus, this structural equation became:

$$\Delta \frac{\hat{\eta}_t}{GDP_t} = 125.74 - 0.42 * \Delta \text{inflation rate} - 0.076 * \Delta \text{minimum wages} + 1.46e-08 * \Delta \text{gouvernement expenditures} - 0.97 * \Delta \text{unemployment rate} \dots \dots \dots (3)$$

The following graph represents the annual growth rate or the development of the UE using the MIMIC model over the period 1990- 2009, basing on the table next to this graph:

Figure18: The index of the Underground economy



Source: author's construction using EViews outputs.

Years	The index of the Underground economy (= $\hat{\gamma} \Delta x_t$)
1990	/
1991	122.24
1992	128.03
1993	131.86
1994	122.65
1995	127.56
1996	135.83
1997	134.16
1998	125.64
1999	128.94
2000	130.76
2001	127.58
2002	132.95

As can be seen in the graph above, in what concerns the development of the Algerian underground economy over the period 1990 to 2009. This graph can be divided in four sub-periods: 1990- 1994, 1994- 1998, 1998- 2004 and 2004- 2009. Each period illustrates upward and downward trends. Thus, the trend of the evolution of the UE is related to the rise of inflation rate, unemployment rate during the period 1990- 1997. Between 1997 and 2002 the rise in the size of the UE is due to the rise in minimum wages and government expenditures. During the period 2002 and 2009, the rising size of the UE is related to the rise in government expenditures and minimum wages.

1.26. **In the second place**, we calculate the size of the UE as percentage of official GDP. To do so, we need to convert the index of the evolution of the UE obtained from the structural equation (3) of the MIMIC 4-1-2, b (*) model using one of the calibration (or benchmarking) procedures, because the MIMIC model provides just a set of coefficients from which one can calculate an *ordinal index* that shows the evolution of the UE.

There are many benchmarking procedures used in the literature, where each one is based on specific hypotheses of the link between the UE and the official economy.

However, using any method among the benchmarking methods required an exogenous value of the UE/ GDP that is extracted from other researches that used the same variables and methodology; usually they used the Currency-demand approach for this purpose because of its simplicity of application.

In this research, we will use an exogenous value that is extracted from our calculations using the Currency demand approach to estimate the size of Algerian UE; which will be demonstrated later.

The benchmarking procedure, applied herein, is applied by Giles and Tedds (2002a); which is based on the assumption that the changes in the official GDP respect to the GDP_{2000} in the base year is related to changes in the UE as percentage of official GDP_{2000} in that base year. In addition to that the reference indicator (Y_1) has no monetary unit of measure; which is directly comparable with index of the UE.

Mathematically, the measurement equation is as follows:

$$\frac{GDP_t}{GDP_{2000}} = - \frac{\Delta \hat{\eta}_t}{GDP_{2000}} ;$$

Thus, the index $\frac{\Delta \widehat{\eta}_t}{GDP_{2000}}$ is transformed from changes compared to 2000 into time series of

UE / current GDP. This operation is shown in the following benchmarking equation:

$$\frac{\eta_t}{GDP_t} = \frac{\Delta \widehat{\eta}_t}{GDP_{2000}} \left[\frac{\eta^*_{2000}}{GDP_{2000}} \frac{GDP_{2000}}{\widehat{\eta}_{2000}} \right] \frac{GDP_{2000}}{GDP_t} \dots\dots\dots (4)$$

With:

$\frac{\eta_t}{GDP_t}$: is the estimated UE as percentage of GDP;

$\frac{\Delta \widehat{\eta}_t}{GDP_{2000}}$: is the index calculated by the equation (3);

$\frac{\eta^*_{2000}}{GDP_{2000}}$: is the exogenous value obtained from the Currency-demand approach; which is equal to 24, 57%;

$\frac{GDP_{2000}}{\widehat{\eta}_{2000}}$: is the value of the index of the UE estimated by equation (3) in the year 2000;

$\frac{GDP_{2000}}{GDP_t}$: is able to convert the index of the UE as changes respect to the base year in respect to current GDP (to ration between the UE and current GDP).

Furthermore, the equation (4) can be simplified and used in converting the index of the Algerian UE, as follows:

$$\frac{\widehat{\eta}_t}{GDP_t} = \frac{\eta^*_{2000}}{GDP_{2000}} \frac{\widehat{\eta}_t}{\widehat{\eta}_{2000}} \dots\dots\dots (5)$$

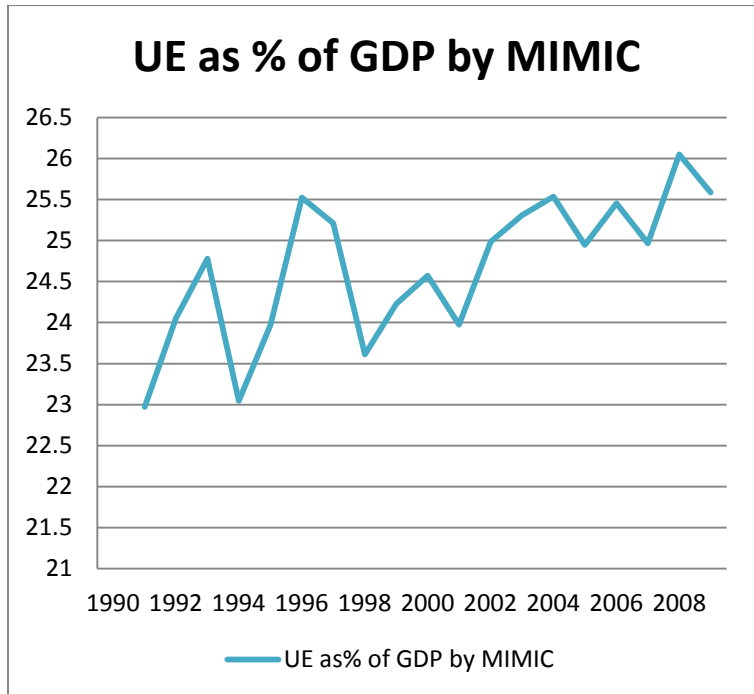
With:

$\frac{\eta_t}{GDP_t}$: is the estimated UE as percentage of GDP;

$\frac{\eta^*_{2000}}{GDP_{2000}}$: is the exogenous value obtained from the Currency-demand approach; which is equal to 24, 57%;

$\frac{\widehat{\eta}_t}{\widehat{\eta}_{2000}}$: $\widehat{\eta}_t$ is the index of the UE estimated by equation (3) divided by the value of that index in the base year $\widehat{\eta}_{2000} = 130.76$.

The following graph shows the size of the Algerian UE as percentage of official GDP over the period 1990- 2009, basing on the table next to this graph:

Figure19: the size of the Algerian UE

Source: author's construction.

Years	The size of the Algerian UE
1990	/
1991	22.97
1992	24.06
1993	24.78
1994	23.05
1995	23.97
1996	25.52
1997	25.21
1998	23.61
1999	24.23
2000	24.57
2001	23.97
2002	24.99
2003	25.31
2004	25.51
2005	24.94
2006	25.44
2007	24.94
2008	26.01
2009	25.31

As can be seen in the graph above, in what concerns the size of the Algerian underground economy over the period 1990 to 2009. The dimension of UE ranges from around 22.97 %, in 1991, to around 25.31 % in 2009. The nineties years; starting from 1993; show an increasing dynamics of the size of the UE until 2009.

3.3.2. Estimating the size of the UE using the Currency Demand Approach :

1.27. As it is mentioned earlier in the chapter two, the currency demand approach was first used by *Cagan (1958)*.

The currency demand approach was developed and refined by *Tanzi* who estimated the quantity of money held by people to settle the underground transactions by estimating the extra demand for currency. He used the underground transactions associated with tax evasion, and thus excluded the illegal activities (drugs and prostitution).

In contrast to *Gutmann* who assumed that tax burden and intensity of regulations are the solely factors that affect the size of the UE, *Tanzi* included other variables. Thus, he used the

share of currency stocks (i.e. All bank notes and coins in public circulation) to M2 as dependent variable, and income tax rate, interest rate, inflation rate, per capita income and proportion of wages and salaries to GDP as explanatory variables. Mathematically, his **basic regression equation for the currency demand is:**

$$C/M2 = A (1 + F)^\alpha y^\beta \exp^{-\gamma i \text{Inf}} .$$

And after introducing natural logarithms, the equation becomes:

$$\ln (C / M_2)_t = \beta_0 + \beta_1 \ln (1 + T)_t + \beta_2 \ln (WS / Y)_t + \beta_3 R_t + \beta_4 \ln (Y / N)_t + \beta_5 \text{Inf} + u_t$$

With: $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 < 0$, $\beta_4 < 0$, $\beta_5 > 0$: are structural coefficients.

Where:

\ln denotes natural logarithms,

C / M_2 : is the ratio of cash holdings to M2,

T : is the scale variable that reflects the incentives to go underground; it could be either the proportion of total taxes to GDP or government expenditures (to proxy changes in the size of the underground economy),

WS / Y : is a proportion of wages and salaries in national income (to capture changing payment and money holding patterns),

R : is the interest paid on savings deposits (to capture the opportunity cost of holding cash) and;

Y / N : is the GDP per capita.

Inf : is the inflation rate;

U_t : the error term.

