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The Determinants of the Informal Economy in Algeria: An Econometric Study

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بسم الله الرحمن الرحيم

I dedicate this dissertation to:
My family, specifically my brother

Aymen Salah Bennihi
August 2021

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I want to express my sincere thanks to my supervisor Prof. **Lahcene Bouriche** to propose this exciting topic and giving me the opportunity to explore it, encouragement, kindness and motivation during my PhD journey.

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Abstract

This study aims first to investigate the main determinants and sources of informality in Algeria, second to estimate the size and evolution of the informal economy (IE) from 1980 to 2017, third to analyse the interaction between the informal and formal economy over the same period. For the first two purposes, the study employs two macroeconomic approaches the Currency Demand Approach (CDA) and Multiple Causes Multiple Indicators (MIMIC) approach, and for the fourth purpose, a growth model and the Granger causality test are employed to explore the direction of causality between these two economies.

The study revealed several significant results. First, according to the MIMIC results, the tax burden is the most crucial determinant, followed by the size of the agriculture sector, quality of institutions, and GDP per capita. Second, the scope of Algeria's informal economy using CDA and MIMIC approaches is 21% and 33.5% of the official GDP, respectively, and it has been growing in scope over the former 15 years. Furthermore, interaction analyses between the two economies revealed that the IE positively influences the official economy in the short run, while in the long run, this influence is reversed. Moreover, unidirectional Granger causality from GDP to IE is observed.

As for policy implications, the Algerian government must review its tax policies, generalize electronic transactions in economic activities, reduce corruption in the public administrations, and re-examine policies performed to stimulate the agricultural sector, which half of their influence is consumed by the IE.

Key words: informal economy; multiple indicators multiple causes approach; currency demand approach; ARDL; Granger causality.

JEL classification: C51; C39; O17; E26

الملخص

تهدف هذه الدراسة أولاً إلى دراسة المحددات الرئيسية ومصادر الاقتصاد غير الرسمي في الجزائر، ثانيًا تقدير حجم وتطور الاقتصاد غير الرسمي (IE) من 1980 إلى 2017، ثالثًا لتحليل التفاعل بين الاقتصاد غير الرسمي والاقتصاد الرسمي خلال نفس الفترة. بالنسبة للهدفين الأولين، تستخدم الدراسة مقاربتين من الاقتصاد الكلي، وهما مقاربة الطلب على العملة (CDA) ومقاربة المؤشرات المتعددة والأسباب متعددة (MIMIC)، وللهدف الرابع، تم استعمال نموذج النمو الاقتصادي ونموذج Granger لاختبار واستكشاف اتجاه السببية بين هذين القطاعين.

كشفت الدراسة عن عدة نتائج مهمة. أولا، ووفقًا لنتائج MIMIC، فإن العبء الضريبي هو المحدد الأكثر أهمية، يليه حجم قطاع الزراعة، ونوعية المؤسسات، ونصيب الفرد من الناتج المحلي الإجمالي. ثانيا، إن متوسط حجم الاقتصاد غير الرسمي في الجزائر باستخدام مقاربة CDA وMIMIC هو 21٪ و33.48٪ من الناتج المحلي الإجمالي الرسمي، على التوالي، وقد زاد حجمه على مدار الخمسة عشر عامًا الماضية. رابعًا، كشفت تحليلات التفاعل بين القطاعين أن الاقتصاد غير الرسمي يؤثر إيجابًا على الاقتصاد الرسمي على المدى القصير، بينما على المدى الطويل، هذا التأثير ينعكس. بالإضافة إلى ذلك، تم العثور على سببية Granger أحادية الاتجاه من الناتج المحلي الإجمالي إلى الاقتصاد غير الرسمي.

أما بالنسبة للسياسات الاقتصادية المقترحة، تحتاج الحكومة الجزائرية إلى إعادة النظر في سياساتها الضريبية، لتعميم استخدام المعاملات الإلكترونية في الأنشطة الاقتصادية، الحد من الفساد في الإدارات العامة، وإعادة النظر في السياسات المنفذة لتحفيز القطاع الزراعي الذي يتم تسريب نصف أثرها للاقتصاد غير الرسمي.

الكلمات المفتاحية: اقتصاد غير الرسمي؛ مقاربة الطلب على النقود؛ مقاربة المؤشرات المتعددة والأسباب المتعددة؛ سببية Granger؛ ARDL.

تصنيف JEL: C51; C39; O17; E26

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ADF: Augmented Dickey Fuller unit root test

C: currency

CDA: Currency Demand Approach

CDR: Currency Demand Ratio

CFI: Comparative Fit Index

GDP: Gross Domestic Product

GLS: General Least Squares

GNP: Gross National Product

IE: Informal Economy

Log: logarithmic transformation

M1: Money supply in the narrow definition

M2: money supply in the broader definition

MIMIC: Multiple Indicators Multiple Causes

PP: Phillips Perron unit root test

RMSEA: Root Mean Square Error Approximation

SEM: Structural Equation Modeling

SRMR: Standard Root Mean Residual

TLI: Tucker-Lewis Index

ZA: Zivot Androws

π: inflation

CASI : Confédération Algérienne des Syndicats Indépendants

NASYE : National Agency for the Support of Youth Employment

GENERAL

INTRODUCTION

i. Problem statement

The informal economy (IE) is an essential issue for policymakers, especially in developing countries, where its existence is severe compared to advanced countries (Schneider, 2005). Figure 1 presents the calculation done by Medina and Schneider (2018) in the year 2015. As shown, this phenomenon is spread all over the world, especially in developing countries. By decreasing government income and impacting governments' economic actions, the IE misrepresents formal statistics and increases the budget deficit (Aigner, Schneider, and Ghosh, 1988). As a result, a growing number of research have been conducted to investigate the drivers, determine the scale, and analyse the interplay of the IE with other economic factors.

Despite the current literature, researchers have failed to settle on one united definition of IE; adopting a specific definition determines the method of measuring it. Most researchers who try to measure and estimate the informal economy face the difficulty of defining it. Several names have been given to the IE, such as "informal economy," "shadow economy," "underground economy," and many others. Consequently, numerous approaches to measure the extent of the IE have been suggested.

In recent years, studies have suggested a number of techniques to determining the real origins of the IE in order to quantify the extent and scope of this multidimensional economic phenomena. Three basic techniques may be identified while reviewing economic publications. The first one is the direct technique, sometimes known as a micro approach since it is based on sample surveys and audit measures of undeclared taxable revenue (Wang, Lin, and Yu, 2006). The second approach is more indirect. This strategy, unlike the previous one, is based on macroeconomic data in general; the main principle of these approaches is to measure traces left in official statistics published by formal agencies. The third strategy is known as the model approach, and it is based on structural equation modelling (SEM) and the statistical concept of unobserved factors; it was initially used by Frey and Weck-Hanneman (1984). These strategies are employed all around the world. Quintano and Mazzocchi (2014) for example, used the model technique to analyse the IE for 17 Mediterranean nations. In the instance of Peru, Hernandez (2009) used the currency demand method (CDA). The dispute over whether technique is superior, or more suited for measuring the IE, is still continuing. Yet, according to Buehn and Schneider (2012), , each technique has advantages and disadvantages, so there is no optimal approach to measuring the IE size.

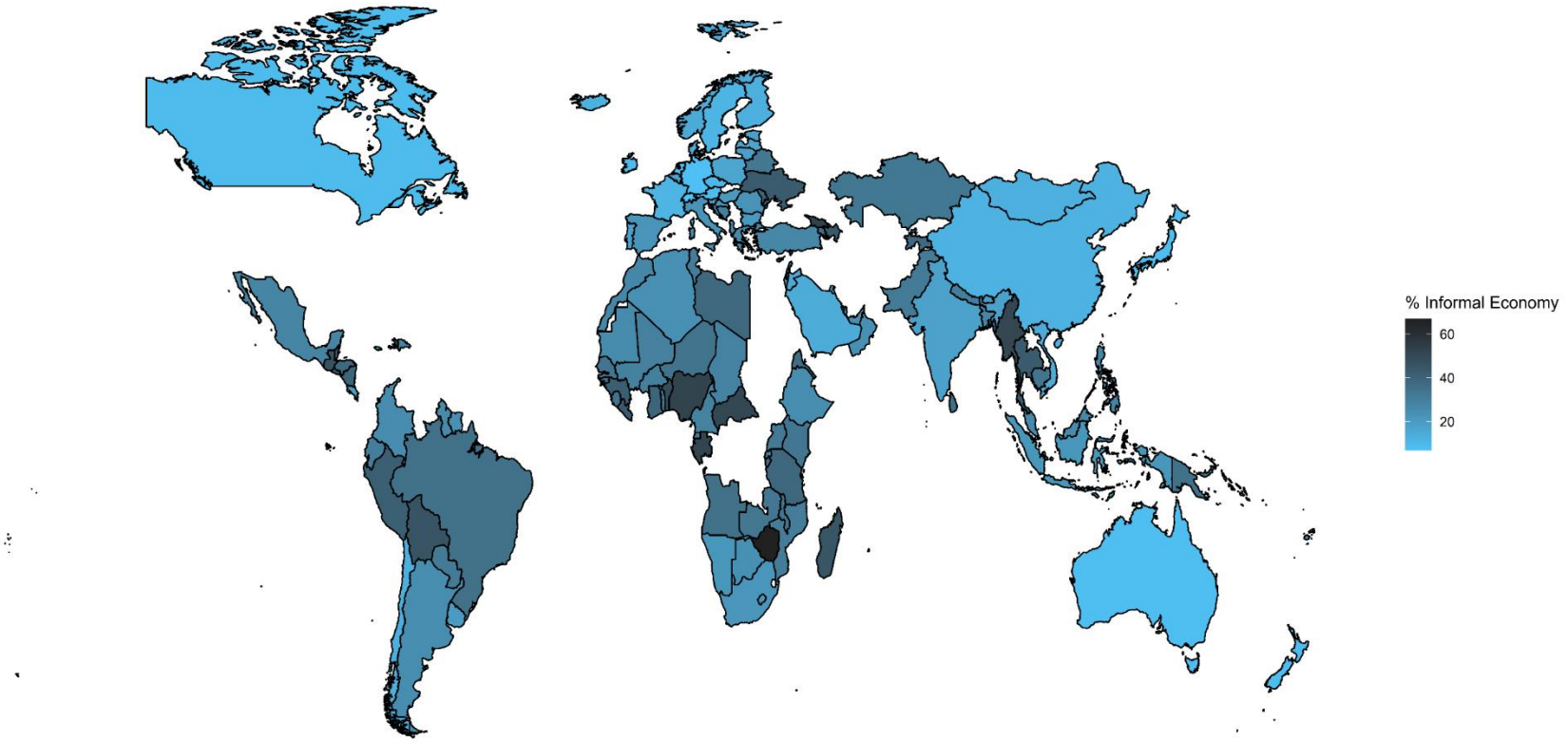

Figure 1 Estimations of the informal economy in 2015.
Source: Medina and Schneider (2018).

There are published articles that measure the magnitude of Algerian IE as a proportion of the declared GDP (see Figure 2). Unfortunately, almost all of these studies use a broad model to analyse numerous nations at once (e.g., Abd El Aziz and Zaki, 2019; Alm and Embaye, 2013; Medina and Schneider, 2019) which may lead to omitting certain crucial causative factors or assessing smaller magnitude and growth behaviour. Medina and Schneider (2019) for one, assessed the size distribution of the IE from 2000 to 2017 to be 32.2 percent of formal GDP, with a downward trend. In contrast, Abd El Aziz and Zaki (2019) calculated a rising trend during the same time period, with a brief fall from 2004 to 2008, and the average magnitude of the IE at 19.9 percent of formal GDP. Furthermore, the two studies identified two unique categories of causative factors that are predicted to influence the size of the Algerian IE. As a result, further research studying the extent and drivers of this phenomena specifically in the Algerian context are required to help clarify the earlier inconsistencies and enhance the IE literature in Algeria, which is one of our primary goals in this work.

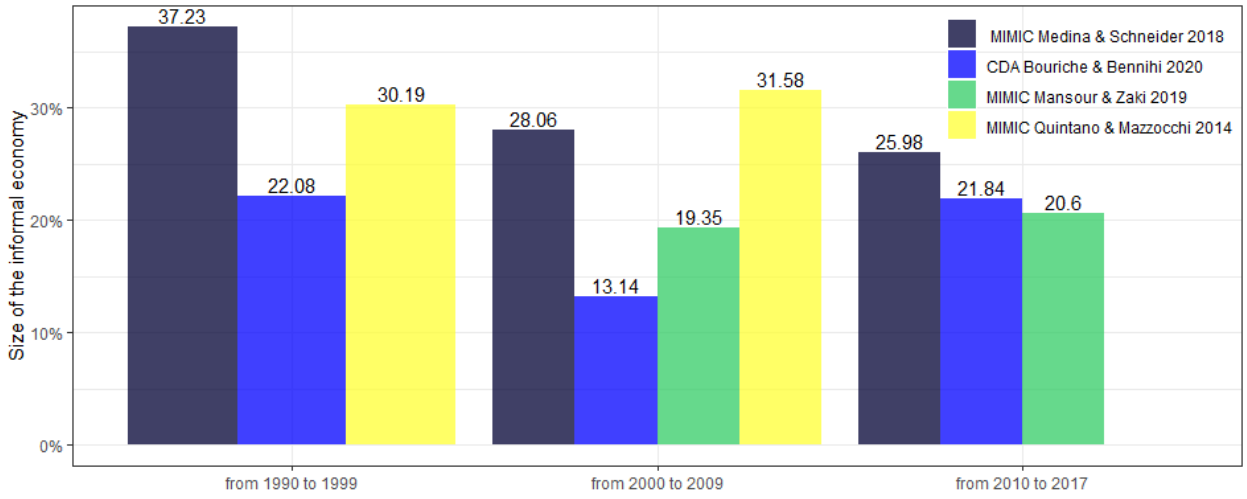

Figure 2 The existing macroeconomic estimations of the IE in Algeria
Source: Author's own construction.