His approach is applied in two stages, *the first stage* is estimating the currency-demand regression equation, using econometric methods, that include a scale variable related to cash transactions in the UE; which is based on the assumption that people use cash in their transactions to leave no traces and they go underground to avoid the tax burden and the intensity of government regulations, which promote more tax evasion and increase the demand for currency. And *the second stage* is estimating the UE using the quantity theory of money. (Guerino Ardizzi et al 2012) (87)

Consequently, the demand for cash to settle underground transactions is calculated as the difference between two values, one value is estimated using the equation of demand for cash of the full model, and the other value is estimated using the equation by removing the

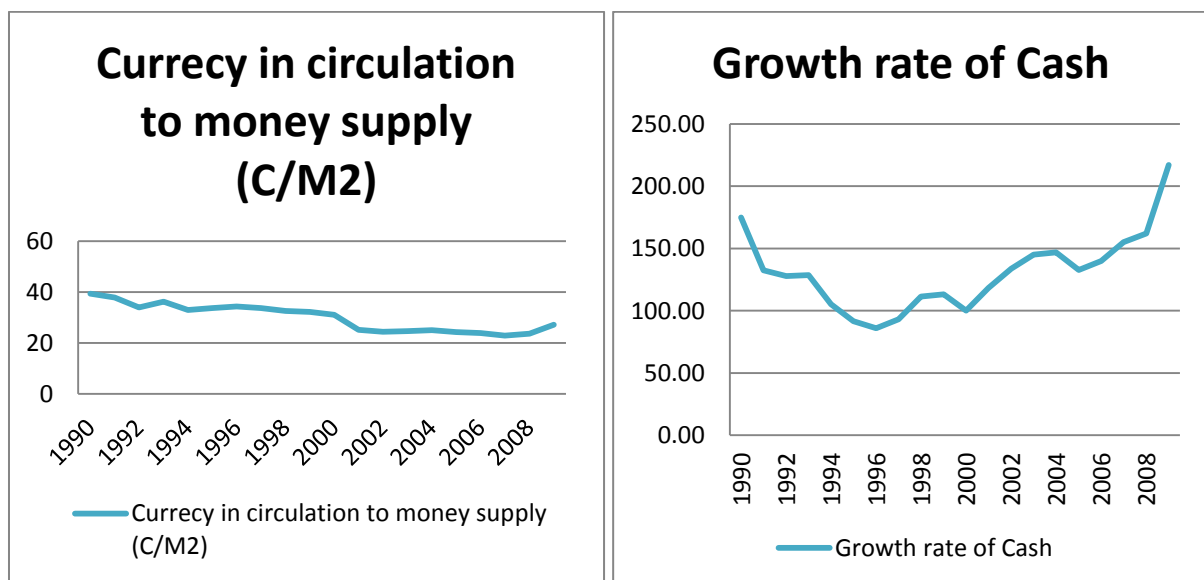
determinants of UE, which means removing the incentives to go underground and thus the demand for currency is motivated only by regular transactions⁴².

Hence, using this difference between the two equations, the UE is then calculated using the Fisherian equation, which is used to calculate first the velocity of money in circulation as the ratio of official GDP to the stock of liquid assets M1 (i.e. currency and sight deposits) where it is assumed that the velocity of money circulation is the same in both sectors.

Thus, the UE is calculated by multiplying the velocity of money by the estimated “excess demand” for cash in the Underground economy, and thus the illegal economy is excluded.

In Algeria the ratio of currency to money supply (C/M2) can be represented in the following graph:

Figure20: the ratio currency to M2, and the growth of the Cash (currency in circulation)



Source: author's construction on constant, USD 2000.

From the graph of the growth rate of cash, we noticed that the cash circulated is about 11257982795.84 dollars in 1990 and 6438059277.97 dollars in 2000 till 13971692344.13 dollars in 2009, where there is downward trend of cash during the period 1990 -2000 and upward trend from 2000 to 2009. **Moreover**, the part of the cash in M2 (money supply) is about 39 % in 1990 and 31 % in 2000 till 27 % in 2009; where it appears that the ratio C/ M2 followed downward trend.

⁴² The equation of the demand for currency of Tanzi includes determinants of cash for regular transactions (wages paid in cash to GDP, interest rate on savings deposits, per capita income) and determinants of cash for underground transactions (tax burden or government expenditures).

1.28. **In here**, we will use Tanzi's regression equation to estimate the size of the Algerian underground economy, as follows:

$$\ln(C/M_2)_t = \beta_0 + \beta_1 \ln(1 + GE)_t + \beta_2 \ln(MW)_t + \beta_3 R_t + \beta_4 \ln(GDP\ capita)_t + \beta_5 Inf + u_t$$

With: $\beta_1 > 0, \beta_2 > 0, \beta_3 < 0, \beta_4 < 0, \beta_5 > 0$: are the structural coefficients.

C/M_2 : is the ratio of cash holdings to M2,

GE: is government expenditures (to proxy changes in the size of the underground economy),

MW: is the minimum wages (to capture changing payment and money holding patterns),

R: is the interest rate on savings deposits (to capture the opportunity cost of holding cash) and;

GDP capita: is the GDP per capita.

Inf: is the inflation rate;

U_t : the error term.

Where we will test the following assumptions:

-An increase in government expenditures (which is the proxy of the intensity of regulations) will increase the demand for currency, as the tax burden promote people to go underground and thus the demand for currency to settle underground transactions and leave no traces ($\beta_1 > 0$);

-an increase in the wages and salaries will increase the demand for currency ($\beta_2 > 0$);

-An increase in interest rate (the opportunity cost of holding money) will decrease the demand for currency ($\beta_3 < 0$);

-An increase in GDP per capita will decrease the demand for currency, as the GDP per capita is a proxy variable of economic development, and thus the higher the standard of living, the lower the use of cash and the greater the use of other payments instruments ($\beta_4 < 0$);

-An increase in inflation rate; which is considered as the opportunity cost of holding cash will increase the demand for cash ($\beta_5 > 0$).

Consequently, we will proceed as Tanzi did when estimating the UE. First, we will estimate the full model. The estimation results using the OLS (ordinary least squares method) are as follows:

Dependent Variable: LOGCM2				
Method: Least Squares				
Date: 10/17/13 Time: 20:46				
Sample: 1990 2009				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGGE	-0.813205	0.302644	-2.687001	0.0169
LOGINF	0.042298	0.018970	2.229704	0.0415
LOGPIBCAPITA	-1.178040	0.228992	-5.144469	0.0001
LOGSNMG	-0.299267	0.163895	-1.825965	0.0878
C	7.654890	1.505628	5.084183	0.0001
R-squared	0.821803	Mean dependent var		-1.221073
Adjusted R-squared	0.774284	S.D. dependent var		0.180664
S.E. of regression	0.085833	Akaike info criterion		-1.860520
Sum squared resid	0.110508	Schwarz criterion		-1.611586
Log likelihood	23.60520	Hannan-Quinn criter.		-1.811925
F-statistic	17.29417	Durbin-Watson stat		1.100653
Prob(F-statistic)	0.000017			

Source: author's construction based on EVIEWS6 output.

Interpretation of the estimation results:

Thus, the results show that some of the variables are highly significant at 5%; while others are not, such as interest rate. Moreover, goodness of fit and f-statistic are also quite higher, such as $R^2 = 0.82$, Prob (F-statistic) = 0.000017 and D- Watson. Statistic = 1.10.

Moreover, inflation rate and GDP per capita have the expected signs, thus an increase in inflation rate by 1 % will increase the demand for currency by (0.04%) and an increase in the GDP per capita by 1 % will decrease the demand for currency by (1.17%). Minimum wages and Government expenditures have an impact on the demand for currency, but they have not the expected signs.

Hence, we have two measurement equations, the first equation of the full model:

$$\ln (C/M2)_t = 7.65 - 0.813 * \ln GE + 0.0422 * \ln INF - 1.178 * \ln PIB / CAPITA - 0.29 * \ln MG.$$

And in the second equation, we exclude the determinants of cash for underground transactions (government expenditures to GDP):

$$\ln (C/M2)_{wt} = 7.65 + 0.0422 * \ln INF - 1.178 * \ln PIB / CAPITA - 0.29 * \ln MG.$$

Using these two equations, we will estimate the excess demand for currency. Mathematically:

$$\text{Illegal demand for currency (Excess demand for cash)} = \ln (C/M2)_t - \ln (C/M2)_{wt} * M2.$$

Hence, we can calculate now legal money or demand for cash in the official economy.

Mathematically:

$$\text{Legal demand for currency} = M_1 - IM .$$

Moreover, the UE is then calculated using the Fisherian equation, which is used to calculate first the velocity of currency in circulation; (*Th  l  se Lafl  che (1994) (88)*)⁴³, as the ratio of official GDP to the stock of liquid assets $M1^{44}$ (i.e. currency and sight deposits) where it is assumed that the velocity of currency circulation is the same in both sectors. (*Ademola Ariyo and William Bekoe, (2011) (89)*, *Qazi Masood Ahmed and M. Haider Hussain, (2006) (90)*)

Thus, the UE is calculated by multiplying the velocity of currency circulated in the UE by estimating the Illegal demand for currency (or “excess demand” for cash).

$$\text{Velocity of currency in the UE (V)} = \text{GDP} / \text{Legal demand for currency} ;$$

$$\text{Underground Economy} =$$

$$\text{Illegal demand for currency} * \text{Velocity of currency circulated in the UE} .$$

⁴³ There are two kinds of the velocity of currency in circulation. Velocity that is related to total transactions (Feige was the only one who use it), and velocity that is related to income. In this research, we used the velocity that is related to income, which is defined as the ratio of income (i.e. official GDP) to quantity of money (i.e. M1).

⁴⁴ Transactions in the shadow economy are typically carried out using cash or money that is drawn from a current account at a moment’s notice. We therefore expect a positive relationship between the shadow economy and M1. The lower the officially measured GDP, the fewer possibilities people have to earn money in the official economy, and the likelier they are to be driven into the shadow economy. In the short run, we expect this negative relationship to exist.

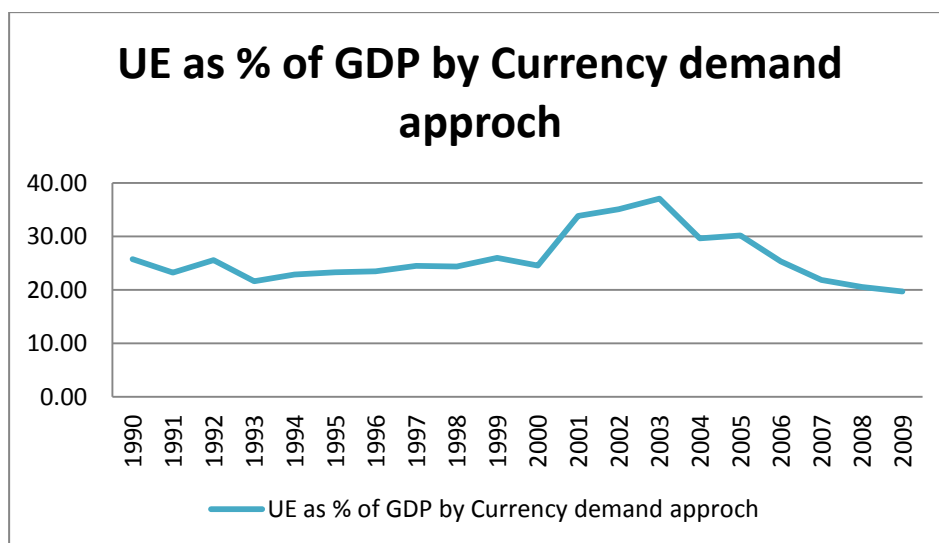
Table4: the monetary aggregates estimated by the Currency- demand approach

Unit of measure: US dollar, 2000

Year	Legal demand for currency (constant USD)	Illegal demand for currency (constant USD)	Velocity of currency circulated in the UE	Underground Economy (constant USD)	The size of the UE as percentage of GDP by Currency –demand approach
1990	15980629533.46	4109491134.07	2.90	11923460036.09	25.72
1991	12779326988.98	2968961172.88	3.58	10642939993.38	23.23
1992	11807559692.44	3017028538.41	3.95	11916044996.35	25.55
1993	12996064441.19	2809362044.81	3.51	9869414955.22	21.62
1994	10600203134.16	2421460563.89	4.27	10335522498.99	22.84
1995	8836802165.24	2056651525.75	5.31	10930301349.23	23.27
1996	8099854731.02	1902626555.62	6.04	11484011086.57	23.49
1997	8523213269.03	2087682977.20	5.80	12106807267.02	24.49
1998	10757498782.30	2619646461.88	4.83	12650350077.96	24.35
1999	10420585926.16	2707633926.14	5.14	13929921755.85	25.98
2000	10110366130.15	2484141229.02	5.42	13462049014.30	24.57
2001	10660124856.60	3602991509.58	5.27	18999844886.14	33.80
2002	11886892752.78	4172816588.97	4.95	20661258004.46	35.10
2003	12330226055.70	4570453016.49	5.10	23321781977.90	37.07
2004	15426452793.75	4569226165.53	4.29	19604954082.73	29.62
2005	14480839267.74	4371934896.15	4.80	21002544571.07	30.19
2006	18123042622.59	4592472155.25	3.92	17980739688.25	25.34
2007	23518006003.30	5133938131.79	3.11	15954363853.55	21.83
2008	24373764812.48	5007700089.68	3.07	15376058052.57	20.55
2009	28641651896.64	5649210151.57	2.68	15115375498.12	19.72

Source: author's construction basing on the equations mentioned above.

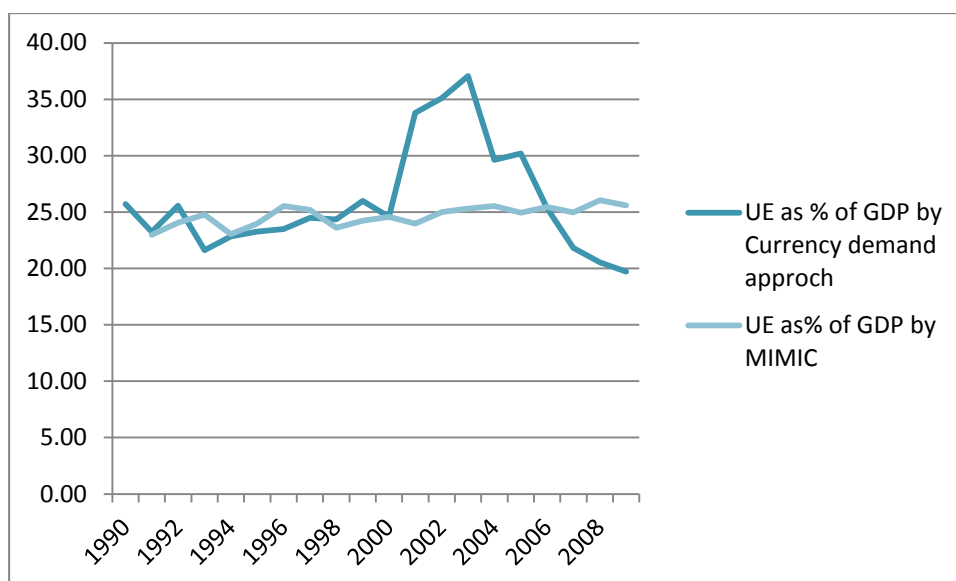
Figure21: the size of the UE as percentage of GDP



Source: author’s construction based on the last column of the table above.

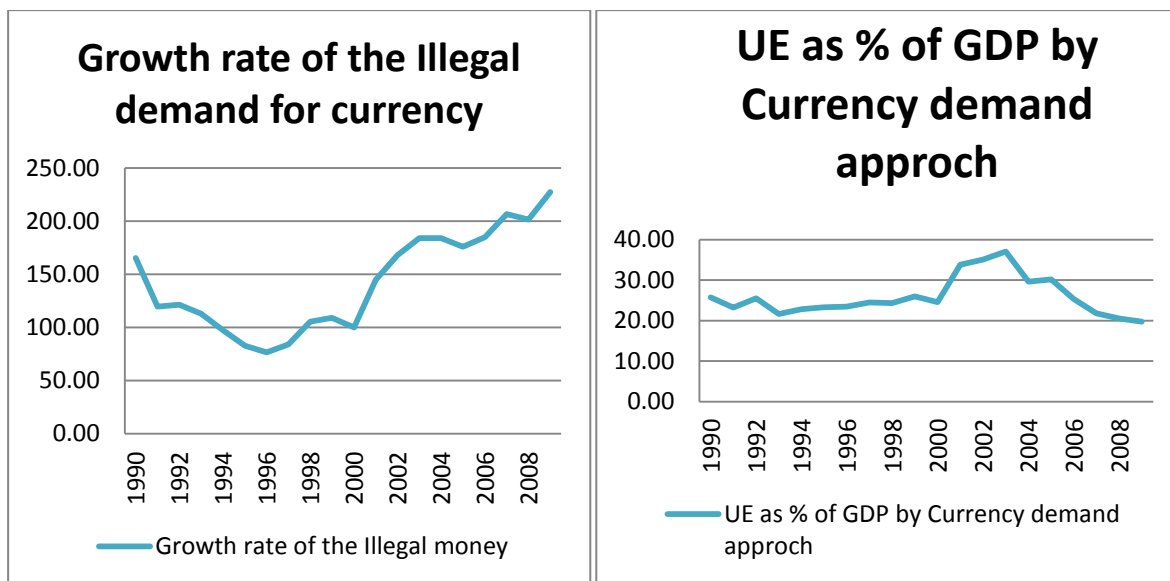
The graph below shows the size of the underground economy from both the MIMIC model and the Currency-demand approach. We can notice that there is an approximation between the size of the underground economy obtained from the MIMIC model and the currency demand approach, except for the period 2001- 2009 where it is noticed an overestimation; and then; an underestimation of the size of the UE from the currency demand approach; which is due to the overestimation of some variables that are used when estimating the size of the UE, such as government expenditures, inflation rate and interest rate.

Figure22: the comparison between the size of the UE using the modeling approach and the currency-demand approach



Source: author’s construction.

Figure23: the illegal demand for currency



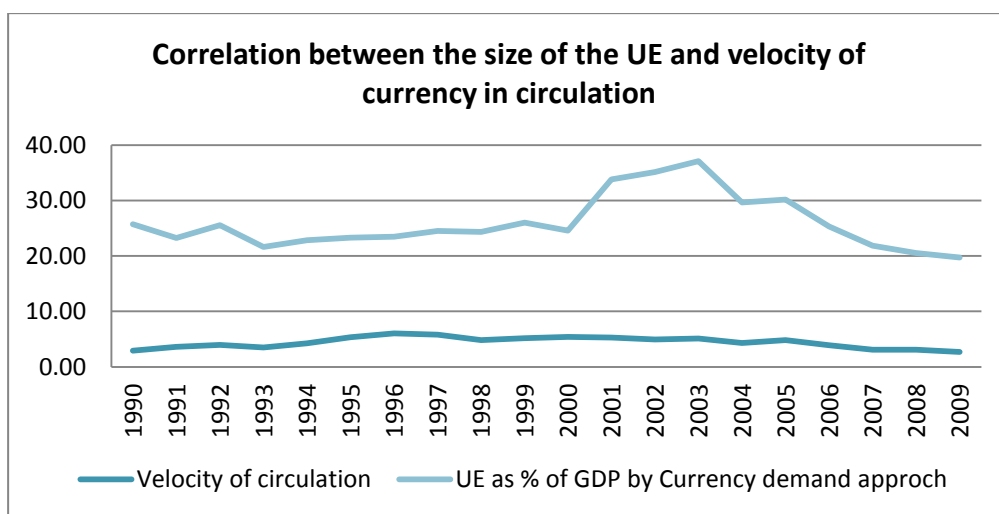
Source: author’s construction based on constant, USD 2000.

From the graph of illegal demand for currency to settle underground activities, we notice a downward trend during the period 1990- 2000. After that, the demand for illegal currency started to rise till the year 2009.

Moreover, the comparison between the growth rate of illegal demand for currency and the size of the UE **stressed** that there is a common downward trend between the two graphs expect after the year 2004, where it is noticed that while the illegal demand for currency increases the size of the UE decreases.

And when correlated the illegal demand for currency with the size of the UE as the following graph illustrates:

Figure24: the velocity of currency circulated in the UE



Source: author’s construction based on the table above.