Compared to the present economic literature, there are less research dedicated to investigating the IE's causes and development, notably in Algeria, using indirect methodologies, mainly the model approach, the only exceptions are Bounoua, Sebbah, and Benikhlef (2014) and Kori (2018). regrettably, these studies experience econometrical and theoretical issues (a more exhaustive discussion of these studies is given in the coming sections). Bounoua et al. (2014) , for example, chose to assess the MIMIC model using the GLS estimator with a sample size of only 20 data. depending on Bollen

(1989), this approach necessitates a large sample size because, with a small sample, the calculated covariance matrix employing GLS has a bias approaching zero.

Furthermore, the best model selection was based solely on R-squared and the importance of individual parameters, rather than the best of fit or bed of fit criterion. Besides this, the model proposed by Kori (2018) included just two factors, both of which are uncommon in the literature: budget deficits and urbanization. Surprisingly, the findings did not converge.

ii. Research problem

As aforementioned, the IE is an international phenomenon that can significantly impact the official statistics and the economic policies adopted by policymakers. Moreover, the definition of the IE is still an ongoing debate. As Schneider (2005) stated, there is no perfect approach for investigating the determinants and evolution of the IE, making it more challenging to find the perfect approach to study this phenomenon. Furthermore, there is a literature gap in studies explicitly devoted to Algeria's IE, which makes the existence of the IE in Algeria ambiguous, especially with few studies devoted to studying and analysing the Algerian IE. Hence, this study aims to answer the following questions:

1- What is the concept and definition of the IE?
2- What are the approaches proposed by scholars and researchers to investigate the IE and which of these approaches are suitable to explore the causes and scope of the IE in Algeria?
3- What are the central determinants of the IE in Algeria? And what is the scope of the Algerian IE?
4- Finally, what is the nature of the relationship between the informal and informal economy in Algeria?

iii. Hypothesis of the research

As stated before, there are several approaches to investigating the size and evolution of the IE proposed by scholars over recent years. On the one hand, there is a direct approach. This approach provides valuable information about the nature of informal activities and the structure of informal employment in the form of either self-employed or employees in the IE. Unfortunately, the direct approach does not give any value to the size of the IE. Instead, it gives an approximate point estimation.

Furthermore, this approach is based on the willingness of the individuals to answer some critical questions correctly. On the other hand, there is the indirect approach that generally relies on macroeconomic data. Over recent decades, these approaches have been developed constantly to overcome their shortcomings.

After collecting theoretical and empirical literature on the IE, especially in the Algerian case. It is clear that there is no perfect approach to investigating the scope and source of informality. The choice of which approach a researcher adopts is affected by several factors, such as the purpose behind the study, the scope, time and financial resources, and other reasons.

Adopting a direct approach to estimate the IE in Algeria is a challenging problem for several reasons, such as these kinds of studies demand funding resources to cover a country like Algeria, the effort and time needed to conduct a full investigation is enormous, and more importantly, with the absence of questionnaire answering culture. Hence, indirect approaches are more suitable for our investigation.

In literature, there are several approaches to choose from. Based on the study aims and the availability of the data, the Currency Demand Approach (CDA) and the model approach, precisely the Multiple Causes Multiple Indicators (MIMIC) approach, have been selected to investigate the determinants of the IE in our case. The CDA and MIMIC approaches are selected for several reasons most important one is using two different approaches to compare and validate the obtained results, in addition to other reasons such as: (a) Despite their detractors, these methods are thought to be better compared to previous indirect methods; (b) the MIMIC approach employs the idea of unobservable variable, which is appropriate with the nature of IE; and (c) it considers multiple determinants and multiple indicators to reflect the scope of the IE at the same time, allows researchers to choose a diverse range of determinants and indicators depending on the characteristics of the economic system under research and the availability of information.

iv. Significance of the research

Regarding the literature gap in the theoretical and empirical studies devoted to investigating the IE in Algeria, the current study is an important contribution to filling this literature gap by:

- First, providing an extensive theoretical review of the IE;
- Second, the study offers a critical review of the previous studies dedicated to examining the Algerian IE;
- Third, it employs two approaches, namely the CDA and MIMIC, to explore the causes and indicators of the size of the IE in Algeria, which can help policymakers formulate counter economic policies to reduce the size of this phenomenon; and
- Finally, for the first time, the long and short run relationships between the informal and formal economies are explored, and the direction of causality is also investigated.

Furthermore, the study concluded by proposing some important policy implications to reduce the size of the IE.

v. Research objective

As a consequence, and for the first time with specific attention to the data's features (e.g., stationarity, multinormality, etc.), this study aims to analyse the determinants of the IE and to estimate its size utilizing structural equation modelling, precisely modelling the multiple indicators multiple causes (MIMIC) from 1980 to 2017. For this purpose, the author has adopted the definition proposed by Hassan and Schneider (2016a, p. 2)"The IE reflects mostly the legal economic and productive activities that, if recorded, should contribute to the national GDP." Hence, all related illegal pursuits are excluded such as human trafficking, smuggling, and criminal activities.

Furthermore, and to our best knowledge, no previous studies so far have explored empirically the interaction between the informal and formal economy in the case of Algeria, which is an important literature gap we aim to contribute to filling. Retaining in mind that the present studies, e.g., Makananisa, Koloane, and Schneider (2020), highlighted the potentiality of an asymmetric influence of the IE on the formal economy in the short and long run, we employed a growth model utilising the autoregressive distributed lag (ARDL) introduced by Pesaran, Shin, and Smith (2001). Moreover, the

Granger causality test is used to analyse the causality direction among the informal and formal economy.

To summarise, the current study aims first to estimate the size and development of the informal economy (IE) in Algeria and investigate the main determinants of the informal economy using the Currency Demanded Approach and the Multiple Indicator Multiple Causes approach. Finally, investigating the association in the short and long run among the IE and the formal economy from 1980 to 2017, and investigate the causality direction by means of Granger causality test.

vi. Organization of the research

Following the IMRAD methodology and to better cover the topic of our dissertation. The current study is organized as follows:

Chapter one, namely state of the art, contains a historical background of the IE, different definitions proposed by scholars, an overview of the debate between the different streams, and the different approaches proposed to estimate the size and evolution of the IE.

Chapter two is the literature review chapter. In this chapter, all the collected empirical literature is summarised and discussed with the goal of finding the methodological and empirical issues in the previous studies, especially those devoted to Algeria. In the end, this chapter is concluded with a discussion on the suitable approach in our case to examine the determinants and evolution of Algeria's IE.

Chapter three includes the empirical part of the dissertation, namely the estimation of the IE in Algeria. In this chapter, the choice of variables for the two approaches is presented and argued. The data characteristics are plotted and statistically investigated using descriptive statistics tools as a first step of the investigation. After that, the statistical proprieties of the time series data are studied to find the best estimation procedure that falls within the aim of the study and the proprieties of the data. Following this, the results of the IE estimation are shown and compared. Finally, the MIMIC estimation is used to analyse the interaction between the informal and formal economy.

The last part of the study is the general **conclusion**, which contains an overview of what has been done, found, and proposed as policy implications after conducting this study.

Chapter 1

STATE OF THE ART

1.1. Historical background

The landmark of the IE was during World War Two and occurred mainly in the United States of America (USA) (Tanzi, 1983). As O'Neill (1983) states, the features of the IE have long been related to pre-capitalist communities all over the world. Previous to the industrial revolution in Western Europe and exceeding, everyday work was considered a significant source of income and livelihood for most individuals, rather than only the poor or marginalised ones in societies. Nonetheless, the IE concept in modern development research is often traced back to the two studies made in a third world context. The first was conducted by the social anthropologist Hart (1973, 1985) in Ghana, and the ILO did the second in Kenya, named the Kenya mission in the early seventies (Werlin, 1974). However, the concept of the IE has much deeper roots.

After the global crises in the late twenties and through the '30s, informal employment became common as formal income employment dwindled, mainly due to the global economic crises. During this period, the self-employed developed their business and skills beyond the official educational system.

Two decades later, four studies carried by Boeke (1953), Lewis (1954), Kaldor (1955), and Cagan (1958), respectively, identified the initial beginnings of research into IE. The most famous study in these four studies was the study of Lewis (1954). Becker (2004) stated that Lewis's theoretical model of economic development was an original idea. This model contains two sectors, a modern one and a traditional sector that comprise small producers, a mixture of irregular jobs, and petty traders. The fundamental assumption in this model is that a large portion of labour will be engaged in the modern economy when the modern sector starts to increase in scope, leading to the dissolution of the labour excess. However, this assumption is not valid in developing countries due to the low economic growth rates, which cannot create enough employment to absorb officially unemployed individuals. Consequently, in general, the IE proliferated and became the daily lifestyle for many people, thus integrated into the formal economy.

An authentic academic definition was not given to the IE until the beginning of the 1970s, when analysed by Hart (1973), who carried his investigation in Accra, Ghana. The latter was the leading researcher who introduced the IE's notation into the academic literature to outline the range of unregistered economic activity by the government authorities conducted by the urban labour force

outside the formal labour market (Mapp and Moore, 2015). At the time, researchers, scientists, policy-makers ignored these kinds of activities, and they were excluded from national economic accounts. Hart observed that the informal and formal economies are not separated. Instead, they are correlated throughout the movements of workers in the two directions.

Nevertheless, the low–productivity subsistence sector's proximity motivated investment and productivity in the formal urban sector. Instead, the researcher found that these informal activities helped several people buffer the unstable employment situation in the official economy.

1.2. Notations of the informal economy

Although the notation of the IE has become associated with different meanings for different purposes, it was limited to subsistence for working families and the self-employed in less developed countries in the early seventies. Initially, it was assigned to a notion for data examination and policy-making. It is sometimes employed in a much more general sense to refer to a concept for gathering data on activities not included by the government authorities and conventional organizations collecting statistics.

In 1972, the ILO (international labour organisation) aimed to formulate the concept of the informal economy through the Kenya report on employment. The term "informal sector" is employed to reflect the activities of poor individuals who worked very hard to survive and satisfy their basic needs but were not registered or controlled by the government official authorities. This study is based on the dualistic aspect of the connection between the informal and formal economy.

Until the 17th International Conference of Labour Statisticians (lCLS), the expression "informal sector" was employed throughout the economic development discussion from the 1970s until 2002. At this conference, there was a discussion on expanding the term to include more activities. Among the recommendations was the suggestion for the term "informal economy" to replace the "informal sector", which was viewed instead as a narrow concept. The more general term "informal economy" was selected to include all legal activities that are not included or insufficiently covered by legal organisations. The former encompasses a continuum of petty trading carried by individuals for survival for small and medium-range firms and enterprises working in various industrial and mercantile activities to increase their income rather than carrying their activities in the formal economy.

1.3. Definition of the Informal Economy

The informal sector is a necessary component of the overall economy, especially in the employment market, generally in all the countries but especially in less developed countries, and plays an essential part in job making, production and income creation. The groups of activities that are probably to be unobserved by the authorities are illegal, underground, informal sectors, or offered by households for their own use. Activities may similarly be unrecorded because of insufficiencies in the initial data gathering programme. The previously mentioned group of activities are referred to as the non-observed economy problem domains. Activities not covered in the initial data because they are in one or more of these difficulty areas are collectively stated to include the non-observed economy (NOE).

Nevertheless, in the 1980s and 1990s, the economic literature discovered several additional criteria to determine IE's constitutes. These criteria are somewhat different across a large number of scholars: causes, outcomes, and the characteristics of the informal activities. For example, Feige (1979) and Tanzi (1980, 1983) separate formal and informal economic activities by the motivation to avoid all types of taxes imposed by the state, while Harding and Jenkins (1989) separate them by the outcomes of these economic activities for employees, such as whether employment is correlated with fewer social advantages or baser than minimum earnings. Furthermore, De Soto (1989) conducted a study in Peru, and he used the legal status to separate formal from informal economic activities. He associates the development of the IE to economic policy and transaction costs. He claims that deregulation of the market, less government intervention in the economy and greater private property rights will reduce the size of the IE.

Moreover, in 1983, the first international conference on the IE took place in Bielefeld, Germany. One of its central goals was to reach mutual grounds on definitional matters. Despite this, the members were unable to reach an agreement and used widely disparate definitions. Defining the IE is a necessary first action towards getting its features and how this complicated phenomenon works. A comprehensive definition can also help have a straightforward and reliable approach, including any robust assumptions.

Establishing a theoretical background for the IE concept was the fundamental purpose of the 15th ICLS conference. This point was the starting point of the 15th ICLS in determining the IE and

understanding the IE as an analytical/political concept rather than just a narrow statistical concept. The 15th ICLS also attempted to provide as far as possible the notion of the IE as a statistical concept in enlarging its scope to as big as the universe of non-registered activities as seemed almost possible and conceptually legitimate but denied its description as a "catch-all" concept. Thus, the definition selected does not lead to a segmentation of the economy or the employed people according to an official and unofficial economy distinction. The 15th ICLS acknowledged that activities concealed from the extent of the informal economy were not fundamentally formal. For example, paid domestic services, household non-market production of goods, and small-scale agriculture fall outside the scope of the 1993 SNA production line, such as domestic or personal services provided by unpaid household members and volunteer services rendered to the community. It was suggested that such activities be recognised as relating to a separate section outside the classical informal and formal economy dichotomy scope.

Although there were many efforts to achieve a general and more practical definition of the IE, these efforts could not agree on a unique definition. Hence, most scholars that try to analyse and estimate the IE face the difficulty of defining it. Furthermore, this economy is referred to by several terms: informal economy, shadow economy, underground economy, and many others. Williams and Schneider (2016) counted 44 adjectives and ten nouns to describe this phenomenon. It must be noted that every term is related to a specific definition and concept. In most cases, the definitions and concepts adopted depend on the chosen approach to estimate the informal economy by the author.

According to Fleming, Roman, and Farrell (2000), usually, there are two approaches that define the IE:

The definitional approach: This approach can be seen in the definition of Imrie and Thomas (1999) as "all economic activities which contribute to the officially calculated (or observed) gross national product"; hence it views informal activities as unregistered economic activities. Several researchers have adopted this definition, such as Smith (1985) and Schneider and Enste (2000).