From the graph above, we notice that during the period 1990- 2001 the size of the underground economy (from the currency demand approach) and the velocity of currency circulated in the underground economy have the same trend; which means that the high level velocity of currency circulated is an indicator of high level of underground activities. Moreover, during the period 2001- 2006, we observe stability in the velocity of circulation and an upward trend in the size of the underground economy; which is inconsistent with the results. We can attribute this divergence between the velocity of currency in circulation and the size of the UE to the overestimation of some variables that are used when estimating the size of the UE, such as government expenditures, inflation rate and interest rate.

1.29. Criticisms of the used methods in measuring the size of the Algerian UE:

We should mention that although there is no consensus nor about the causes neither about the indicators of the UE, we think that the used causal variables and indicator variables; that are linked in one way or another, in our MIMIC model is the correct approach to evaluating the development and the size of the underground economy, even that the UE is treated as a latent variable, which by definition is not directly observable.

Moreover, the employed causal variables have a direct and positive effect on the UE. On the other hand, the development of the indicator variables (monetary aggregates and the GDP per capita) reflected in real economic activity; in terms of labor and money; differs from official to unofficial economy.

Because of the lack of database on such variables and the difficulty of using the modeling approach, besides our sample size, we have not introduced other causal variables, such as the resources governments spend on combating tax evasion, electricity consumption, and institutional indices.

Furthermore, when using the monetary approach to measure the size of the UE, we found that it is much better to follow the following instructions:

-We should use a monetary aggregate that is broader than M1, because part of the currency circulating in the UE is held as savings.

-The income velocity of money circulated in the UE is much higher than M2+. In addition that hoarding in the UE is less than in the official economy.

-Some authors used a direct measure of cash transactions, which is the flow of cash withdrawn from current accounts with respect to total payments. And thus, they overcome the need for an arbitrary base year for calculating the income velocity of money.

-They also use flow of cash rather than stock of liquid assets (M1), because a certain amount of money is held for purposes other than transactions and the velocity of money is assumed to be constant with respect to GDP component (including UE).

To sum up, when using the currency demand approach, two main problems are revealed: the first is estimating the quantity of currency used in the UE and the second is estimating the velocity of currency circulated in the UE, besides that these problems depend on the pre-assumed assumptions that are difficult to verify and thus affect the estimation results. Finally, among the macro-modeling approaches that are used to estimate the size of the underground economy, the monetary approach is the one that overestimate its size.

3.3. Conclusion

1.30. The objective of this study was to estimate and analyze the development, the size and consequences of the underground economy and tax evasion in Algeria. To do so, we used two macro-economic methods, namely, the MIMIC model and the currency demand approach.

Our findings indicate the existence of a large underground economy and tax evasion in Algeria, even with the economic reforms implemented in the 1990s. Moreover, we found that indirect taxes, social security contributions, government expenditures, inflation rate, minimum wages and unemployment rate are the main causes of the rising size of the underground economy and tax evasion, even when the combination of some variables are not significant.

Furthermore, when using the Tanzi's monetary approach, we have confirmed that inflation rate and GDP per capita the main factors that influence the demand for currency to settle transactions in the underground economy.

We have shown that because of the rising size of the underground economy and its potential effects on the official sector, many authors try to measure its magnitude; though it is a difficult task; in order to help the bureaucrats in elaborating efficient development policies that promote growth.

Moreover, we have seen that each estimation method has advantages and disadvantages that limit its use, where the modeling approach (the MIMIC model) is considered as the most appropriate method for measuring the size of the underground economy, even the criticisms that we have cited earlier.

For Algeria, we have shown that although the several researches that attempt to estimate the size of the underground economy; using the direct approaches, they just led to an approximation of this phenomenon, because of the lack of data and the costs spent in elaborating such questioning and surveys techniques and the heterogeneity of the hidden activities.

According to our estimates of the Algerian underground economy, we find that the size of the underground economy is about 24 % in average; and the main causes of the development of the hidden activities are: unemployment rate, indirect taxes, government expenditures and social security contributions; but after using the tax burden; which includes direct and indirect taxes and social security contributions; we found that inflation rate, government expenditures, unemployment and minimum wages are the causes of informality. Therefore, we can confirm the assumptions about the effect of tax burden, government regulations, unemployment rate and low wages and salaries positively on the rising size of the hidden activities and evaded taxes.

However, the estimation results showed no significant effect of the variables: crude oil prices and tax burden, which seems strange. We can interpret this insignificance of the variable tax burden, is that this variables is a TS variable (trend stationary and it's integrated of order 0, $I(0)$).

Furthermore, concerning the estimation of the size of underground economy using the currency-demand approach, we found that inflation rate and GDP per capita affected the cash holding; which confirm that the increase of inflation rate and decrease in GDP per capita will increase the cash holding to settle hidden transactions.

General conclusion

Besides this, after comparing the size of the UE estimated by the MIMIC model and the currency- demand approach, we notice that there is an approximation between the results of these two methods, except for the period 2001- 2009 where it is noticed an overestimation; and then, an underestimation of the size of the UE from the currency demand approach estimation results; which is due to the overestimation of some variables that are used when estimating the size of the UE, such as government expenditures, inflation rate and interest rate.

Basing on our estimation results, we found that the increasing size of the underground economy is due to fluctuations in the labor market and inefficient and corrupt formal institutions that hinder the development of the formal economy. Besides this, the state tolerance vis-à- vis the illegality is the result of the incapacity of the state to create jobs and provide social services. This incapacity covers both its inability to finance certain economic activities, and to impose the tax and social regulations on economic agents.

Moreover, the state should include social norms in the elaboration of its policies because of their roles in reducing social conflicts, and thus increase cooperation and economic performance in the society.

And finally, the law is important for the functioning of the economy, but it is up to the state to simplify the process of creating and enforcing its regulations. This is the only way to fight against corruption, protect property rights, and restore the confidence of economic agents into the institutions of the state.

This perspective could significantly reduce the size of the underground activities.

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Appendices:

Appendix 1: synopsis of the commonly used variables, both causes and indicators, in the estimation of the NOE in different countries

Authors	country	period	Causes	Indicators	results
Edgar L. Feige, 1990 Currency demand approach		1962 - 1994	/	/	/
Edgar L. Feige, and Richard Cebula, 2011 General Currency ratio Model	United States	1960 - 2008	/	/	18-19%.
Tedds Lindsay (1998). MIMIC 11-1-3	Canada	1976- 2001	-Labour force participation rate, -Average direct tax rate, -Average indirect tax rate , -Average marginal tax rate , -Average payroll tax rate , -Dummy variable for the Voluntary Disclosure program (VDP) that equals the marginal tax rate for 1994 and onwards; -Crime rate ,	-Growth rate of gross domestic product; -Real currency per capita -Ratio of expenditures on goods and services to disposable income.	The NOE is about 7.5% in 1976 and 15.3% in 2001.

References

			<p>-Dummy variable for the implementation of the GST that equals 1 in 1991 and onwards;</p> <p>-Dummy variable for the implementation of the Underground Economy Initiative (UEI) that equals 1 in 1994 and onwards;</p> <p>-Logarithm of real self-employment income; and</p> <p>-Flow of federal regulatory transactions by the Governor in Council and individual Ministers.</p>		
<p>Loayza (1996)</p> <p>A SIMPLE ENDOGENOUS GROWTH MODEL</p> <p>MIMIC 3-1-2</p>	<p>Latin America countries</p>	<p>the early 1990's.</p>	<p>- Corporate income tax rate,</p> <p>- Labor market restrictions,</p> <p>- The strength of the enforcement system.</p>	<p>- Value-added tax evasion rate,</p> <p>- Fraction of labor force not contributing to social security.</p>	<p>Chile: 18.2%</p> <p>Argentina: 21.8%</p> <p>Costa Rica : 23.3%</p> <p>Mexico : 27.1%</p> <p>Venezuela: 30.8%</p> <p>Ecuador : 31.2%</p> <p>Colombia: 35.1%</p> <p>Uruguay: 35.2%</p> <p>Brazil : 37.8%</p> <p>Honduras: 46.7%</p>

References

					Guatemala: 50.4% Peru : 57.9% Panama: 62.1% Bolivia : 65.6%
Guillermo Vuletin, 2008 MIMIC 5-1-3	32 mainly Latin American and Caribbean countries	Early 2000s (2002 or 2003).	-Tax burden, -Labor rigidities (minimum wage), -The importance of agriculture, -The inflation rate -The strength of enforcement system.	-Workers contributing to the social security system, -The degree of unionization ³⁰ , - The gross enrollment ratio for secondary school ³¹ .	Bet 25 and 70%.
David Giles, 1999 MIMIC 5-1-3	New Zealand	1968-1994	-The degree of economic regulation, -The development of	-Growth rate of GDP per capita, -The male	11.3% in 1994.

³⁰ The *degree of unionization*, measured as the percentage of labor force with membership in some labor union, is considered. The larger the informal economy, the weaker the bargaining power of the workers in the formal sector and, therefore, the lower the degree of unionization.

³¹ The *gross enrollment ratio for secondary school* is included as an informal economy indicator. Most countries in the world have signed International Labor Organization Convention 138, which made fourteen the minimum working age.

References

			<p>taxation legislation;</p> <ul style="list-style-type: none"> -The tax-bracket "creep"; -Effect of inflation; -Measures of the "tax burden. 	<p>labor force participation rate,</p> <ul style="list-style-type: none"> -The proportion of currency to M3. 	
<p>Astrem Prokhorov, 2001</p> <p>MIMIV 8-1-5</p>	Russia	1992-2000	<ul style="list-style-type: none"> -Tax rates, -The share of public sector employees, -Indicator of quality of regulation, -The output decline, -Inflation, -The share of population living below the subsistence level, -Unemployment rate, -Labor force participation. 	<ul style="list-style-type: none"> -Cash on hands, -Share of M0 in M2, -The share of hard currency purchases in personal income; -Crime rates ; -The excess of electricity consumption over GDP. 	/
<p>Dell'Anno (2003)</p> <p>MIMIC 6-1-2</p>	Italy	1976-1980.	<ul style="list-style-type: none"> -Tax Burden, -Government consumption /GDP, -Unemployment, -Self-Employment, -Index of Efficacy of Justice, -Index of Illegality. 	<ul style="list-style-type: none"> -Real GDP, -Currency outside of banks. 	10.5% in 1980.

References

Bajada and Schneider (2003) MIMIC 3-1-2	Australia and 18 other Asian countries.	1990-2000.	-Increase of Tax and Social Security contribution Burdens, -Disposable income, - Welfare benefits.	-Currency holdings, -GDP.	For Australia, the NOE is about 13.89% in 2000.
Friedrich Schneider and Andreas Buehn, 2007 MIMIC 7-1-3	120 countries (among which we find Algeria)	Over 1999/2000 to 2005/06.	-Share of direct taxation, -Size of Government -Fiscal freedom -Economic freedom -Business freedom -Unemployment rate -GDP per capita.	-Growth rate of GDP per capita, -Employment quota, -Growth rate of local money per capita.	For the Algerian NOE, 35.8 % in 2006.
Roberto Dell'Anno, 2006 MIMIC 6-1-2	Portugal	1977-2004	-Government employment in labor force, -Tax burden, -Subsidies, -Social benefits paid by government, -Self-employment.	-Index of real GDP, -Labor force participation rate.	17.6% in 2004
Chaudhuri, Schneider and Chattopadhyay (2006) MIMIC 3-1-2	India	1960/1961 to 1997/1998.	-Inflation, -The number of persons working in the public sector, -The ratio of indirect	-The growth rate of real GDP, -The cash to M3 ratio of the	23, 19% in 1998.

References

			taxes, direct taxes.	economy.	
Dell'Anno, Gomez and Alañón Pardo (2007) MIMIC 6-1-3	France, Greece and Spain	1968 to 2002.	-Direct Tax upon the GDP, -Indirect tax upon the GDP, -Social security contributions upon the GDP, -Public employment upon the labour force -Unemployment rate -Self-employment upon the labor force.	-Real gross domestic product, -Participation ratio of the labour force, -Currency in circulation outside of banks.	9% for France, 26% for Spain and 28% for Greece.
Andreas Bulm, Friedrich schneider 2008 MIMIC 4-1-2	France	1981-2006	-Tax and social security contributions burden; -Unemployment rate, -Regulation, -Working hours.	-The monetary aggregate M1. -GDP volume index.	15.9% in 2006
Brambila Macias Jose 2008 MIMIC 5-1-2	Mexico	1970-2006	-Taxes, -Inflation, -Salaries, -The size of the public sector, -Unemployment.	-GDP, -Currency in circulation,	27.2% in 2006

References

<p>Ademola Ariyo and William Bekoe 2011 ; Currency demand approach</p>	<p>Nigeria</p>	<p>1975-2010.</p>	<p>/</p>	<p>/</p>	<p>58.63% in 2010.</p>
<p>Vjekoslav Klaric 2010 MIMIC 4-1-2</p>	<p>Croatia</p>	<p>1998-2009</p>	<p>-Tax burden (indirect and direct,) -The unemployment rate, -social security contributions.</p>	<p>-Gross Domestic Product, -M1 monetary aggregate.</p>	<p>12.1% in 2009</p>
<p>Ahmed Gulzar, Novaira Junaid, 2010 MIMIC 7-1-4</p>	<p>Pakistan</p>	<p>1973-2010</p>	<p>-Interest Rate, -Banking Services, -Financial Development, -Size of Government, -Inflation Rate, -Openness, -Total Electricity Consumption, -Economics of Freedom Index, -Corruption Index, -Literacy Rate: A Proxy of Human Capital, -Labor Force, -Unemployment Rate, -Total Population.</p>	<p>-Currency in Circulation, -Gross Domestic Product.</p>	<p>28% in 2010</p>

References

<p>Micheal Pickhardt, Jordi Sarda, 2010</p> <p>Cash-Deposit-Ratio approach</p>	<p>Germany</p>	<p>1960-2008</p>	<p>/</p>	<p>/</p>	<p>15.4% in 2008</p>
<p>Corina Maria, Andrei Stefanescu, 2011</p> <p>MIMIC 7-1-3</p>	<p>Romania</p>	<p>1990-2009</p>	<ul style="list-style-type: none"> -Tax burden; -Corruption index; -Direct taxes share in GDP; -Indirect taxes share in GDP; -GDP per capita (USD), -The official unemployment rate; -Net investments share in GDP. 	<ul style="list-style-type: none"> -Population activity rate; -Real GDP index; -M1 share in M2. 	<p>35% in 2010-2011</p>
<p>Cassar Alan. (2001).</p> <p>MIMIC 4-1-3</p>	<p>Malta</p>	<p>1971 - 1997</p>	<ul style="list-style-type: none"> - Tax Rate, - Income Effect on Workers in the Official Economy, -Unemployment Rate, -Inflation, 	<ul style="list-style-type: none"> - Currency Demand, -Male Participation Rate, -Productivity in the Recorded Economy. 	<p>25% in 1997</p>

References

<p>Trevor Breusch, 2005</p> <p>MIMIC 7-1-2</p> <p>Replication of David E.A. Giles and Lindsay M. Tedds</p>	<p>Canada</p>	<p>1976- 1995.</p>	<p>-Total number of male holders of multiple jobs,</p> <p>-Income of self- employed persons;</p> <p>-Real annual disposable income per member of the labour force</p> <p>-Nominal Canadian-US exchange rate,</p> <p>-Ratio of total corporate tax revenue to GDP,</p> <p>-Ratio of total indirect tax revenue to GDP,</p> <p>-Unemployment rate.</p>	<p>-Currency (notes and coins) in circulation outside of banks,</p> <p>-GDP Real gross domestic product.</p>	<p>15.64% in 1995.</p>
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Source: author's construction based on the different empirical evidences.

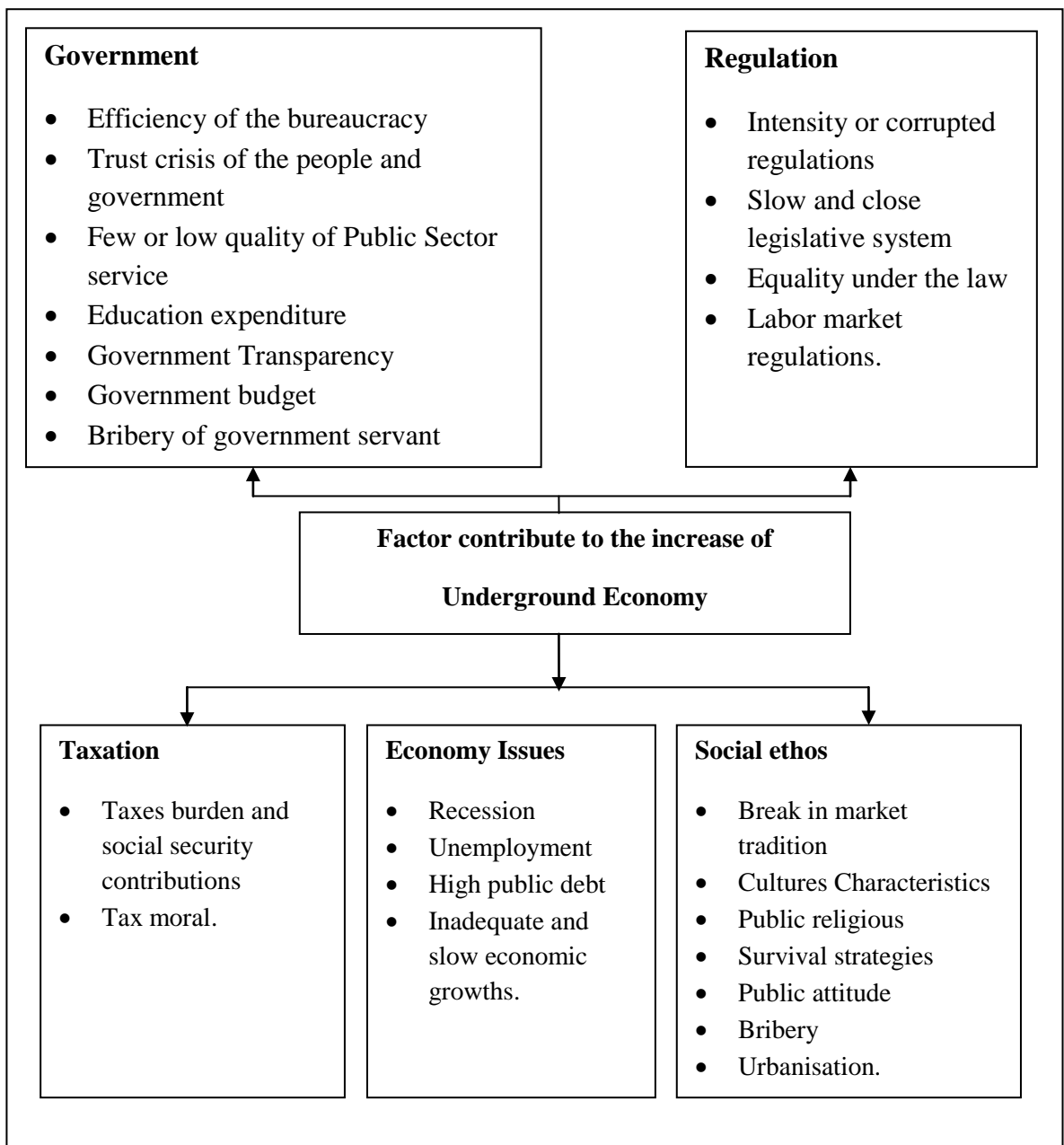
Appendix 2: relationship Underground Economy – Growth rate of GDP

	Authors	Country	Notes
POSITIVE Relation	Adam, Ginsburgh (1985)	Belgium	----
	Adds (1998)	Canada	MIMIC method
	Giles (1999b)	New Zalend	MIMIC method
	Giles, Tadds (2002)	Canada	MIMIC method
	Chatterjee, Chaudhuri, Schneider (2003)	18 Asian Countrirs	MIMIC method
	Frey, weck-	17 OECD	MIMIC method

NEGATIVE Relation	Hannemann (1984)	countries	
	Helberger, Knepel (1988)	17 OECD countries	MIMIC method
	Loyaza (1996)	14 Latin America Countries	MIMIC method In economies where : “ (1) the statutory tax burden is larger than the optimal tax burden and (2) the enforcement of compliance is too weak”, thus: “ The increase of the relative size of the informal economy generates a reduction of official economic growth” · “The negative effect is due to the shadow economy’s congestion effect that (1) reduce the availability of public services to the official economy and (2) result in the existing public services being used less efficiently”.
	Kaufmann, Kaliberda (1996)	Transition Countries	The shadow economy mitigates the decrease in official GDP, particularly in countries that experienced a large drop. They find that for every 10 percent cumulative declines in official GDP, the share of the irregular economy in the overall increases by almost 4 percent .
	Eilat, Zinnes (2000)	Transition Countries	“ A change in GDP is associated with an opposite change in the shadow’s size” ⁴⁴ and “ a one-dollar fall in GDP is associated with a 31 percent increase in the size of the shadow economy” .
	Schneider, Enste (2000)	76 countries	“ According to some studies, a growing shadow economy has a negative impact on official GDP growth” .