The behavioural approach: interprets the IE as a shift in economic agents' behaviours responding to institutional and regulatory constraints imposed by the state authorities, such as tax burden, social contribution and bureaucracy. This approach defines the IE as " Informal economy is unregulated by the institutions of society, in a legal and social environment in which similar activities are regulated" (Loayza, 1996).

There is another different kind of classification for the IE in the economic literature that relies on the purpose of definitions. In this type of classification, the usual accurate and often used definitions attempt to link the IE to the formally estimated national income; for example, it includes all presently unregistered productive activities that should be included in the Gross National Product (GNP), but for some reason, it did not. Still, Schneider and Enste (2000) believe that this definition eliminates two critical sets of economic activities:

1- The first important set excluded from the definition above is tax evasion, which is not value-adding but is redistribution. Nonetheless, commonly, all the informal activities do not pay taxes, which is value-adding. As a result, informal activities are related to but not the same as tax evasion;
2- The second set includes all the productions excluded from the GNP measures by convention, especially those carried out by private households. This point is significant because the household sector comprises between 35% and 49% of GNP, depending on the approach and measurement technique.

However, it is noted in the literature that the IE uses several other terms to reflect these kinds of activities. Williams and Schneider (2016) counted 44 adjectives and ten nouns to describe this phenomenon, and it must be noted that every term is related to a specific definition and concept. In most cases, the definitions and concepts adopted depend on the chosen approach to estimate the informal economy by the author. For example:

According to Dell'Anno (2003), the IE term reflects all "all economic activities by workers and economic units that are—in law or in practice—not covered or insufficiently covered by formal arrangements." While Andrews, Sánchez, and Johansson (2011) employed it to reflect "economic activities and transactions that are sufficiently hidden so that they are unmeasured or untaxed, and it is presumed that economic agents are at least passively aware that bringing these activities to the attention of authorities would imply tax or other legal consequences."

Schneider wildly uses the term shadow economy. According to Zukauskas (2013), it is described as "an economic activity (i.e., producing goods and services), which is carried out without complying with the legal environment and to avoid taxes and/or regulations".

The illegal economy, in the opinion of Feige (1979), it "consists of the income produced by those economic activities pursued in violation of legal statutes defining the scope of legitimate forms of commerce."

Bajada and Schneider (2005) use the underground economy term to reflectto reflect "consists of unmeasured economic activity that has contributed to value added according to the national accounting convention but is not recorded because of the failure to report income in whole or in part. Activities that are not usually measured by the national accounting convention (e.g., criminal activity) will not form part of the measure of the underground economy."

Marinov (2008) argues that the term "hidden economy" includes three types of informality, namely the informal economy, the grey economy, and the black economy. In contrast, Schneider and Enste (2000) proposed a different taxonomy for the IE, as shown in Table 1 below.

Table 1
The taxonomy of the IE proposed by Schneider and Enste (2000).
Source: Schneider and Enste (200)

	Monetary Transaction		Nonmonetary Transactions	
Illegal Activities	Trade in stolen goods; drug dealing and manufacturing; prostitution; gambling; smuggling and fraud.		Barter: drugs, stolen goods, smuggling etc. Produce or growing drugs for own use. Theft for own use.	
	Tax Evasion	**Tax Avoidance**	**Tax Avoidance**	**Tax Avoidance**
Legal Activities	Unreported income from self-employment; wages, salaries and assets from unreported work related to legal services and goods	Employee discounts and fringe benefits	Barter of legal services and goods	All do-it-yourself work and neighbor help

Finally, in this thesis, the more conventional interpretation of the IE is adopted. This definition is employed by the Organization for Economic Co-operation and Development (OECD). It is also consistent with definitions employed by other researchers such as Schneider (2014). The IE in the current thesis covers only market-based legal and economical production of goods and services that are intentionally hidden from state authorities for several reasons, such as:

1. To evade payment of personal income, value-added or any other taxes,
2. to evade payment of social security contributions,

3. to avoid complying with particular bureaucratic procedures, such as performing statistical surveys or other regulatory forms.; and

4. to evade having to meet particular legislative labour market criteria, e.g., maximum working hours, minimum wages, safety rules and other labour laws.

Consequently, this thesis excludes all standard underground economic (classical crime) activities, which are all illegal actions that fit the characteristics of classical crimes like narcotics, burglary, theft, blackmailing, and other related crimes. Additionally, the undeclared household economy is omitted, which consists of all household products and services. The second significant set omitted from the definition above is tax evasion, which is not value-adding but is redistribution.

1.4. Theories explaining the informal economy

In economic theory, four main schools of thought have tried to explain the IE and its interaction with the formal economy and other economic and social phenomena, namely the dualist school, structuralist school, legalist school, and voluntarist school.

1.4.1. The dualist theory:

The original dualist concept traces back to the work of Boeke (1953) and Lewis (1954), which was later expanded by the work of Harris and Todaro in the 70s. However, Dualist was first presented by the International Labour Organization (ILO) World Employment Mission Kenya at the beginning of the 70s, precisely in 1972. They view the IE activities, mainly face-to-face economic activities, i.e., street vending, as independent with few (if any) associated with the formal economy. These marginal activities afford alternative informal income for the poor and a security web in periods of social and economic crisis. In other words, the two economies operate concurrently and separately within the same space. According to this theory, informal workers are excluded from accessing job opportunities in the formal economy for two main reasons: inequalities between the ever-increasing rates of the population and the work opportunities in the industrial sectors. Second, the asymmetries among the individual's educational and working skills and the structure of formal economic employment chances.

Unlike the formal economy, which is characterised by a high level of technology, intensive exploitation of capital, and a qualified labour force, the IE is defined by the following properties:

- The facility of market entry due to the low constraints;

- Dependence on domestic or classic resources;
- The family generally runs businesses;
- The modest scale of employment chances;
- Labour-intensive and adapted technology;
- Experiences procured outside the official academy system;
- Unchecked and contentious markets.

In the dualist view, the IE is counter-cyclic to the formal economy. In times of economic contraction, when unemployment rates rise, individuals are motivated to search for an income source in the unofficial economy. In the same sense, under the assumption that individuals prefer formal and more secure jobs when the economy expands, more employment opportunities are created. As a consequence, these individuals switch to the official economy (contraction of the IE). Therefore, the dualist argues that the expansion of the formal economy, in which the government provides financial and business development and creates more formal jobs, will diminish IE activities.

1.4.2. The structuralist theory:

This theory emerged when the Marxian theory challenged the dualist concept of the IE by Moser (1978) and Castells and Portes (1989). In contrast to the dualist school of thought, the structuralist school of thought alleges that the informal and formal economies are linked and interdependent. Furthermore, they argue that the IE presence is related to the structured expansion within the capitalist manufacturing system. Generally, the IE is a consequence of formally declared enterprises and companies trying to increase their competitiveness and profit by lowering labour costs, reducing the power of labour unions, and avoiding official state regulations.

Some structuralist pioneers argue that informal enterprise owners engage in a power conflict with the official government authorities due to the latter's direct, indirect tax burden and social security regulations. Consequently, they chose to engage in the IE rather than the formal one to reduce the start-up costs of their businesses, production costs and lessen the impact of trade organisations to the lowest minimum. In addition, while the IE serves as a general expression for the collection of sub-economies not caught by conventional economic estimation methods, the structuralist approach sees it as a natural consequence of the development of capitalism. Without question and beyond any doubt, these informal firms' engagement in the IE is driven by the intention of making more profit.

Despite the fact that unofficial enterprises are modest in size, laborious, regionally located, undeclared in official documents, and ordinarily hidden from government authorities, the means of exchange among the demand and supply sides of the IE are comparable to those in the formal capitalist economy. These exchanges often happen in three distinct forms: associational results from the association, entrepreneurial -an entrepreneur willing to take risks in order to make a profit- and intimate -particular to a given individual- as trading is usually conducted in bounded topographical zones over head-on connections between associates and/or acquaintances.

Furthermore, the structuralist school states that the IE partially serves as an assistant to the official economy, as the last subcontracts the prior to overcoming workers' cost and essential physical inputs. As a matter of fact, by joining the IE, legal firms or entrepreneurs can ensure competitiveness. By determining the IE as subordinate to the formal one, the structuralist approach offers some combination and collaboration between the corporations operating in the official economy and practitioners in the IE. A considerable number of goods and services are frequently swapped between these two economies in a bidirectional way.

The structuralist has defined three kinds of informality: survival, dependent exploitation, and growth. First, survival activities generally occur when poor and low-income individuals start producing and selling goods and services for survival purposes. The primary reason is that labour is plentiful, and the modernised manufacturing sector cannot generate enough jobs to meet demand. the restraints generated by the modern manufacturing sector are denied by these unoccupied people will find the means to make ends meet. Remarkably, people engage in any sort of activity that will provide food on their table. Second, dependent exploitation describes legitimate corporations' activities that involve informal enterprises with the primary goal of pressing down their input costs. These enterprises' owners' policies are transforming the type of work from usual to non-usual and closing production to modest corporations and unofficial workers (see Castells and Portes, 1989; Chen, 2012). This is similar to the remark given by Piore and Sabel (1986), who remarked that production was revolutionised entirely, as massive scale production enterprises were decentralised, rearranged, and little flexible enterprises were set up in their area. Finally, growth represents the process where small enterprises or informal workers use their relationships to expand the capital, as previously explained.

1.4.3. The legalist theory

This current appeared in the mid-1980s with the work of the Peruvian economist, Hernando de Soto, who in his two books claims that the IE is compounded by several entrepreneurs who wilfully engage in the margins in order to dodge the costs, time, and effort of official registration. De Soto (1989) says working illegally is complex. In fact, legality is the margin as illegality and informality have been the rule. But de Soto also showed that this situation could make conventional sense for small entrepreneurs, as extra-legal may be more expensive and inconvenient than formal.

The engrossment of the legalist's view tends to be underpinned by how small enterprises react to the government administrations system and regulatory burden. Notably, the theory outlines the connection between the activities of the IE and the formal regulatory context. It contends that enterprises will fully engage in the IE in order to reduce the cost, time and strict processes associated with the formal registration of their companies and the tremendous expenses of continuing legal, which appears in the form of extraordinary taxes, strict regulations, and the considerable charge of public services.

Concerning economic interactions, the legalist school views the IE as both counter-cyclic and pro-cyclical. Castells and Portes (1989) framework, Biles (2009, p. 226) divided between three distinct informal activities: 'subsistence', 'subordinate' and 'autonomous'. Subsistence activities are linked with meagre earnings, modest levels of education, inferior goods and services and weak capitalisation and technology. Individuals regularly switch to subsistence activities due to alternative work opportunities. On the other hand, subordinate and autonomous activities are connected with more substantial income and education levels, exchanging extra precious commodities and services. They have more basic levels of capital endowments, and so these workers opt for informal activities because they are motivated by the opportunity of assuring more income opportunities and higher adaptability. According to Biles (2009) view, it is reasonable to recognise "subsistence activities" as counter-cyclical by first low economic growth rates will push some firms to close and release their workers, hence increasing official unemployment rates. In opposition, "autonomous activities" and "subordinate activities" are pro-cyclical because they are associated directly with the demand for their goods and services. These activities are expected to experience a negative effect from the economy's slowing as

demand drops and to experience substantial growth rates when demand for their goods and services is important.

1.4.4. The voluntarist theory

The more recent school of thought is called the voluntarist. Their view is closely related to the legalist school of thought led by De Soto, which claims that the IE is full of firms and entrepreneurs, primarily self-employed, who wilfully decide to take their activities to the IE for the sole goal of avoiding tax burdens and regulatory burdens. In contrast to the legalism view, which highlights the effect of the government bureaucracy, the voluntarist approach tends to concentrate on the rational choice process of IE participants. Surprisingly, voluntarists believe that entrepreneurs or people in general who engage in the IE first conduct a cost-benefit analysis of the IE in relation to the formal economy before deciding to engage in informal activities. Lastly, the voluntarist claims that government authorities can only raise their tax base and decrease the improper competition facing legal enterprises and corporates by assuring those informal enterprises that work under the regulatory situation. Although the legalist view declares that informal enterprises engage legal enterprises in unfair competition, they have been criticised for giving inconsiderable consideration to the dynamics among the latter two enterprises.

To summary the previous four school of thoughts main ideas, pioneers and differences in views are summarised in the Table 2 below.

Table 2
Summary of the main school of thought that explained the IE.
Source: Hernandez (2017)

School of thought	Pioneers	Position	Vision IE	Economic relation with the formal economy	Policy implications
Dualist school	Boeke (1942) Lewis (1954) Greetz(1963) Harris and Todaro (1970)	Marginal activity No linkage between informal and formal economy	Hidden unemployment	Counter-cyclical *(grows as unemployment increases)*	Expand formal economy and repress IE
Legalist school	De Soto (1986, 2000)	Reactive activity Government and formal economy exclude the IE	Micro-enterprises	Counter-cyclical *(Survival activities)* Pro-cyclical *(micro-enterprises activities)*	No government intervention, neglecting IE, formalisation and property rights
Structuralist school	Castells and Porters (1989, 2006) Moser (1978)	Dependent activity IE depends on the situation of the formal economy	Exploited cheap labour force	Pro-cyclical *(Expends when formal economy expends)*	Welfare and informal union support
Voluntarist school	Maloney (2004) Fiess, Fugazza and Maloney (2010) Bosh, Goni-Pacchioni and Maloney (2012)	Rational choice Informal and formal economy are continuum labour marcket	Voluntary choice	Counter-cyclical *(grows as unemployment expands)* Pro-cyclical *(as demand for specific informal sectors growth)*	Expand formal economy and repress IE

1.5. Econometric modelling of the informal economy

In economic theory, two different approaches can be distinguished in analysing the determinants, measuring and modelling the IE. The first is founded on theories like the economic growth theory to examine macroeconomic data and infer the IE's scope and evolution, which is referred to as the macroeconomic approach. The second approach is based on theories like the neoclassical leisure-income theory and uses microeconomic data, frequently collected using surveys, to infer the status of the IE in a country at a point in time, which is called the microeconomic approach.

On the one side, in the microeconomic approach, the individuals' choice process is the back boon for this approach. The choice behaviour is then inspected under different conditions and variable restrictions. This approach aims to solve the central question: under what circumstances will individuals decide to work in the IE rather than in the formal economy? The answer to this question gives more profound insights into the causes of the growth of informal activities worldwide. The investigations concentrate more on the individuals and their behaviour. Using theories from research areas like microeconomics, psychological approaches, and micro-sociology, which assume rationality and stability in individuals' preferences, gives a deeper and more complete understanding of the individuals' choice processes to engage in the IE. For example, the variable of tax morale, which was first discussed by Schmolders (1970), is the result of the interaction of two disciplinaries, economic and psychology, are added in the investigations.

On the other side, in macroeconomics approaches, a theoretical model of the business cycle, taxes, and monetary policy linkages with the IE is proposed, and under specific assumptions such as extremely weak entry costs of the IE due to a moderate likelihood of enforcement, it exposes a positive association between the growth of the formal economy and the IE.

Several studies imply that an explanatory fiscal policy motive is both informal and formal economy. However, this approach can often reveal a statistical correlation rather than a causal and effect relationship. Hence, it does not explain economic puzzles such as:

- Why do people prefer to engage in informal activities rather than conducting these activities in the formal economy?
- What are the primary and significant reasons driving this choice away from the classical cause of increasing their income?
- Which social and economic theories can explain economic factors leading to this choice?

Considering only people can decide, according to methodological individualism, it might offer assistance to have a closer look and understand the rationality behind this individual choice process.

The macro and micro approaches discussed above can be summarised in Figure 3 below. The top right area shows the macroeconomic level of research on the IE. The aggregate type of data can be employed to examine potential associations between causes (e.g., growth in the overall tax and social security burden) and consequences (e.g., supplementary extension of the IE). The rest of the figure covers the research fields of microeconomics, psychological approaches, and micro-sociology.

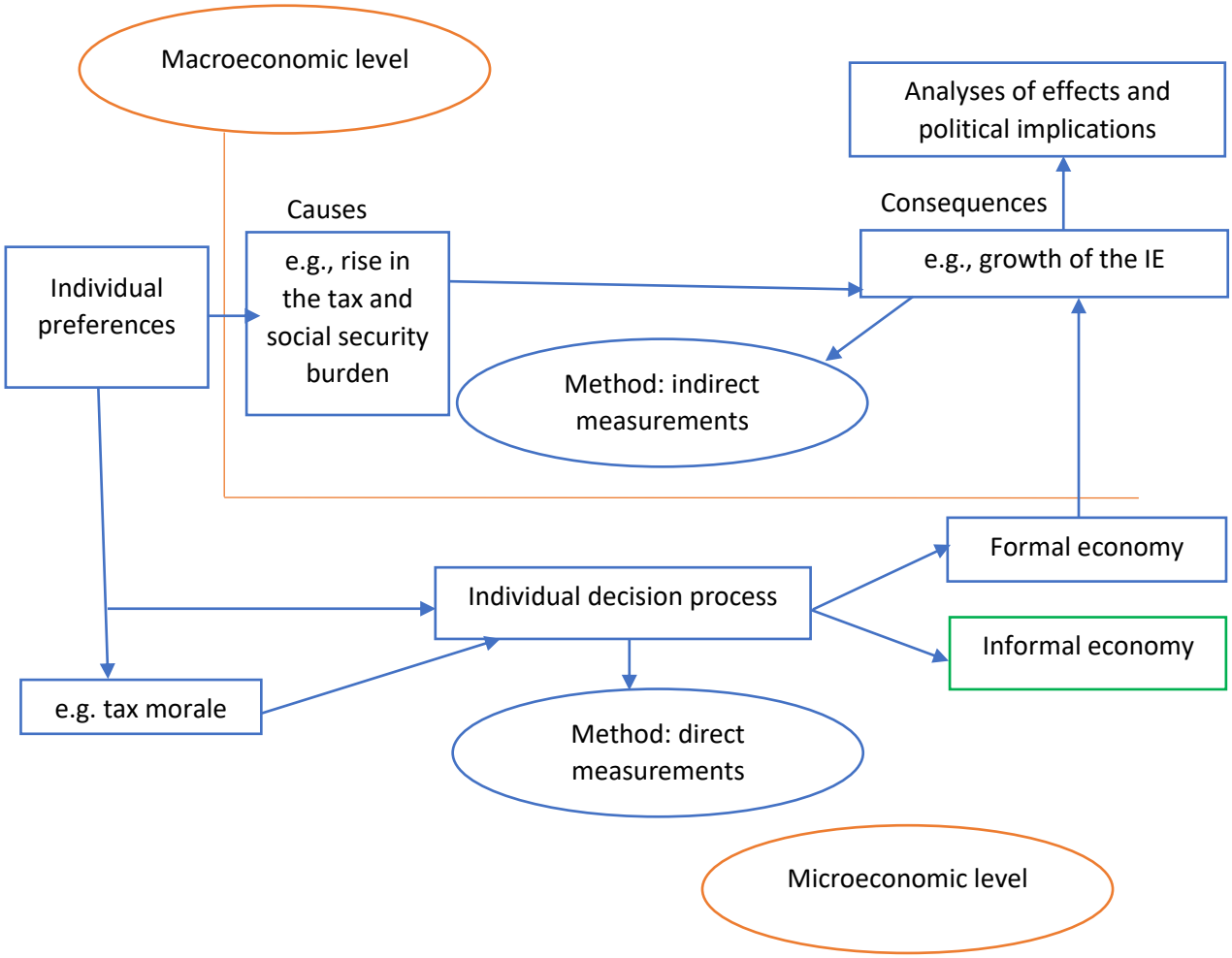

Figure 3 levels of estimations of the informal economy.
Source: Schneider and Enst (1998)

1.6. The existing approaches to estimate the informal economy

1.6.1. Direct approach

1.6.1.1. Survey approach

A reasonable way to investigate and estimate the IE is to conduct questionnaires among providers and buyers of such activities. This approach provides a comprehensive knowledge of the composition of this type of economy. Usually, this type of investigation is done in three phases. The first phase is to gather data on labour supply in the economy; the second phase is to identify informal and formal workers; and the last phase is to gather data around income and expenditures in the economy.

Academics and institutions have frequently used two types of surveys in recent years to analyse the determinants or motivations behind IE activities as well as the size of those activities. The first set of surveys generally concentrate on finding the impact of socio-demographic variables (e.g., age, gender, the level of education, working skills etc.), socioeconomic variables (e.g., income level, household size etc.) and spatial characteristics (e.g., whether the responding lives in urban or rural areas). In addition to tax morality, the expected punishment and other factors will be discussed in detail next. The second group of surveys targets firms in which to estimate the size of IE, the company managers are asked to answer a well-structured questionnaire. Due to their unique position, this method assumes that company managers are the most likely to know the volume of wages and business that goes unreported (Putniņš and Sauka, 2015). Many studies adopted this method, e.g., Putniņš and Sauka (2015) applied it in three countries, namely Estonia, Latvia and Lithuania, with over 500 firms included in the survey.

However, the survey approach produces only a point estimation of the IE, and it does not produce time-series estimations. In addition, according to Schneider (2005), these approaches have sensitive results because respondents do avoid declaring their actual connection to the IE to avoid getting punished.

Nevertheless, this approach is used by several scholars and researchers to investigate the structure of the IE; for example, Feld (2005) carried a comparison of the IE in Germany, Williams (2006) in the UK, La Porta and Shleifer (2008) in 44 developing countries, Henley, Arabsheibani, and Carneiro (2009) in Brazil.

1.6.1.2. Tax auditing method

The second frequently used direct approach relies on the auditing of tax returns. This approach aims to find the difference between the volume of income reported by individuals for tax purposes and the tax audits conducted by the government authorities that requested selective comparisons. The discrepancy between the income reported for tax purposes and the income assessed by selective checks lets us determine the size of the informal activities. Hence, this method shows the effect of fiscal auditing programs in combating and decreasing tax evasion. Consequently, this approach can be used to estimate the size of the IE.

Unfortunately, the estimations retrieved employing this approach are considered lower bound estimations due to the inconsistencies in this approach. According to Schneider (2005), the selected sample should be randomly obtained to achieve objective estimations. However, the selected sample is not done randomly but collected based on the submission of (tax) returns. Besides, it does not provide insights into the amount of income generated by informal activities. Therefore, the estimations are probably biased. Nevertheless, the trend is estimated to be significant.

1.6.2. Indirect approach

1.6.2.1. Discrepancy approach

There are two approaches to the discrepancy proposed and used by scholars. The first is based on the discrepancy between national income and national expeditors'. This approach's fundamental assumptions are that the national income and expenditures are theoretically equal. Any difference between the empirical estimations is caused by informal income; second, all elements on the expenditure side are estimated error-free and built to be statistically autonomous of income variables. However, this approach was heavily criticised due to national account estimation issues.

The second is based on the discrepancy between the formal and actual labour force. This approach assumes that the entire labour force participation is considered to be fixed. Under this condition, a drop in formal labour force participation can be described as an alteration in the size of the IE. Inconstancy in the participation movement might have several other causes, such as the state of the official economy, trouble in getting formal employment, education levels, and retirement choices. Nonetheless, these measures serve as weak signs of the IE's scope.

1.6.2.2. Transaction approach

Using Fischer's quantity equation, M*V = P*T, in addition to the assumption of a stable relationship over time between the official GDP and the number of transactions made in the economy. From the overall value-added (including formal and informal), i.e. P*T = k (official GDP + IE), it is reasonable to derive the following equation: M*V = k (official GDP + IE). The stock of money and official GDP estimates are known, and money velocity can be estimated. Hence, if the IE as a proportion of the formal economy is known for a base year, then the IE can be estimated for the rest of the years. Though theoretically attractive, this approach has several flaws, for instance:

(1) other factors such as the development of checks and credit cards could likewise influence the wanted volume of currency outside the banks and thus velocity; and

(2) the assumption that k would be fixed over time appears completely unreasonable.

1.6.2.3. Currency demand approach

One of the popular and most used indirect monetary methods to estimate the IE in literature is the Currency Demand Approach (CDA). This method traces back to the work of those who investigated the behavior and determinants of the currency -to- money supply ratio in the United States over the period from 1919 to 1955. In the spirt of Cagan’s (1958) model and assuming that all transactions made by individuals in the informal economy are cash based for the purpose of not leaving any trace authorities, which fits with the monetarist's views since the main assumption of this approach is that all informal payments are made in cash for not to be detected. Gutmann (1977) proposed a model to estimate the size of these informal activities. Consequently, a rise in the demand for the currency may indicate the growth of the IE.

Unfortunately, this method was heavily criticized by Tanzi (1980) for several reasons, among them the author’s assumption that fluctuations in currency ratio are only due to changes in taxes and the luck of any statistical producers in the estimation. Furthermore, and based on the criticisms of Gutmann (1977), Tanzi (1980) proposed a new perspective for estimating the IE using monetary data. To isolate "excess" demand for currency, Tanzi (1980) suggests using macroeconomic time series in which currency demand is a function of conventional variables, such as the development of outcome and income, payment behaviour and practices and variables that reflect opportunity lost i.e., nominal or real interest rates, and factors motivating individuals to engage in the informal economy, such as direct and indirect taxes, the complexity of the tax system and government regulation. This approach was

used to estimate the size of the IE in America from 1929 to 1980. This estimation is based on three main assumptions: first, the informal economy is a result of high taxes; Second, the currency is basically used to carry out informal transactions (Mehnaz and Qazi Masood, 1995). Finally, the equality of velocity in the formal and informal economy. Hance, the theoretical model proposed by Tanzi (1983), is the following:

$$\ln\left(\frac{C}{M_2}\right)_t = \beta_0 + \beta_1 \ln(1+TW)_t + \beta_2 \ln\left(\frac{WS}{y}\right)_t + \beta_3 lnR_t + \beta_4 \ln\left(\frac{y}{N}\right)_t + \varepsilon_t \ (01) \qquad (01)$$

Where: ln (C/M_2) is the natural logarithm of currency in circulation outside

the banks to M2; TW is a weighted average tax rate; WS / Y is a percentage of wages and salaries to national income; R is the interest paid on savings deposits and Y / N is the per capita income.

The expected signs of $\beta_1; \beta_2; \beta_3 > 0 \ while \ \beta_4 < 0$.

To estimate the informal economy, there are two steps: the first step is the estimation of the previous model two times. For the first time in its current state, and again imposing the tax burden, the tax rate is held at its lowest value. The difference between the two estimates represents the volume of illegal currency that circulates in the informal economy. The second step is to multiply this difference by the velocity, assuming that the velocity in both formal and informal economies is the same, yielding the nominal aggregates of the IE (Greenidge, Holder, and Mayers, 2009).

Still, there are various problems affiliated with this approach and its hypotheses.

1. This method may undervalue the scope of the IE because not every transaction takes place using money as a means of trade;
2. Increments in money demand deposits may happen because of a decrease in request deposits rather than an expansion in currency utilised in IE's activities;
3. It appears unreasonable to pretend to know the exact velocity of money in the two economies; and
4. The acceptance of no IE in a base year is unreasonable.

Furthermore, Ahumada, Alvaredo, and Canavese (2009) argued and proved that the assumption of equality between velocity in the formal and informal economy is invalid, except in one case when income velocity is equal to one. Thus, the studies which found income velocity is not equal to one must be corrected. Nevertheless, over the last four decades, the original equation has been modified and new

variables were added, Schneider (2009), and it has been applied worldwide. Giles (1999) used it to estimate the size and trend of the IE and tax evasion in New Zealand over the period 1968 to 1994;Hernandez (2009) in the case of Peru from 1979 to 2005;Asante (2012) in the case of Ghana during the period 1990 to 2010.Hassan and Schneider (2016a) in Egypt and Gamal and Dahalan (2016) in Saudi Arabia form 1980 to 2010.