Source: author’s construction based on Dell’Anno, 2003.

Appendix 3: factors contribute to the increase of Underground Economy



Source: Sim Wan Jie, Huam Hon Tat, Amran Rasli, (2011). "UNDERGROUND ECONOMY: DEFINITION AND CAUSES", Business and Management Review Vol. 1(2) pp. 14 – 24

Appendix 4: the used database in percentage of GDP (constant, USD 2000)

Année	PIB par capita (taux d'évolution)	Masse monétaire (en % du PIB)	Taux du chômage	Taux d'inflation	Fardeau fiscal (en % du PIB)	Dépenses publiques (Prix constant, USD 2000)	Prix du pétrole	SNMG (Prix constant, USD 2000)	Indice de l'ES (= $\hat{\gamma} x_t$)	Taux d'évolution de l'ES (= $\hat{\gamma} \Delta x_t$)
1990	102.14	61.77	19.7	9.272	1.95439E-05	5048111218.82	22.26	83.42830843	/	/
1991	98.45	49.11	21.2	25.900	2.23427E-05	5527681715.62	18.62	108.4921613	99.03	122.24
1992	97.86	51.94	23.8	31.700	2.29394E-05	6041756158.06	18.44	111.2262328	96.20	128.03
1993	93.65	50.10	23.15	20.500	0.000139185	6017588963.37	16.33	97.88799566	95.00	131.86
1994	90.86	45.31	24.36	29.000	1.95094E-05	6258292760.58	15.53	121.3422701	91.24	122.65
1995	92.51	37.16	28.1	29.800	2.04663E-05	6514882268.50	16.86	94.37240323	91.32	127.56
1996	94.65	33.00	27.99	18.700	2.17488E-05	6775477887.43	20.29	76.09299518	95.60	135.83
1997	94.19	36.08	26.41	5.700	2.1855E-05	6910987519.77	18.68	85.33575157	98.80	134.16
1998	97.56	42.37	28.02	4.950	1.7665E-05	7118317003.64	12.28	110.1182384	97.42	125.64
1999	99.26	42.20	29.29	2.600	2.00827E-05	7296274555.79	17.48	99.33430072	99.47	128.94
2000	100	37.82	28.89	0.300	2.72296E-05	7442200375.10	27.6	79.72384546	101.05	130.76

References

2001	101.12	53.90	27.3	4.200	2.45802E-05	7710119770.59	23.12	105.547466	99.25	127.58
2002	104.32	59.99	27.66	1.400	2.22933E-05	8134176055.90	24.36	103.5731854	104.51	132.95
2003	109.87	60.20	23.72	2.583	2.4571E-05	8475811324.94	28.1	95.61433668	107.09	134.69
2004	113.86	56.90	17.65	3.562	2.54846E-05	8857222778.62	36.03	108.0440625	111.62	135.88
2005	117.88	50.59	15.3	1.640	2.81407E-05	9043224827.17	50.64	92.76556342	114.00	132.75
2006	118.42	53.26	12.3	2.326	2.92259E-05	9477299618.87	61.08	83.36098343	119.81	135.45
2007	120.12	59.67	13.8	3.560	2.7275E-05	10150187891.81	69.08	93.19955904	119.84	132.85
2008	121.14	58.82	11.3	4.862	3.07466E-05	10840400668.45	94.45	81.32514268	123.63	138.63
2009	122.20	66.96	10.17	5.740	2.5137E-05	11555867112.57	61	91.65030827	123.04	136.15

We used the following averages if the transformation of variables from current prices to constant USD prices:

First of all, we need to convert all the variables into US. Dollar using the official exchange rate³². To be precise, we used the following formula:

$$\text{values in US dollar} = \frac{\text{value in local currency}}{\text{Official exchange rate}}$$

Secondly, we transformed the variables into constant prices, base year 2000, by using the GDP deflator, (2000= 100)³³, because it shows the rate of prices change in the economy as a whole. To be precise, we can use the following formula:

$$\text{Constant prices} = \frac{\text{current prices}}{\text{GDP deflator, (2000 = 100)}}$$

Finally, we used the variables as share of GDP (as % of GDP), using the following formula:

$$\text{Percentage value of GDP} = \frac{\text{current or constant values}}{\text{GDP current or constant}} * 100$$

Moreover, we found that whether using the current values or the constant values when calculating the percentage value of GDP, we obtained the same results.

As mentioned above, all the variables are used as percentages values of GDP, except for the GDP per capita; which is used as annual growth rate. Besides, the growth rate is calculated using the constant, USD 2000, or current LCU.

³² Official exchange rate (LCU per US\$, period average) refers to the exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar).

³³ Inflation, GDP deflator (annual %): inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency.

Appendix 5: Data description

Variables	Symbol	Unit root	Transf.	Note	Data sources
Growth rate of GDP per capita (2000=100)	Y_1	I(1)	$\Delta (Y1)$	Growth rate	FMI ; Perspective data base
Money and quasi money (M2)	Y_2	I(1)	$\Delta (Y2)$	As % of GDP	FMI
Unemployment rate	X1	I(1)	$\Delta (X1)$	As % of total labor force	ONS; FMI
Direct taxes	X2	I(0)	/	As % of GDP	ONS (TEE)
Indirect taxes	X3	I(1)	$\Delta (X3)$	As % of GDP	ONS (TEE)
Social security contributions	X4	I(1)	$\Delta (X4)$	As % of GDP	ONS (TEE)
General government expenditure (current US\$)	X5	I(1)	$\Delta (X5)$	As % of GDP	FMI; World Bank
Crude Oil Prices	X6	I(1)	$\Delta (X6)$	US. Dollar per barrel	OPEC; US. Energy Information Administration
Minimum wage (current LCU)	X7	I(1)	$\Delta (X7)$	As % of GDP	ONS (TEE)
Inflation, GDP deflator	X8	I(1)	$\Delta (X8)$	/	FMI
Interest rate	X9	I(1)	$\Delta (X9)$	/	FMI

Official exchange rate (used in the calculations of constant values)	/	/	/	LCU per US\$, period average	FMI
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Source: author's construction based on the IMF and World Bank database.

Appendix 6: Residual tests

Model 01: MIMIC 6-1-2

Serial correlation test (LM test):

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.268798	Prob. F(2,9)	0.7702
Obs*R-squared	1.127320	Prob. Chi-Square(2)	0.5691

Heteroscedasticity (Breusch-Pagan-Godfrey test)

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.619435	Prob. F(8,11)	0.2251
Obs*R-squared	10.81630	Prob. Chi-Square(8)	0.2123
Scaled explained SS	3.289759	Prob. Chi-Square(8)	0.9149

Model 02: MIMIC 4-1-2, a

Serial correlation test (LM test):

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.043951	Prob. F(2,13)	0.9571
Obs*R-squared	0.134326	Prob. Chi-Square(2)	0.9350

Heteroscedasticity (Breusch-Pagan-Godfrey test)

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.966614	Prob. F(4,15)	0.4543
Obs*R-squared	4.098763	Prob. Chi-Square(4)	0.3928
Scaled explained SS	2.351234	Prob. Chi-Square(4)	0.6715

Model 03: MIMIC 4-1-2, b (*)

Serial correlation test (LM test):

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.340700	Prob. F(2,12)	0.7179
Obs*R-squared	1.020913	Prob. Chi-Square(2)	0.6002

Heteroscedasticity (Breusch-Pagan-Godfrey test)

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.003086	Prob. F(4,14)	0.4386
Obs*R-squared	4.232348	Prob. Chi-Square(4)	0.3755
Scaled explained SS	2.557760	Prob. Chi-Square(4)	0.6343

Appendix 7: Stationarity results

- GDP per capita :

At level :

Null Hypothesis: PIBCAPITA has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.309348	0.0948
Test critical values:		
1% level	-4.532598	
5% level	-3.673616	
10% level	-3.277364	

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

Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 19

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(PIBCAPITA)

Method: Least Squares

Date: 10/19/13 Time: 20:27

Sample (adjusted): 1991 2009

Included observations: 19 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PIBCAPITA(-1)	-0.246040	0.074347	-3.309348	0.0044
C	20.12216	6.624599	3.037491	0.0078
@TREND(1990)	0.641633	0.133520	4.805530	0.0002

R-squared	0.609881	Mean dependent var	1.055798
Adjusted R-squared	0.561117	S.D. dependent var	2.584388
S.E. of regression	1.712113	Akaike info criterion	4.057272
Sum squared resid	46.90127	Schwarz criterion	4.206394
Log likelihood	-35.54409	Hannan-Quinn criter.	4.082510
F-statistic	12.50658	Durbin-Watson stat	1.556774
Prob(F-statistic)	0.000537		

In first difference :