Physical input approach (electricity consumption)

Kaufmann and Kaliberda's approach: Kaufmann and Kaliberda (1996) imply that the units of electricity consumed are the best indicators that reflect the overall economic activities. Utilising findings that reflect that electricity-overall GDP elasticity is near unity, the main idea behind this approach is to find the difference between the growth rates of economic growth and the growth rates of electricity consumption as an approximation to the development of IE. Utilising findings that reflect that electricity-overall GDP elasticity is near unity, the main idea behind this approach is to find the difference between the growth rates of economic growth and the growth rates of electricity consumption as an approximation to the development of IE. Although this approach is theoretically attractive, it has several disadvantages. First, not all IE's activities are done using electricity or other sources of energy (e.g., street vendors use gas). Second, electricity consumption behaviour is not constant over time and in different countries, which may cause different estimation problems and biases. Finally, the assumption of a base year is also questionable. Consequently, this approach will catch only a part of the IE's actual size and evolution.

Lacko's approach: To overcome some of Kaufmann and Kaliberda (1996) approach drawbacks. This approach starts from the hypothesis that several IE activities are directly connected with household electricity consumption. In addition to other activities, it includes household production, do-it-yourself activities, and other non-reported production. Furthermore, the author hypothesises that in countries where the IE's activities are related to household electricity consumption, IE's activities will be high. However, this approach was criticised for several reasons, including that it is the same as the previous method; not all the IE's activities do use electricity, but other sources of energy can be employed; informal production is not limited to the household sector only; and in developing countries, the consumption behaviour of electricity differs from other countries, which can lead to missed calculations and bias in the final estimations.

1.6.3. Model approach

The MIMIC model is a particular case of the Linear Interdependent Structural Relationships LISREL models. Jöreskog and Goldberger (1975) model is primarily composed of two distinct equations: the first is known as the measurement equation, and it correlates the unobserved variables with a collection of manifested indicators.

$$\eta = \gamma' x + \zeta \tag{10}$$

Where η is the latent variable, x is a $(1 \times q)$ vector of observable causal variables, γ is $(1 \times q)$ vectors of structural parameters, and ζ is white noise.

The causal link among the unobserved variables is defined by the second equation. The structural equation is the name given to the latter equation. There is just one unseen variable in the current investigation, and that is the IE size. It is supposed to be indirectly observable through a collection of the latter's indicators, capturing the IE's structural reliance on variables.

$$y = \lambda\eta + \varepsilon \tag{31}$$

Where y is a $(1 \times p)$ vector of observed indicator variables, λ is a $(1 \times p)$ vector of regression parameters, and ε is a $(1 \times p)$ The measurement error term is considered to be a matrix of white noise. It should be highlighted that the independence assumption among structural perturbation and measurement error is critical to assess dependability.

The MIMIC's advantages stem from its ability to assess numerous indications at the same time. According to Tedds (1998), in the context of the IE, the outcomes are expected to surface concurrently in several markets, along with the labour market, financial market, and industrial market. Furthermore, the causes are diverse and more complex than simply the tax rate. Further, this technique helps the researcher to select a variety of causes determinants and indicators based on the characteristics of the economy under investigation and the accessibility of data.

Numerous criteria were employed to evaluate the quality improvement in the empirical model. The goodness of fit indicators employed were chi-square, the Tucker–Lewis index (TLI), and the Comparative Fit Index (CFI). Concerning the last two criteria, values closer to one indicate a good fit. the Standardized Root Mean Square Residual (SRMR) and Root Mean Square Error of Approximation

(RMSEA) were used to assess the badness of fit. As stated by Hu and Bentler (1999) values less than 8% indicate reasonable adjustment.

Admittedly, this technique has certain issues when using the MIMIC method to determine the IE. Because the MIMIC methodology is a confirmatory instead of exploratory technique, the scholar is more likely to determine if a given model is efficient than to acquire an appropriate model. A further critique was given by Breusch (2005) and Helberger and Knepel (1988) concerning the stability of the predicted coefficients. They demonstrate that changes in units of measurement or sample size led to different estimations. Besides this, the researcher should determine a proper calibration procedure because the MIMIC model only provides an ordinal series. Over the years, scholars and academics have proposed numerous calibrations or benchmarking approaches to overcome the last and most crucial problem to convert the IE index to a series percentage of formal GDP.

Notwithstanding these shortcomings, the method is still preferred relative to other strategies. The adopted approach has been applied by economists to estimate the scope of the IE in the current decade and is yet applied today.

1.7. The interaction between the informal and formal economy

There are various studies that examine the interaction between IE and economic growth by integrating the IE into macroeconomic models and empirically examining how this relationship works and whether the positive effect leads to the negative one or vice versa (see Figure 4).

To better understand how these two economic phenomena interact with each other, we provide Table 3, below which summarises the interaction between IE and economic growth into three main topics, namely taxation, general locations, and the biased effects of economic policies (Schneider and Hametner, 2014). According to Schneider, Buehn, and Montenegro (2010), the formal economy could never work efficiently if it were totally separated from the shadow economy. Therefore, there is an important interaction between these two complex economic phenomena. Some researchers argue that these two are complementary to each other like, Bajada and Schneider (2005) and Dell'Anno and Halicioglu (2010), and that's because firms operating in the shadows tend to employ lower-skilled workers, meaning lower unemployment in the formal economy, operating with less capital. This adverse selection in itself could raise productivity in the formal economy, according to Amaral and Quintin (2006)**.** However**,** other researchers argue that the IE is substitutional for the official economy

Loayza, Oviedo, and Servén (2005), Johnson, Kaufmann, Shleifer, Goldman, and Weitzman (1997), thus lowering economic growth for a number of reasons:

First, a third factor, such as excessive regulation, could lead to a larger shadow sector as well as reduce economic growth.

Second, a large IE could severely limit government resources to finance several public goods such as education, health, or infrastructure investment. Hassan and Schneider (2016b) empirically found that the impact depends on the level of development of countries. In developing countries, they are complementary, and in developed countries, the opposite is the case.

Table 3

Interactions between the informal and formal economy
Source: Schneider & Hametner, 2014, p. 298

The informal economy influences ↓	**Through**	**Effects on formal economy and overall economic performance**
Tax system →	Tax evasion →	Redistribution policies to finance qualitative and quantitative improvements of public goods are impaired, thus economic growth may be negatively affected
	Additional tax revenues	If the informal economy activity is complementary to the formal economy, extra income is generated via the formal economy which is then (at least partly) spent in the official economy for goods and services
Allocations	Stronger competition and stimulation of markets →	More efficient use of scarce resources Incentives for firms and individuals, stimulation of creativity and innovation
	→	Enlargement of market supply through additional good and services
	→	Cost advantages of producers acting from the shadow economy may lead to ruinous competition
	→	Problems in information flows for producers and consumers due to reduction in transparency and lack of structure in unofficial sector
Policy decisions →	Bias in officially published data →	Stabilizing, re-distributional and fiscal policies may fail desired effects

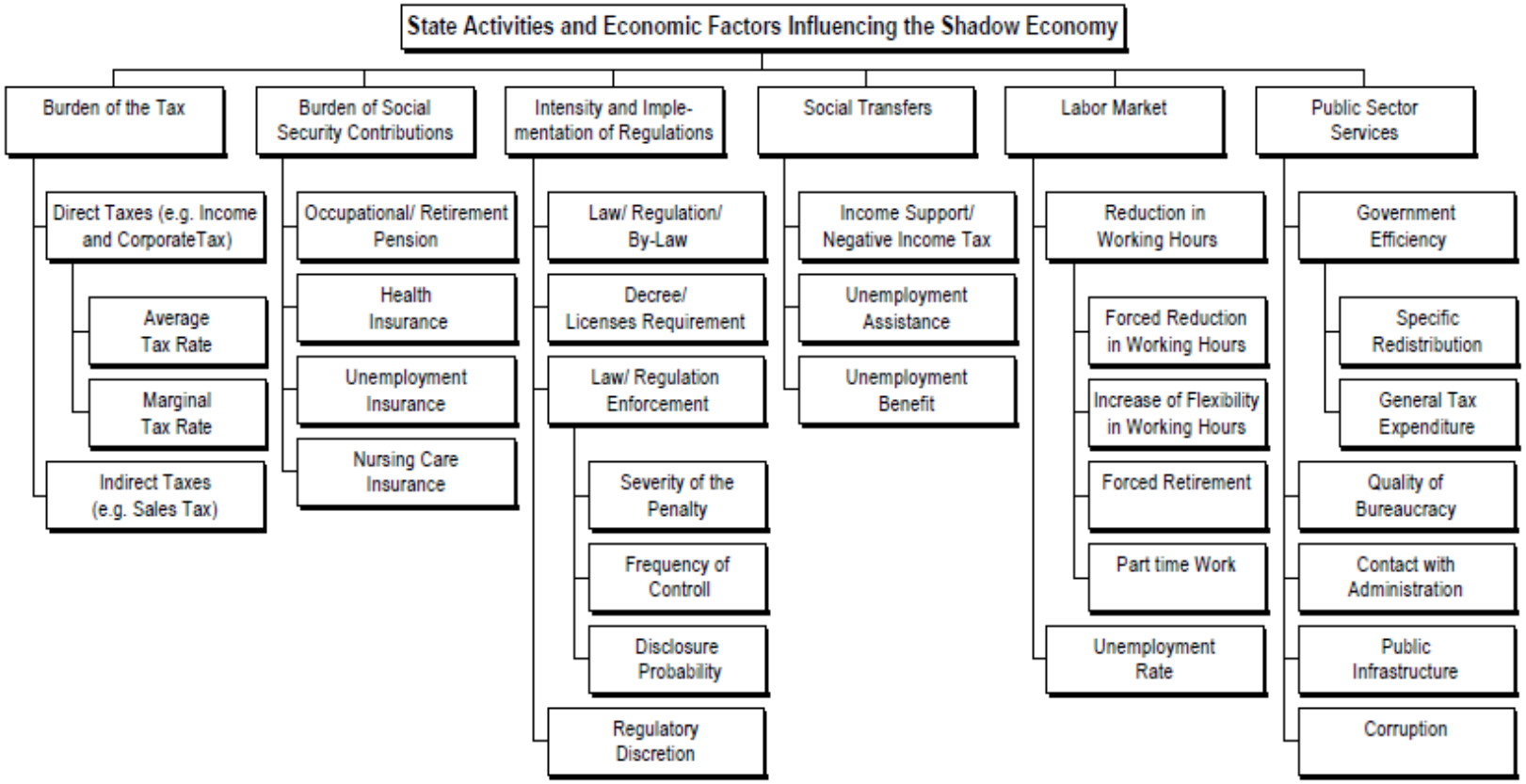

Figure 4 The state activities and economic factors that influence the IE size.
Source:

Chapter 2

LITERATURE REVIEW

Conducting a literature review is a means of demonstrating an author's knowledge about a particular field of study, including vocabulary, theories, key variables and phenomena, and its methods and history (Boote and Beile, 2005; Feld, 2005). Besides these reasons, Hart (2018) added several reasons for reviewing the literature: (1) Choosing and distinguishing the explored areas of the subject from the unexplored areas of the subject under study; (2) synthesising and gaining a new perspective; (3) selecting essential variables related to the subject; (4) establishing the context of the subject or problem; and (5) synthesising and gaining a new perspective.

Moreover, a good literature review provides a framework for relating established new findings to previous qualitative or quantitative findings in the study's discussion section. Without establishing the state of the previous research, it is impossible to establish how the new research advances the previous study.

As aforementioned, the quality and quantity of the gathered literature are essential in every piece of research. Hence, this chapter includes all the literature that has a direct relation to our problem. This chapter is motivated by several reasons: exploring the different angles that have been explored to analyse the IE in the last several decades; the methods that have been adopted to analyse this phenomenon and to find which approach is more appropriate for the Algerian case; summing up the different causal variables and indicators found in the empiric literature to have a significant effect on the scope of this phenomenon; what are the usual problems researchers face and how they overcome them; and most importantly, analyzing the previous studies that investigated the size and development of the IE.

2.1. The existing literature on IE determinants and indicators

2.1.1. Using micro-approach

Feld (2005) carried a comparison of the IE in Germany in 2001 and 2004 based on survey data. The 2004 survey was conducted on 2143 individuals, where the 2001 survey included a response of 5686 individuals. The results of multivariate analyses showed that the informal activities went from 10.4% in 2001 to 8.8% in 2004, which means that these activities have decreased in three years. A large portion of this decrease is found among self-employees. The investigation also revealed that the

perceived risk of getting detected plays a significant role in choosing to work in the IE or not. Moreover, the region in 2001 had no significant effect, but it had a significant effect at 1 % in 2004.

While in the absence of direct survey data, Williams (2006) aimed to conduct the first direct survey of business perception on the scope of the IE during 2004/2005 in the UK. The survey included the responses of 7505 small business owners. The results showed that

- 14% of the respondents reported that they were negatively affected by the IE;
- The most affected sectors by IE are construction, land transport, the motor vehicle trade, and restaurants;
- Informal activities are concentrated in peripheral, more rural regions of the UK.
- It is found in every sector an average of 8% of trade is done informally.

La Porta and Shleifer (2008) aimed to analyse the IE in developing countries using firm-level survey data from the World Bank. The data collected is from three different surveys. The first survey is an enterprise-based one that covers 105 countries. The second survey is on the informal firms available in 13 countries. The last survey is a micro survey available for 14 countries, most of which are African countries. The results indicate that the informal enterprises are small and unproductive compared to the smallest formal enterprises. The quality of human capital in informal enterprises is better than in informal firms, which less-skilled individuals manage. Consequently, their economic decisions are inefficient, have less capital and finance and target a close circle of customers. Although informal enterprises provide working opportunities to less-skilled workers, they do not contribute to economic growth and disappear over time.

Schneider (2009) investigated the size and determinants of the IE in Germany, Austria and other OECD countries using different approaches; one of them is a direct approach. Starting with the investigation in Germany in 2007, a sample of people were asked if they regularly worked in the IE. 20.7% answered yes, and 30% of the sample declared regularly demanding informal activities to save money. Surprisingly, 73% of respondents identified tax burden and social security burden as the two most important factors influencing informality. The case of Austria, Schneider (2002) conducted a survey on IE in this country for two main reasons: to collect information on the reaction and perception towards informal activities, and to measure the scope of IE in the construction and craftsman sector. The sample included a representative sample of the population, 55 self-declared IE workers and 320

craftsmen and construction enterprises, managers. The results indicated that 918000 individuals supplied the informal activities in the two sectors; the average wage declared by the 55 self-declared IE workers is 15.45 euros per hour; and according to the managers, 50% of their workers work in the IE.