Null Hypothesis: D(PIBCAPITA) has a unit root				
Exogenous: None				
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2.177171	0.0319
Test critical values:	1% level		-2.699769	
	5% level		-1.961409	
	10% level		-1.606610	
*MacKinnon (1996) one-sided p-values.				
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(PIBCAPITA,2)				
Method: Least Squares				
Date: 10/19/13 Time: 20:28				
Sample (adjusted): 1992 2009				
Included observations: 18 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PIBCAPITA(-1))	-0.385927	0.177261	-2.177171	0.0438
R-squared	0.207728	Mean dependent var	0.263159	
Adjusted R-squared	0.207728	S.D. dependent var	2.358799	
S.E. of regression	2.099558	Akaike info criterion	4.375284	
Sum squared resid	74.93846	Schwarz criterion	4.424749	
Log likelihood	-38.37755	Hannan-Quinn criter.	4.382104	
Durbin-Watson stat	2.076670			

- Money and quasi-money (M2) :

At level :

Null Hypothesis: M2 has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 1 (Automatic based on SIC, MAXLAG=4)				
			t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-1.757080	0.6825
Test critical values:	1% level	-4.571559	
	5% level	-3.690814	
	10% level	-3.286909	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(M2)

Method: Least Squares

Date: 10/19/13 Time: 20:29

Sample (adjusted): 1992 2009

Included observations: 18 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
M2(-1)	-0.337840	0.192273	-1.757080	0.1007
D(M2(-1))	0.106252	0.231485	0.459001	0.6533
C	11.27574	8.375645	1.346253	0.1996
@TREND(1990)	0.592581	0.323619	1.831105	0.0884

R-squared	0.247827	Mean dependent var	0.991597
Adjusted R-squared	0.086647	S.D. dependent var	6.086756
S.E. of regression	5.817082	Akaike info criterion	6.552604
Sum squared resid	473.7381	Schwarz criterion	6.750465
Log likelihood	-54.97344	Hannan-Quinn criter.	6.579887
F-statistic	1.537582	Durbin-Watson stat	1.630818
Prob(F-statistic)	0.248589		

In first difference :

Null Hypothesis: D(M2) has a unit root

Exogenous: None

Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.943610	0.0005
Test critical values:	1% level	-2.699769
	5% level	-1.961409
	10% level	-1.606610

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(M2,2)

Method: Least Squares

Date: 10/19/13 Time: 20:29

Sample (adjusted): 1992 2009

Included observations: 18 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
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D(M2(-1))	-0.887132	0.224954	-3.943610	0.0010
R-squared	0.467283	Mean dependent var		1.155383
Adjusted R-squared	0.467283	S.D. dependent var		8.393895
S.E. of regression	6.126491	Akaike info criterion		6.517074
Sum squared resid	638.0761	Schwarz criterion		6.566539
Log likelihood	-57.65367	Hannan-Quinn criter.		6.523895
Durbin-Watson stat	1.663903			

- Unemployment rate :

At level :

Null Hypothesis: TCH has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.377510	0.8340
Test critical values:		
1% level	-4.532598	
5% level	-3.673616	
10% level	-3.277364	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 19

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TCH)
Method: Least Squares
Date: 10/19/13 Time: 20:30
Sample (adjusted): 1991 2009
Included observations: 19 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TCH(-1)	-0.126738	0.092005	-1.377510	0.1873
C	5.540490	2.755184	2.010933	0.0615
@TREND(1990)	-0.317418	0.097542	-3.254157	0.0050

R-squared	0.401052	Mean dependent var	-0.501579
Adjusted R-squared	0.326183	S.D. dependent var	2.430172
S.E. of regression	1.994839	Akaike info criterion	4.362943
Sum squared resid	63.67015	Schwarz criterion	4.512065
Log likelihood	-38.44796	Hannan-Quinn criter.	4.388181
F-statistic	5.356746	Durbin-Watson stat	1.832374
Prob(F-statistic)	0.016562		

in first difference :

Null Hypothesis: D(TCH) has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

		t-Statistic	Prob.*	
Augmented Dickey-Fuller test statistic				
		-2.736072	0.0092	
Test critical values:	1% level	-2.699769		
	5% level	-1.961409		
	10% level	-1.606610		
*MacKinnon (1996) one-sided p-values. Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(TCH,2) Method: Least Squares Date: 10/19/13 Time: 20:30 Sample (adjusted): 1992 2009 Included observations: 18 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TCH(-1))	-0.606993	0.221848	-2.736072	0.0141
R-squared	0.303706	Mean dependent var		-0.146111
Adjusted R-squared	0.303706	S.D. dependent var		2.785952
S.E. of regression	2.324716	Akaike info criterion		4.579026
Sum squared resid	91.87319	Schwarz criterion		4.628491
Log likelihood	-40.21123	Hannan-Quinn criter.		4.585846
Durbin-Watson stat	2.078612			

- Government expenditures :

At level :

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			
		-1.665400	0.7242
Test critical values:	1% level	-4.571559	
	5% level	-3.690814	
	10% level	-3.286909	
*MacKinnon (1996) one-sided p-values. Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18			
Augmented Dickey-Fuller Test Equation Dependent Variable: D(DP) Method: Least Squares Date: 10/19/13 Time: 20:31 Sample (adjusted): 1992 2009 Included observations: 18 after adjustments			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.251718	0.151146	-1.665400	0.1180
D(DP(-1))	0.512054	0.178547	2.867904	0.0124
C	3.233601	2.005050	1.612729	0.1291
@TREND(1990)	0.022882	0.015046	1.520755	0.1506
R-squared	0.486228	Mean dependent var		0.167368
Adjusted R-squared	0.376134	S.D. dependent var		0.366957
S.E. of regression	0.289842	Akaike info criterion		0.554165
Sum squared resid	1.176114	Schwarz criterion		0.752026
Log likelihood	-0.987488	Hannan-Quinn criter.		0.581448
F-statistic	4.416479	Durbin-Watson stat		2.387705
Prob(F-statistic)	0.022000			

in first difference:

Null Hypothesis: D(DP) has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.792480	0.0081
Test critical values:		
1% level	-2.699769	
5% level	-1.961409	
10% level	-1.606610	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 18

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP,2)
Method: Least Squares
Date: 10/19/13 Time: 20:32
Sample (adjusted): 1992 2009
Included observations: 18 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DP(-1))	-0.431650	0.154576	-2.792480	0.0125
R-squared	0.308669	Mean dependent var		-0.032499
Adjusted R-squared	0.308669	S.D. dependent var		0.363862
S.E. of regression	0.302538	Akaike info criterion		0.500732
Sum squared resid	1.555996	Schwarz criterion		0.550197
Log likelihood	-3.506589	Hannan-Quinn criter.		0.507553
Durbin-Watson stat	2.383331			

- Crude oil prices :

At level :

Null Hypothesis: PP has a unit root

Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.221333	0.4523
Test critical values:		
1% level	-4.532598	
5% level	-3.673616	
10% level	-3.277364	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 19

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PP)
Method: Least Squares
Date: 10/19/13 Time: 20:32
Sample (adjusted): 1991 2009
Included observations: 19 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PP(-1)	-0.398504	0.179399	-2.221333	0.0411
C	-0.901088	5.024483	-0.179339	0.8599
@TREND(1990)	1.534044	0.703261	2.181328	0.0444

R-squared	0.254085	Mean dependent var	2.038947
Adjusted R-squared	0.160845	S.D. dependent var	11.48282
S.E. of regression	10.51888	Akaike info criterion	7.688159
Sum squared resid	1770.348	Schwarz criterion	7.837281
Log likelihood	-70.03751	Hannan-Quinn criter.	7.713397
F-statistic	2.725081	Durbin-Watson stat	1.866291
Prob(F-statistic)	0.095833		

in first difference :

Null Hypothesis: D(PP) has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.734038	0.0009
Test critical values:		
1% level	-2.699769	
5% level	-1.961409	
10% level	-1.606610	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PP,2)
Method: Least Squares
Date: 10/19/13 Time: 20:33
Sample (adjusted): 1992 2009

Included observations: 18 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PP(-1))	-1.209986	0.324042	-3.734038	0.0017
R-squared	0.444271	Mean dependent var		-1.656111
Adjusted R-squared	0.444271	S.D. dependent var		15.87314
S.E. of regression	11.83298	Akaike info criterion		7.833612
Sum squared resid	2380.332	Schwarz criterion		7.883077
Log likelihood	-69.50251	Hannan-Quinn criter.		7.840432
Durbin-Watson stat	1.624675			

- Inflation rate :

At level :

Null Hypothesis: INF has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 2 (Automatic based on SIC, MAXLAG=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-0.781925	0.9472
Test critical values:		
1% level	-4.616209	
5% level	-3.710482	
10% level	-3.297799	

*MacKinnon (1996) one-sided p-values.
 Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 17

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(INF)
 Method: Least Squares
 Date: 10/19/13 Time: 20:33
 Sample (adjusted): 1993 2009
 Included observations: 17 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF(-1)	-0.200576	0.256515	-0.781925	0.4494
D(INF(-1))	-0.027372	0.276893	-0.098852	0.9229
D(INF(-2))	-0.135778	0.217296	-0.624851	0.5438
C	0.027315	8.434695	0.003238	0.9975
@TREND(1990)	0.031001	0.532534	0.058214	0.9545
R-squared	0.275450	Mean dependent var		-1.527059
Adjusted R-squared	0.033933	S.D. dependent var		5.566833
S.E. of regression	5.471568	Akaike info criterion		6.476936
Sum squared resid	359.2567	Schwarz criterion		6.721999
Log likelihood	-50.05396	Hannan-Quinn criter.		6.501296
F-statistic	1.140499	Durbin-Watson stat		1.601653
Prob(F-statistic)	0.383795			

in first difference :

Null Hypothesis: D(INF) has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.611053	0.0001
Test critical values:		
1% level	-2.699769	
5% level	-1.961409	
10% level	-1.606610	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 18

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INF,2)
Method: Least Squares
Date: 10/19/13 Time: 20:33
Sample (adjusted): 1992 2009
Included observations: 18 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF(-1))	-0.912679	0.197933	-4.611053	0.0002

R-squared	0.550804	Mean dependent var	-0.875000
Adjusted R-squared	0.550804	S.D. dependent var	8.583936
S.E. of regression	5.753130	Akaike info criterion	6.391318
Sum squared resid	562.6746	Schwarz criterion	6.440783
Log likelihood	-56.52186	Hannan-Quinn criter.	6.398139
Durbin-Watson stat	2.154300		

- Minimum wages :

At level :

Null Hypothesis: SNMGSS has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic based on SIC, MAXLAG=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.036783	0.0268
Test critical values:		
1% level	-4.571559	
5% level	-3.690814	
10% level	-3.286909	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations

and may not be accurate for a sample size of 18

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(SNMGSS)

Method: Least Squares

Date: 10/19/13 Time: 20:34

Sample (adjusted): 1992 2009

Included observations: 18 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SNMGSS(-1)	-1.381017	0.342108	-4.036783	0.0012
D(SNMGSS(-1))	0.364488	0.231331	1.575612	0.1374
C	143.4559	36.25453	3.956911	0.0014
@TREND(1990)	-0.979642	0.587613	-1.667154	0.1177
R-squared	0.579368	Mean dependent var		-0.935659
Adjusted R-squared	0.489232	S.D. dependent var		16.33579
S.E. of regression	11.67487	Akaike info criterion		7.945884
Sum squared resid	1908.235	Schwarz criterion		8.143744
Log likelihood	-67.51296	Hannan-Quinn criter.		7.973166
F-statistic	6.427742	Durbin-Watson stat		1.907864
Prob(F-statistic)	0.005816			

in first difference :

Null Hypothesis: D(SNMGSS) has a unit root

Exogenous: None

Lag Length: 1 (Automatic based on SIC, MAXLAG=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.257894	0.0000
Test critical values:		
1% level	-2.708094	
5% level	-1.962813	
10% level	-1.606129	

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

Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 17

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(SNMGSS,2)

Method: Least Squares

Date: 10/19/13 Time: 20:35

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SNMGSS(-1))	-2.042781	0.326433	-6.257894	0.0000
D(SNMGSS(-1),2)	0.544049	0.198664	2.738538	0.0152
R-squared	0.775630	Mean dependent var		0.446535
Adjusted R-squared	0.760672	S.D. dependent var		27.37914
S.E. of regression	13.39418	Akaike info criterion		8.137649
Sum squared resid	2691.062	Schwarz criterion		8.235674

Log likelihood	-67.17002	Hannan-Quinn criter.	8.147393
Durbin-Watson stat	1.958538		

- Tax burden :

At level :

Null Hypothesis: FARD has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-4.596723	0.0088
Test critical values:				
	1% level		-4.532598	
	5% level		-3.673616	
	10% level		-3.277364	
*MacKinnon (1996) one-sided p-values.				
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 19				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(FARD)				
Method: Least Squares				
Date: 10/19/13 Time: 20:35				
Sample (adjusted): 1991 2009				
Included observations: 19 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
FARD(-1)	-1.124848	0.244706	-4.596723	0.0003
C	4.45E-05	1.59E-05	2.792991	0.0130
@TREND(1990)	-1.08E-06	1.16E-06	-0.926812	0.3678
R-squared	0.569634	Mean dependent var		2.94E-07
Adjusted R-squared	0.515838	S.D. dependent var		3.94E-05
S.E. of regression	2.74E-05	Akaike info criterion		-18.02521
Sum squared resid	1.20E-08	Schwarz criterion		-17.87609
Log likelihood	174.2395	Hannan-Quinn criter.		-17.99998
F-statistic	10.58882	Durbin-Watson stat		2.071870
Prob(F-statistic)	0.001177			

- The ratio C/ M2 :

At level :

Null Hypothesis: CM2 has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)				

	t-Statistic	Prob.*		
Augmented Dickey-Fuller test statistic	-1.441706	0.8134		
Test critical values:				
1% level	-4.532598			
5% level	-3.673616			
10% level	-3.277364			
*MacKinnon (1996) one-sided p-values. Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 19				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(CM2) Method: Least Squares Date: 11/09/13 Time: 19:40 Sample (adjusted): 1991 2009 Included observations: 19 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CM2(-1)	-0.399772	0.277291	-1.441706	0.1687
C	0.139272	0.109499	1.271912	0.2216
@TREND(1990)	-0.002533	0.002697	-0.939152	0.3616
R-squared	0.200597	Mean dependent var		-0.006357
Adjusted R-squared	0.100672	S.D. dependent var		0.021052
S.E. of regression	0.019964	Akaike info criterion		-4.845843
Sum squared resid	0.006377	Schwarz criterion		-4.696721
Log likelihood	49.03551	Hannan-Quinn criter.		-4.820606
F-statistic	2.007471	Durbin-Watson stat		1.725538
Prob(F-statistic)	0.166773			

In first difference :

Null Hypothesis: D(CM2) has a unit root Exogenous: None Lag Length: 0 (Automatic based on SIC, MAXLAG=4)		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.737511	0.0009
Test critical values:		
1% level	-2.699769	
5% level	-1.961409	
10% level	-1.606610	
*MacKinnon (1996) one-sided p-values. Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18		
Augmented Dickey-Fuller Test Equation Dependent Variable: D(CM2,2) Method: Least Squares Date: 11/09/13 Time: 19:41 Sample (adjusted): 1992 2009 Included observations: 18 after adjustments		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CM2(-1))	-0.966982	0.258724	-3.737511	0.0016
R-squared	0.446271	Mean dependent var		0.002735
Adjusted R-squared	0.446271	S.D. dependent var		0.030120
S.E. of regression	0.022413	Akaike info criterion		-4.704362
Sum squared resid	0.008540	Schwarz criterion		-4.654897
Log likelihood	43.33926	Hannan-Quinn criter.		-4.697541
Durbin-Watson stat	1.812460			

- Interest rate :

At level :

Null Hypothesis: R has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic based on SIC, MAXLAG=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.970402	0.1676
Test critical values:		
1% level	-4.616209	
5% level	-3.710482	
10% level	-3.297799	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 17

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(R)
Method: Least Squares
Date: 11/09/13 Time: 12:02
Sample (adjusted): 1993 2009
Included observations: 17 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
R(-1)	-0.484189	0.163005	-2.970402	0.0117
D(R(-1))	0.495835	0.208721	2.375591	0.0350
D(R(-2))	-0.001146	0.237588	-0.004822	0.9962
C	7.752606	2.583300	3.001047	0.0110
@TREND(1990)	-0.400011	0.133536	-2.995521	0.0112
R-squared	0.576815	Mean dependent var		-0.367647
Adjusted R-squared	0.435753	S.D. dependent var		2.000203
S.E. of regression	1.502480	Akaike info criterion		3.892040
Sum squared resid	27.08936	Schwarz criterion		4.137103
Log likelihood	-28.08234	Hannan-Quinn criter.		3.916400
F-statistic	4.089091	Durbin-Watson stat		2.326094
Prob(F-statistic)	0.025622			

In first difference :

Null Hypothesis: D(R) has a unit root				
Exogenous: None				
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2.609315	0.0123
Test critical values:	1% level		-2.699769	
	5% level		-1.961409	
	10% level		-1.606610	
*MacKinnon (1996) one-sided p-values.				
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(R,2)				
Method: Least Squares				
Date: 11/09/13 Time: 12:02				
Sample (adjusted): 1992 2009				
Included observations: 18 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(R(-1))	-0.571940	0.219192	-2.609315	0.0183
R-squared	0.285970	Mean dependent var		-1.11E-16
Adjusted R-squared	0.285970	S.D. dependent var		2.112311
S.E. of regression	1.784909	Akaike info criterion		4.050564
Sum squared resid	54.16029	Schwarz criterion		4.100029
Log likelihood	-35.45508	Hannan-Quinn criter.		4.057385
Durbin-Watson stat	1.780952			

Abstract

Today's development challenge lies in the link between institutions and growth rates, which conduct to a crucial problem of developing countries, the so-called the underground economy (UE). In this research we will emphasize the impact of institutions on the rising size of the UE. To do so, we will measure the size of the Algerian UE using the modeling approach (the MIMIC model), in addition to the monetary approach over the period 1990 to 2009. We find that the size of the underground economy is about 24 % in average; and main causes of the development of the hidden activities are: inflation rate, government expenditures, unemployment and minimum wages.

Keywords: Underground economy, New Institutional Economics, MIMIC model, economic growth, tax evasion and tax compliance.

Résumé:

Le défi actuel de développement réside dans le lien entre les institutions et les taux de croissance, qui conduisent à un problème crucial dans les pays en développement, dite l'économie souterraine (ES). Dans cette recherche, nous mettrons l'accent sur l'impact des institutions sur le développement de l'ES. Pour ce faire, nous allons mesurer la taille de l'économie Algérienne souterraine en utilisant le MIMIC modèle, en plus de l'approche monétaire durant la période de 1990 à 2009. Nous trouvons que la taille de l'économie Algérienne souterraine est d'environ 24% en moyenne, et causes principaux du développement des activités souterraines sont: taux d'inflation, les dépenses publiques, le chômage et le salaire minimum.

Mots clés : Economie souterraine, économie des institutions, le modèle MIMIC, taux de croissance, évasion fiscale.

الملخص:

إن من أبرز التحديات التي تواجهها الدول النامية في الوقت الراهن هي ما يسمى بالاقتصاديات الغير الرسمية، لذا سنقوم في هذا البحث بدراسة أثر المؤسسات على نمو الاقتصاد الغير الرسمي. ولتحقيق ذلك سنقوم بقياس حجم الاقتصاد الغير الرسمي في الجزائر باستعمال نموذج MIMIC و المقاربة النقدية خلال الفترة 1990 - 2009، و تشير النتائج إلا أن حجم الاقتصاد الغير الرسمي في الجزائر يقدر ب 24 % و أن الأسباب الرئيسية لنمو هذه الأنشطة الغير الرسمية هي: معدل التضخم والإنفاق الحكومي و البطالة و الحد الأدنى للأجور.

الكلمات المفتاحية: الاقتصاد الغير الرسمي، اقتصاد المؤسساتية، النموذج MIMIC، معدل النمو، التهرب الضريبي.