Henley et al. (2009) aimed to investigate the size of the IE in Brazil using household survey data over the period from 1992 to 2004. The authors constructed three measures of informality different from the ones usually adopted in the literature. The results showed that 40% of the economic activities are informal.

Bellache (2010) conducted a household investigation on the magnitude of the IE in Bejaia, Algeria. The sample included 522 households and nearly 1000 officially employed workers. This same database was used later in Bellache (2013) by the same author. The authors based their analyses on multivariate analyses and other econometrical tools. The results showed that there was intra-sectoral solid upward mobility within the informal sector and a segmentation between the non-mobile and mobile self-employed. Low human capital, low income, and weak linkages with the formal economy support the dualist view of segmentation between the informal and formal economy. However, the results indicated a large IE in Algeria.

In another investigation by Adair and Bellache (2009), they used the same database collected previously. The results uncovered several findings, such as the determinants of informality among unpaid and officially paid workers, which are not the same.

First, some of the main determinants of informality for unpaid workers are:

- The likelihood of being informal decreases with age. Entrepreneurs aged 30 to 39 are half as likely to be informal compared to entrepreneurs aged 20 to 29. Those aged 40 to 49 are five times less likely to be informal. Micro-entrepreneurs in the informal sector are predominantly young;
- The likelihood of being informal decreases with the level of education. Entrepreneurs with an average level of education are three times less likely to be informal than entrepreneurs with no education or with a primary level. Those with a secondary or higher level are respectively 10 and 15 times less likely to be informal;
- The likelihood of a business being informal decreases as the number of employees increases. Compared to the self-employed (0 employees), companies with 1 to 4 employees are three times less likely to be informal. Those employing between 5 and 9 people are four times less likely to be informal

than the self-employed. The probability of being informal for a company with more than nine employees is almost zero.

Second, some of the main determinants of officially paid workers are:

- Single employees (and widowers or divorced) are six times more likely than married employees to belong to the informal group;
- The likelihood of being informal decreases with the level of education. Employees with an average level of education are twice as likely to be informal compared to employees with no education or a primary level. Those with a secondary or higher level are respectively 5 and 13 times less likely to be informal;
- Employees in construction and services are more likely to be informal than employees in the industry. Civil service employees (administration, education and health) are declared to the CNAS and therefore formal (apart from multiple activities).

Putniņš and Sauka (2015) cited two micro-studies done in Denmark and Germany. The first study investigated the scope and development of informal work in Denmark from 2008 to 2010. The sample consisted of 2200 random individuals. According to the results, 52% of the sample engaged in informal work the year before and were paid in cash. 28% were willing to buy goods and services from the IE, even though they did not engage in any informal activities in the year before. Furthermore, 80% of the questioned individuals are potential customers for everyday work. One of the exciting findings in this study is the high acceptance of informal activities among Danish people. The second survey used a database generated in 2010 using answers the of 2104 individuals. However, the results showed that the people questioned have a clear idea that IE reduces tax revenues. They claim that high tax rates make the IE more desirable and that informal labour is more flexible and available than formal one. Maybe this is why, on average, the respondent does not declare informal activities.

Putniņš and Sauka (2015) developed a new survey method based on interviews with company managers to measure the scope of the informal economy. This method is based on the assumption that company managers, due to their position and experience in dealing with the two economies (formal and informal), know how much business revenue and wages go unreported. To ensure the objectiveness of the answers, the authors relied on a variety of surveys design. The method combines miss reported business income, informal employees, and unreported wages to estimate the size of the IE as a percentage of the official GDP. This method was applied to Latvia, Estonia and Lithuania between March and April 2011, 2012 and 2013. The sample included 500 companies from each of the three

countries. The study revealed many interesting findings, such as firms that are dissatisfied with the tax system are more likely to engage in informal activities, and the probability of being detected and punished has a significant effect on the decision to engage in informal activities.

Ekici and Besim (2016) estimated the size and evolution of the IE in north Cyprus using the 2008 household budget survey. The participants were selected randomly and asked to answer a set of questions on consumption and spending habits in addition to other demographic and socio-economic questions. After that, the data was modified; for example, it was classified based on the income source, resulting in three groups: private, public, and self-employed. Further modification of the data was done. The results showed that the private employed and self-employed underreport their income by 13% and 20%, respectively. The estimated size of the IE scope in north Cyprus is 8.6% of official GNP, which represents the lower bound.

Buszko (2017) estimated the size of the IE in Poland using a sample of 249 company managers representing 119 official small and medium-sized enterprises from different economic sectors taken in September 2016. Unfortunately, the authors were forced to exclude 25% of the questionnaires. The findings indicated that SEMs engage in the IE because they see an opportunity for development and a source of additional untaxed income. In the same year, (16) measured the size of the street vending in Cali, Colombia. The study was conducted over two years, from 2014 to 2016, in two of the most populated cities in the city.

2.1.2. Using macro-approach

The first scholars that used an indirect approach to estimate and determine the main variables that affect the IE size were Gutmann (1977) and Feige (1979). In which they relied on monetary data released by the American government. In his study, Gutmann (1979) relies on some simple key assumptions to measure the United States' IE. First, individuals avoid using checks, and all transactions made in this economy are done using currency only to avoid being detected by government authorities. Second, the only determinants of IE activities are the tax burden and government-imposed restrictions. Third, the currency to demand deposit changes are the net result of variations in taxes and government restrictions. Thus, this ratio is an indicator of IE size. The last and most important assumption is that a base year is selected as a base year. The ratio of currency to deposit demand is considered normal, implying that the size of the informal economy is zero. Gutmann (1977) selected the year 1937-41 as the base years to estimate the size of IE in 1976 and later in 1979. Assuming there were no IE activities

in 1937-41 and the deposit demand in 1976/1979 was regular, he estimated the extra currency related to IE estimated then multiplied by GNP to legal money. The result reflects the estimated size of IE activities in these years.

However, this method's assumptions were heavily criticised. Tanzi (1980) criticised the assumption that the changes in currency to deposit demand are the net result of high taxes and government restrictions, when many other variables can significantly impact this ratio. Furthermore, assuming that there were no IE activities in a base year is a naive assumption, and its impact on the estimation results is crucial. Therefore, overcoming these critics is very important to this approach. To overcome the problem in Gutman's (1977) method and have more sophisticated estimations, Tanzi (1980) proposed to making the demand for currency explicitly a function of several variables, including tax levels. By measuring the sensibility of currency demand to taxes, the researcher estimated the amount of illegal currency held by individuals. From this estimation, he estimated the size of the IE. A modified currency demand function proposed by Cagan (1958) was used, where the dependent variable can be either the ratio of currency to deposit demand or the ratio of currency to M2, and the independent variables are split into two groups, namely, legal variables and illegal variables.

Legal variables were distinguished between long-run and short-run factors. Among the long-run variables we find: the increasing use of credit cards; the volume of travel per capita; the number of commercial banks in the country; and the degree of urbanisation in the country. In the case of short-run legal variables, there is the relative cost of holding currency vis-a-vis demand deposit and income composition. Also, the illegal variables were distinguished between tax-related variables and non-tax related variables. For the latter, even if taxes do not exist, the current demand will be affected by other variables such as gambling, smuggling, narcotics, etc. Because most of these activities involve the use of currency, any increase in these activities will result in an increase in currency demand. Unfortunately, statistical data on some of the previous variables were unavailable or couldn't be measured, which led Tanzi (1980) to select approximative variables that could reflect the above factors, e.g., to capture the impact of long-run legal variables, he used per capita income. The ratio of total wages and salaries in personal income was used to reflect income decomposition; the interest rate on time deposits was used to approximate the relative cost of holding currency.

The theoretical model in that study consisted of the following variables over the period from 1929 to

1976:

- The ratio of holding currency to the money in general M2 as the dependent variables;
- Taxes: this variable was measured by three indicators, namely, the ratio of personal taxes to the personal income net; top-pocket statutory tax rate; weighted average tax rate on interest income;
- Wages: this variable was the ratio of wages and salaries to the personal income;
- Interest rate: the interest rate on time deposits;
- Income: this factor was reflected in two variables: real measured per capita income and real permanent per capita income empirically estimated by Freidman & Schwartz.

The empirical results suggested that taxes and wages have a positive statistically significant impact on the dependent variable. Interest rates have a significant negative impact, where the impact of per capita income is ambiguous. After three years, Tanzi (1983) re-estimated this model using log transformations on the original time series. The common signs were empirically found, and the per capita income had the right sign, which suggests that the data had some statistical problems. Although the method and model proposed by Tanzi (1980) were novel at the time, they had some econometrical problems. First, the data was not tested for unit root tests, which may lead to spurious regression. Second, there was no post hoc estimation to test the obtained results. Furthermore, as Garcia (1978) noted, over this period, the increase in the ratio of currency to deposit demand was due to a decrease in demand on deposits rather than an increase in currency caused by informal activities. Besides this remark, Gershuny (1979) pointed out that the US dollar is used across the globe as international money, and Tanzi (1980) did not consider this factor in his model.

In an attempt to overcome these disadvantages, Klovland (1984) proposed to substitute the currency to deposit demand ratio by currency demanded by the public to the price level as the dependent variable. This dependent variable is a function of:

- The volume of transactions made in the official economy is measured by household disposable income;
- Interest rate;
- Marginal taxes.

Klovland (1984) explained that marginal taxes, which are defined as the amount of additional tax paid by individuals for every additional money unit earned as income, are more important than the average tax rate, which is the total taxes paid by individuals over their total income, to labour supply decisions to engage in the IE or not. To empirically test this hypothesis, he constructed data series of three-time series of Norway's and Sweden's aggregated marginal tax rates. The first series is the aggregated marginal income tax rate, and the second series is the marginal tax rate; the final time series is a broader marginal tax rate that includes the previous two. The researcher adopted the error correction model methodology to estimate the model parameters to account for short-run dynamics impacting the dependent variable.

The findings differed between the two countries; the three tax variables have no significant influence on Norway. In the case of Sweden, the marginal taxes have the expected impact, and it was found statistically significant, confirming that the IE activities raise the demand for currency. The author justified the Norway results by mis specifying in the model, referring to other variables that may influence the currency demand. Nevertheless, Schneider (1994) used a modified difference of the previous model to estimate the IE size in Austria by adding regulation intensity as a determinant of IE activities rather than only marginal taxes as done by Klovland (1984). The latter variable was found to positively impact the size of IE. It must be noted that the two studies of Klovland (1984) and Schneider (1994) added lagged variables of the dependent variable to achieve a better model fit.

The previous studies discussed above were the starting points of several studies conducted around the world. Especially Tanzi's (1980) study, in which he proposed a model that had a significant impact on studies that followed. Even though this model was the soul of these studies, it has been modified over the years, either by modifying the dependent and independent variables that motivate individuals to work in the IE or by using new and more sophisticated empirical models. A synthesis of the studies that we were able to access is provided next, along with their proposed determinants of IE and theoretical model to have a general idea of how this modal was calibrated until recent years.

After giving a literature review of the existing studies that estimated the IE and comparing their weaknesses and advantages, Mehnaz and Qazi Masood (1995) decided to adopt Tanzi's (1980) model with some modifications to better fit it to Pakistan's case and used it to estimate the IE activities from 1919 to 1955. To this end, he proposed two models with the same independent variables. However,

they deferred in the dependent variable; the first model had currency to M2 as the dependent variable, while the second model had the ratio of currency plus bearer bonds to money supply M2 (CURCB) as the dependent variable. A double log transformation was introduced to the two models. The independent variables were interest rate on time deposit (INTDP), a dummy variable to control for currency holdings of the former East and West Pakistan, and the ratio of total taxes to GDP as the only determinant of IE activities. Therefore, the estimated equation for the second is as follows:

$$\ln CURCB = \alpha_0 + \alpha_1 \ln(1 + TAX/GDP) + \alpha_2 \ln INTDP + \alpha_3 DUM + \varepsilon \qquad (4)$$

The empirical exercise showed that the ratio of currency plus bearer bonds to money supply M2 (CURCB) was affected by the changes in tax variables more than currency to M2, indicating that bearer bonds were used in the IE activities in Pakistan over the study period. Although, the first model performed better than the second model in the model fit indicators.

Kasipillai, Baldry, and Rao (2000) estimated the IE economy in Malaysia from 1971 to 1994. In doing so, they used the same model as Tanzi's (1980), except they added the inflation rate (π) as an independent variable, which they argue has a significant impact on the demand for currency because the higher the inflation rate, the greater the incentive is to favour currency on time deposits. Moreover, they kept the average tax rate on personal income as the only determinant of IE activities over this period. The proposed semi-logarithmic theoretical model in this study is written as:

$$\ln C/M2 = \alpha_0 + \alpha_1 TAX + \alpha_2 R + \alpha_3 \pi + \alpha_4 \ln Y + \alpha_4 SF + \varepsilon \qquad (5)$$

Where Y is the real per capita GNP, and SF is a dummy variable to capture Malaysian structural change in the financial market. After conducting an OLS regression, all the empirical results showed the expected signs and effects. This study is significant because it shined the light on the role of inflation in the currency demand model. Finally, the size of the IE was estimated to range from 8.7% to 3.7% of official GNP.

After gaining much intention from the South African government and scholars in South Africa, Saunders and Loots (2005) conducted one of the first empirical studies to estimate the size of IE from 1967 to 1993. The empirical part of the study was built on a log model, including the ratio of notes and coins holdings to M1 and M2 as a dependent variable. For the independent variables, the researchers argue that the CDA is only reasonable if all factors influence the currency ratio to the money supply.

For this reason, they added to the original independent variables the proportion of final consumption expenditure by households in national income; this variable was added to capture the changes in payment and money holding patterns over the study period. In addition, government intervention in the economy is measured by the ratio of government revenue to GDP. Like the previous studies, the only motive for IE is the general government tax index. The primary findings showed that the model had a serial correlation problem, which led the theme to include an AR (1) term in the model. After adding this term, the model performed well, and all the signs, as expected, except for the government intervention index, which was found to negatively impact IE activities. Finally, the average size of IE over the study period was estimated to be 9.5% of official GDP.

Fethi, Fethi, and Katircioglu (2006) adopted two monetary methods: the currency demand approach, and the simple currency ratio approach to estimate the IE in Cypriot currency from 1960 to 2003. The proposed CDA model followed the idea proposed by Kasipillai et al. (2000) to add inflation as a determinant. As a dependent variable, the authors used real currency to M2 (RMC) as an indicator instead of nominal currency to adjust the data for the impact of inflation. For the independent variables, they kept taxes as the only determinant of IE activities and added inflation. The estimated model in this study is:

$$\ln RMC = \alpha_0 + \alpha_1 \ln YT + \alpha_2 WSY + \alpha_3 \ln IR + \alpha_4 \ln PGNP + \varepsilon_t \qquad (6)$$

The model was estimated using OLS regression with no dynamic variables added. All the variables were found to have the expected sign. It is noted that inflation significantly impacted the dependent variable; thus, it is essential to account for its influence in the present study. Lastly, the mean size of IE was estimated to be around 9.41ù of official GDP.

Pickhardt and Sardà Pons (2006) proposed a modified CDA model using the Taylor series to estimate parameters. This approach does not require the assumption of a base year where the IE is equalled to zero, nor does it assume the equality of income velocity in the two economies. Thus, it overcomes two of the main shortcomings of the original CDA. The equation is written as:

$$C_t = \alpha_0 . {Y_t}^{\alpha_1} . {P_t}^{\alpha_2} . exp^{(\alpha_3 . T_T + \alpha_4 . R_t + \varepsilon_t)} \qquad (7)$$

As hypothesised earlier, tax rate variations cause fluctuations in currency demand attributed to informal activities. After that, the current demand is attributed to total income. So, the total income is composed

of two parts: formal income (Y_{ft}) and informal income($_{Gift}$). This can be shown in the equation below, assuming that the tax variable equals zero.

$$C_t = \alpha_0.(Y_{ft} + Y_{ift})^{\alpha_1}.{P_t}^{\alpha_2}.exp^{(\alpha_4 R_t + \varepsilon_t)} \quad (8)$$

From the two equations above and after rearranging yields

$$\frac{Y_{ift}}{Y_t} = exp^{(\alpha_4.R_t/\alpha_1)} - 1 \approx \alpha_4.R_t/\alpha_1 \quad (9)$$

This equation is solved using Taylor series expansion; therefore, estimating the IE size requires knowing α_1 and α_4.

The currency demand approach was popular among researchers as one way to estimate the IE on a macroeconomic scale. However, the method has an internal consistency highlighted by Ahumada, Alvaredo, and Canavese (2007). According to the author, many empirical studies that tried to measure the size of IE are inconsistent with the method itself. As mentioned before, to find the size of IE, the estimated illegal currency is multiplied by income velocity, which is assumed to be the same in the formal and informal economy. That paper demonstrates that this equality is only valid when the income elasticity is found to equal one, or the results are needed. The following equation can do the correction of estimations:

$$Informal\ economytYt = (\frac{illegal\ currency_t}{legal\ currency_t})^{1/\beta} = (\frac{Informal\ economy_t}{Y_t})^{1/\beta} \quad (10)$$

Where Y_t is the registered income, measured in early studies by GNP and in more recent by GDP. β is the income elasticity.

Therefore, researchers that use the currency demand approach need to pay intention to income elasticity and adjust their results if needed. Unfortunately, some studies found income elasticity to be different from one another and did not adjust their results.

Hernandez (2009) analysed the determinants of IE in Peru using the currency demand approach for the period 1979 to 2005. The author proposed to use two models with different motivations to work in the IE. The first model, as all previous ones, had taxes as the sole determinants of these activities. The second model had government intervention measured by the ratio of government expenditure in

the economy as the motive for individuals to switch to IE activities. The author tested all the data for the unit root test before using it in the estimation to avoid spurious regression. The estimated model is written as:

$$\ln C = \alpha_0 + \alpha_1 \ln(1+F) + \alpha_2 \ln Y + \alpha_3 i + \alpha_4 \pi + \varepsilon \qquad (11)$$

Where F has replaced ones with the ratio of total taxes to GDP and by the ratio of government expenditures to GDP, the estimation showed that taxes to GDP had more impact than the government intervention. At the end of the empirical exercise, the paper estimated that the size of IE fluctuated between 44% and 50% of official GDP.

The investigation carried out by Greenidge et al. (2009) was the only second study to analyses the determinants and size of IE activities in Barbados. In the opinion of the authors, the best method to estimate the IE activities is CDA due to the availability of macroeconomic time series for a long period (1972-2007). The authors implemented the modified equation of Bajada (1999) with a further modification. Rather than estimating a simple model, a general unrestricted error correction model with several lagged terms, the authors applied the method generally to a specific approach (GETs) to eliminate all statistically irrelevant variables, thus reducing the model to a more precise congruent one. As claimed by the authors for the goal of eliminating the impact of inflation and population growth, the model proposed had real capita currency as the dependent variable, for the independent variables, real disposable income, inflation rate, interest rate, private consumption expenditure over GDP, technological trend variable and tax rate. Before starting the estimations, all-time series were tested for the existence of a unit root. After that, the authors gave their estimations. All the variables were found statistically significant and had the right expected sign. Lastly, the paper estimated that the size of IE fluctuated between 20% and 40% of official GDP with an average of over 32%.

AnaMaria, Ion, and Catalin (2009) analysed the trend of IE activities in Romania from 1998Q1 to 2008Q4. The paper highlighted the importance of knowing the size and evaluation of IE to policymakers. The authors proposed deflating the currency rather than standardized it by M2. This is because M2 contains amounts that correspond to long-run wealth accumulation, thus using M2 is inadequate. As independent variables, the authors used wages to GDP, nominal interest rate, national income reflected by real GDP, and total tax revenues over GDP. All the data was log-transformed and checked for unit root existence. The unit root tests suggested that all the data are integrated of order one

I(1); thus, the authors ruled out traditional estimation methods and further investigated the existence of long-run relationships using cointegration tests. After estimating the size of IE, the estimations were corrected using the proposed correction by. At the end of the investigation, the size of IE was found to fluctuate between 27% and 38.12% of official GDP.

Annual data from 1970 to 2006 was used by Macias and Cazzavillan (2009) to estimate the IE in Mexico. The authors begin their paper by stating the existence and the spread of IE activities in Mexico. The authors pointed out that these street vendors are well organised and protected by specific groups, making it difficult for authorities to manage themes. The availability of long time series justifies the choice of using this approach and that this method was not used to estimate the Mexican IE. The dependent variable in this study is a real currency, the meaning currency was normalised by the GDP deflator. This choice of the variable was motivated by the critics of Spiro (1996).

Turning to the independent variables. All the usual variables were used in addition to total remittance normalised by GDP. According to the authors, this variable has a significant long-run effect on the currency demand function for two reasons. First, this variable is directly and strongly related to informal activities because individuals are usually engaged in "smurfing", separating transfers into different accounts or smaller packages, to avoid reporting and satisfy local necessities such as taxation on larger quantities of money. The second reason is the massive immigration of Mexicans to the developed world, especially the United States. This caused remittance magnitude to surpass foreign direct investment. This variable is expected to positively impact the currency because migrants import currency to Mexico, especially in the form of US dollars, which forces them to convert it to local currency, thus increasing the demand for currency. Unfortunately, the authors state that it is impossible to have a true, reflecting time series for this variable because individuals do not report this kind of money. However, the recorded amount of remittance data as a lower bound for this factor was used in the estimation.

Before the estimation, the authors tested the series for the unit root test. All the series were found to be strongly non-stationer in level, but stationer at the first level, which motivated them to test for cointegration between the series. Additional models besides the original model were tested to check the stability and robustness of the results by replacing taxes by government consumption over GDP and by omitting the remittance variable. The results confirmed the author's hypotheses concerning the

additional variable. It must be noted that government intervention had a more statistical impact on the independent variable than taxes. Furthermore, the estimated size of IE was corrected using the Ahumada et al. (2009) method. At the end of the empirical exercise, the paper estimated that the size of IE fluctuated between 20% and 80% of official GDP with an average of over 35%.

Dell'Anno and Halicioglu (2010) employed the CDA to estimate the size of IE in Turkey from 1987 to 2007. For this purpose, the paper employs a revised version of CDA. The authors started with a literature review of the previous studies that estimated the IE in Turkey; in this matter, there were a variety of methods used over the years. Surprisingly, the methods yielded different sizes of the IE activities, indicating that no method is optimal and more research is needed. This point was the sole motivation for the authors to investigate the size of this phenomenon. Furthermore, the paper continues to analyses the interaction between the latter and the official economy. In the empirical part of the study, the real currency was used as an independent variable following the previous work of Spiro (1996). The independent variables included real income, nominal interest rate, tax burden measured by a tax imposed on businesses in addition to the nominal exchange rate. The last variable is expected to have a negative impact on the currency demand function. After testing the data for stationarity proprieties, which were found to be various I (0) and I (1), the ARDL method was employed. This method is superior to the traditional model because it produces the coefficients of the long and short-run relationships. Finally, the authors estimated the size of IE to range between 10.7% and 18.9% over the study period.

Pickhardt and Sarda (2011) closely analysed Germany's IE activities and size from 1960 to 2008. The authors took the observation of Ahumada et al. (2007) and re-estimated the existing estimations that used CDA. It turned out that the tax variable was found to have less impact after the correction. Consequently, several studies have provided missleading findings to policymakers.

Gulzar, Junaid, and Haider (2010)estimated the size of IE activities in Pakistan from 1973 to 2010 using various indirect approaches, namely, CDA, model approach (MIMIC), electricity consumption approach and labour market approach. In the theoretical part of the paper, the authors provided an excessive literature review on CDA especially, the studies that estimated IE in Pakistan. Moving to the empirical part of the paper, a modified version of Tanzi's (1980) model was used. The independent variable is the same in the original model. The independent variables were the same.

However, they were measured differently with additional variables such as population, inflation and a lagged dependent variable. Overall, taxes measured the tax variable to GDP. Income was reflected by real GDP growth. Finally, a dummy variable was added to take values from 1991 to 2009 to capture the effect of foreign currency accounts. After specializing in the theoretical model, the authors applied the ARDL method to overcome the limits of CDA. The results suggest that taxes have the most significant effect on currency demand. The population had a positive and significant impact on the currency ratio. The robustness of these results was tested using different approaches and found very robust in the Pakistani case over the study period. The paper concluded the estimation section by estimating the size of the IE, which ranged between 39.1% and 30%.

Ardizzi, Petraglia, Piacenza, and Turati (2011) proposed modified variables to assess the size of IE using a panel of 91 Italian provinces for the years 2005-2008. This paper contributes to the literature on CDA by suggesting three main ideas. First, it proposes to use the flow of cash withdrawn from bank accounts relative to total noncash payments as the dependent variable. This variable eliminates the problem of selecting a base year for the estimation and the equality of income velocity in the two sectors. Second, the study uses a detected tax evasion index rather than using tax burden, which overcomes the assumption that these IE activities are motivated only by taxes. Finally, an additional covariant is added to control for illegal money demand, mainly drugs and prostitution. To test if the added variables have a significant statistical effect, the authors estimated the first model using only taxes as the sole determinant of IE activities; then, a complete model is estimated. The results suggest that all variables are significant in the two models and have the expected sign.

Boudlal (2012) estimated the size of the informal Algerian economy using the CDA approach from 1970 to 2010. The author used currency to M2 as the dependent variable, an average of GDP, wages to GDP, taxes to GDP, and interest rate as independent variables. The results based on OLS regression revealed that the average of the informal economy was 24.5% of official GDP; all the variables had a positive impact on the dependent variable except average GDP. However, some remarks can be made in this study; the author did not report the tests of stationarity or cointegration; also, he did not specify if he included or excluded oil-tax revenues from his tax variables, knowing that Algeria is an oil-rich country. If the author did add oil taxes, the results would be missleading. The author assumed that the velocity in both formal and informal economies is the same, and according to Ahumada et al. (2007, 2009), this assumption is not valid. The estimated results do not need to be

corrected.

estimated the size and evolution of IE activities for Ghana from 1990 to 2010 using the model proposed by Pickhardt and Sardà Pons (2006), the main benefit of this model is that it does not require existing observation of the informal economy and does not assume the exact velocity of cash circulation in the formal and informal economy. At the beginning of the paper, the problem of high informality in developing countries was highlighted and discussed theoretically. In the empirical part of the investigation, and after testing for existing unit root, the authors employed Stock-Watson Dynamic Ordinary Least Square (DOLS) to estimate the theoretical model. This method is a robust single equation approach that corrects endogeneity by enhancing with lags and leads to the first differences between the independent variables and serially correlated errors by a GLS procedure. For the data used, the author chose to use M1as a dependent variable, which is unusual for this variable. For the independent variables, the current GDP, inflation rate, and nominal interest rate were used. As expected, all the variables had the right expected signs. In the end, the size of IE was estimated to fluctuate between 4% and 14% of official GDP.

Asante (2012) assessed the informal activities and tax evasion in Nigeria from 1975 to 2010 using yearly macroeconomic data. This study aims to fill the literature gap on the size and determinants of IE activities in Nigeria using macroeconomic approaches. The theoretical model proposed in this study is composed of currency to M2 as the dependent variable and total taxes over GDP, GDP per capita, household final consumption expenditure over GDP, inflation rate, interest rate, education level, and finally, urbanization ratio. All the variables were log-transformed except the interest rate and inflation. For the estimation of the model, the authors employed a unit toot test and a cointegration test. After pre-diagnostic, the ECM model was found to be the appropriate model for the data. The results suggested that all the variables had the expected theoretical sign over the study period. Further, the estimation of IE size suggested that it ranged between 42.54% and 72.32% of the official GDP.

Makochekanwa (2012) employed the CDA to assess the determinants and size of IE in Zimbabwe from 1980 to 2009. The paper employs a variant of Tanzi’s (1980) model using the currency in circulation as a dependent variable, explained by real GDP, nominal interest rate, time trend, average tax rate, and final private consumption expenditure over GDP to capture the Mitchell-Hawtrey effect. According to this effect, two variables affect the relative use of currency over the business cycle. First,

relatively more currency is needed per unit of transaction in retail transactions than in other types of transactions. Second, the rise in the share of wage and salary incomes relative to overall factor incomes should increase cash-use. Wages and salaries are generally paid in cash rather than by check, which is more often used for other forms of factor income, and the informal exchange rate is an additional variable that is expected to positively impact the fluctuation of currency demand. After constructing the theoretical model, the paper tested all data series for stationarity proprieties and the empirical estimation. The results were significant and in line with economic theory, except for the nominal interest rate, which was statistically insignificant. Lastly, the paper found that the size of IE was raised from 10% to reach 52% of official GDP over the period under investigation.

Alm and Embaye (2013) aimed to estimate the size of the IE in 111 countries using the currency demand approach from 1984 to 2006. This study was based on a dynamic panel approach using the GMM method to estimate the parameters. The researchers used the tax rate, real per capita income, and the interest rate on time deposits, the inflation rate, the degree of urbanisation, and the enforcement strength of the tax administration as independent variables. The results suggested that Algeria had an average of 48.09% of GDP as the informal economy, which is the highest estimate in the existing literature. However, the authors did not correct their estimation, arguing that "when the dependent variable is the currency to the M2 ratio, the expected coefficient on the income variable is negative, and it does not have the usual interpretations of elasticity.

Schneider and Hametner (2014) aimed to estimate the size of the IE in Colombia and its interaction with the formal economy using the CDA approach from 1980 to 2012. After establishing theoretical reasoning on how the formal and informal economies are related, the authors proposed their theoretical CDA model that included GDP per capita, the average interest rate on deposit, exchange rate, average tax rate, indirect tax rate, unemployment, expenditures for public employees and intensity of regulations. Results showed that unemployment, average tax rate and indirect tax rate were the primary sources of informality over the study period.

Asiedu and Stengos (2014) based their work on the model of Bhattacharyya (1990) to estimate the size of IE in Ghana from 1983 to 2003. Unlike the original CDA model, Bhattacharyya (1990) implicitly allows for income velocities in the formal and informal economy. The key assumption in this model is that at any given time, the total currency demand is the sum of the currency demand by the

formal economy (M_{ft})and the informal economy (M_{Gift}). Thus:

$$M_t = M_{ft} + M_{ift} \tag{12}$$

Assuming the currency demand function is given as:

$$M_{ft} = \alpha_0 . Y_{ft}^{\alpha_1} . R_t^{\alpha_2} . P_t^{\alpha_3} \tag{13}$$

$$M_{ift} = Y_{ift}^{\alpha_4} \tag{14}$$

Where $Y_{ft}^{\alpha 3}$ and $Y_{ift}^{\alpha 4}$are formal and informal real output and income, respectively, $R_t^{\alpha 2}$ is the interest rate, P_t^{α} is price level. consequently, the total currency in circulation is found by the combination of the two equations above to yield:

$$M_t = \alpha_0 . Y_{ft}^{\alpha_1} . Y_{ift}^{\alpha_4} . R_t^{\alpha_2} . P_t^{\alpha_3} \tag{15}$$

The ratio of informal to formal output is a function of factors such as the inflation rate, the change in inflation rate, and the tax ratio over GDP. The inflation rate factor is added to control for individuals' incentives to engage in the informal economy. Thus, the ratio of formal to informal output is given as followed:

$$\frac{Y_{ift}}{Y_{ft}} = \beta_1 + \beta_2 T_t + \beta_3 \Delta Y_{mt} + \beta_4 \Delta log P_t + \beta_5 \Delta (log P_1) \tag{16}$$

Solving this equation for $_{Gift}$, substituting the previous yields the non-linear function to be estimated. Then the $\beta' s$ coefficients are substituted in the ratio of formal to informal output to find the size of IE activities. As usual, the stationarity tests were used in recent studies, then the non-linear model is estimated. Moving to the estimation part, the authors only presented the long-run coefficients because short-run coefficients were insignificant. At the end of the empirical exercise, the paper estimated that the size of IE fluctuated between 25% and 54% of official GDP with an average of over 40%.

Gamal and Dahalan (2016) aimed to assess the size and evaluation of IE activities in Saudi Arabic from 1980 to 2010. The authors, unlike previous studies in Saudi Arabic, examined the link between fiscal expenditures and IE employing the CDA model with structural breaks. The proposed model in this study is written as:

$$lnM1_t = \alpha_0 + \alpha_1 lnT_t + \alpha_2 lnG_t + \alpha_3 lnREM_t + \alpha_4 R_t + \alpha_5 \pi_t + \varepsilon_t \tag{17}$$

Where $M1$ is the narrow definition of money (currency plus demand deposits), T is the financial factor that motivates individuals to engage in IE activities, G is the income, REM is the outflow money remitted by foreign workers to their home countries, R is the interest rate, and π is the inflation rate. Moving to the estimation phase, all the data were tested using Perron's test Perron and Rodriguez (1998) unit root test, which allows for structural breaks; after that, the cointegration test of Pesaran, Shin, and Smith (1996) was employed. Based on the previous tests, the ARDL method was found to better fit the data proprieties. After getting the estimation, the authors corrected them using the Ahumada et al. (2007) method. In addition to determining the size of IE, the authors employed the Toda-Yamamoto causality test to investigate the causality direction between public expenditures and the informal economy. It is noted that the results were contradictory to the expected signs in the short-run estimations.

Tan, Habibullah, and Yiew (2016) estimated the size of IE in Malaysia from 1972 to 2012. According to the authors, this approach is selected for the following reasons. First, this approach consists of reliable, available and comparable time series. Second, it is widely used by scholars and academics. Finally, and more importantly, the evolution and trend of IE can be examined as its causes contain the relevant information. The model proposed is written as:

$$lnCM2_t = \alpha_0 + \alpha_1 lnT_t + \alpha_2 lnY_t + \alpha_3 R_t + \alpha_4 \pi_t + \varepsilon_t \quad (18)$$

The dependent variable is currency over M2, T is the total of indirect taxes over GDP, Y is the nominal income per capita, R is the interest rate, and π_t is the inflation rate. The authors tested the priorities of the time series and employed the ARDL method to estimate the long and short-run coefficients over the study period. The empirical results contradict the previous studies in the case of income effect on currency demand, which was found to have a negative effect.

Nchor and Konderla (2016) used a variant of the original CDA to measure the size of IE in the Czech Republic from 1991 to 2013. In addition to currency outside the bank, the authors included the total of automatic teller machines, interest rate, GDP deflator and average tax rate as explanatory variables. The interest rate and GDP deflator were log-transformed, and stationarity proprieties were tested before the estimation. The expected effect of automatic teller machines on currency demined is negative because the increase of this machine countrywide will decrease the need for money to make transactions. The empirical investigation confirmed all the expected signs for all the variables included

in the model. In the end, the paper found that the average size of IE is more than 20%.

One of the recent studies that assessed the size and determinants of IE in Pakistan using CDA is the study of Iqbal and Rahman (2017). To this end, four models were proposed; this was motivated by the idea of knowing the sensitivity of the dependent variable to a different linear combination of independent variables. Unlike the previous works, the authors included lag taxes to GDP ratio by one year, the number of banks' deposits over the total number of banks' ratio, and a dummy variable to capture the effect of tax reform in 1997. The stationarity proprieties of the time series were not tested for, nor were any other proprieties. The findings suggested that the growth rate of GDOP has a negative effect on currency demand in two models out of the tree. This is justified by the improvement in the economic situation that made individuals less dependent on the currency. Lastly, the size of IE was estimated to range between 5% and 40% of official GDP.

One of the most recent studies to measure the size of the informal economy in Ghana is the study of Ocran (2018). The aim of this investigation has two goals. First, the purpose is to provide a detailed analysis of the economic situation and labour force characteristics. Secondly, to estimate the size of IE activities from 1960 to 2007. According to the authors, this approach was adopted for the following three reasons. First, the majority of transactions in the informal economy are made using currency. Secondly, since the CDA is widely used worldwide, a meaningful comparison can be made. Lastly, an important reason is the availability of the data. The model proposed is the following:

$$ln\frac{CU}{DD} = \alpha_0 + \alpha_1 \ln Y + \alpha_2 \ln I + \alpha_3 \ln E + \alpha_4 \ln T + \alpha_5 T + \alpha_6 D + \varepsilon \quad (19)$$

Where $\frac{CU}{DD}$ is the ratio of currency to demand deposit, Y is the income, I is the interest rate, E is the exchange rate, T is the tax burden, and D is a dummy to capture the business regulatory environment. It is argued by the author that the exchange rate has a positive effect on the currency in circulation. Individuals fear capital loss due to depreciation, which leads them to substate their financial assets for a more stable foreign-denominated currency, in addition to the original dependent variable, i.e., currency to M1 and currency deflated by CPI. Moving to the empirical part of the paper, the data was tested for the existence of a unit root. The authors chose to use the OLS method to estimate the parameters. The model with currency set at M1 outperformed the other models. However, only the tax variable was statistically significant in all the models.

A new perspective on the CDA was introduced by Dybka, Kowalczuk, Olesiński, Torój, and Rozkrut (2019). In their paper, the authors suggested merging the CDA with a MIMIC approach to have a hyper red model that is more efficient to measure the informal economy. The authors proposed an enhanced CDA to better catch the real size of IE activities and to overcome some of the issues in the original approach. According to the authors, their approach is superior because: first, it adds a group of additional variables to capture the influence of electronic payment system development to the traditional group of variables that capture the demand for the currency to be used in the formal economy; second, it adds a group of additional variables to capture the excessive demand for the currency. By doing so, the authors addressed an important discrepancy between micro-econometric and macro-econometric factors of currency demand. Secondly, the model does not include tax level variables but proxies for tax morale and tax complexity. Thirdly, the model does not use the log transformation on dependent variables because this transformation generates different IE estimations depending on the scale of exogenous variables. In addition, the authors did not use log-log transformation because they argued that it violates the economic assumption that the formal and informal demand for currency is separated and additive.

Further, no lagged dependent variable is added since it requires the knowledge of IE level in an initial period. Fourthly, to overcome the identification problem, the model uses linear identification. Fifthly, to avoid the assumption of zero tax, it is suggested to set the determinant group of IE and the determinants of electronic payment system development to their best observable values and estimate the theoretical values of the dependent variables. The difference between actual and theoretical values can be interpreted as the currency demand attributed to informal activities. Finally, as the last step, the obtained values are transformed to IE size as a percentage of official GDP, assuming the equality of velocity in the two economies.

To sum up, the paper contributes to the literature of CDA by including variables related to the electronic payment system; rather than assuming the non-existing of taxes in the calibration, it is proposed to use the values at their lowest, which is more realistic, overcoming the problem of miss specification and finally avoiding the controversial assumption of velocity.

In the empirical part of the study, the MCDA was applied to a panel of OECD countries over the period of 2005Q1 to 2015Q4. The results showed that taxes and social contributions were found to

be insignificant in most models. This is very interesting because the CDA is built on the assumption that this variable positively impacts the size of IE. The results also indicate that interest rates have a positive effect on currency demand. The decalin explained this in the dependent denominator with a weaker shift from currency to a term deposit. In the end, the size of IE was estimated to fluctuate between 2.8% and 29.9% of official GDP.

A recent study in Romania made by Dell'Anno and Davidescu (2019) employed two indirect approaches to investigate the size and determinant of IE, namely, CDA and structural equation model. The authors claim that the CDA only detects the size of tax evasion and not the informal economy. Thus, the first approach was used to estimate tax evasion, while the second was used to estimate the size of informal activities. For the CDA, the author used three main determinants, namely, tax evasion determinants, standard determinants of currency and additional control variables. The tax evasion determinants were reflected using two variables: total taxes to GDP ratio and enforcement strength of public administration. These variables are expected to positively influence currency demand. The second group of determinants consists of real GDP, the inflation rate, and the interest rate.

Furthermore, the authors added a group of control variables to account for the number of diasporas, estimated to be more than 20% of the total Romanian population, using a real effective exchange rate and real personal remittance. The model was estimated from 1999Q1 to 2017Q4. Moving to the empirical part of the paper, the authors tested the data for stationary proprieties and cointegration. They concluded that the ARDL approach is the most suitable method for the data. The results showed that all variables were statistically significant and had the right sign, except for the interest rate and the real effective exchange rate. It must be noted that the estimation was corrected using the correction. Lastly, the paper found that the size of IE was raised from 30% to reach 36% of official GDP over the period under investigation.

In their recent research, Gamal, Rambeli, Jalil, and Viswanathan (2019) assessed the IE size trends in Malaysia from 1972 to 2012. The paper starts by revisiting the existing literature on Malaysian informal economies and finds that they suffer from estimation errors and the probability of spurious regression such as the estimation of the wrong sign, i.e., finding that income negatively affects currency demand where the economic theory argues that it should have a positive impact, omitting essential variables, which may lead to a weak performance of the estimated model and other

econometric issues. Finally, some studies did not find the income elasticity equal to one and did not correct their estimations. Hence comes the purpose of the author's study to overcome these problems and assess the size and determinants of Malaysian IE. correctly by adopting a modified model that includes all the explanatory variables that may affect the demand currency and account for inequality in the two economies. The adopted model is written as follows:

$$\ln M1 = \alpha_0 + \alpha_1 \ln TR + \alpha_2 \ln G + \alpha_3 I + \alpha_4 \pi + \varepsilon \qquad (20)$$

Where M1 is the currency in circulation plus demand deposit, TR is the total of indirect taxes, G is the real GDP, I is the interest rate and inflation rate. After elaborating the theoretical model and gathering the needed data, the authors tested the existence of unit root and cointegration between the series and then carried out their estimation. The empirical investigation suggested that all the variables are significant and have the right expected sign. Finally, the authors estimated the average size of IE to be 42.53% over the study period.

2.1.3. Model approach

In the early '80s, Frey and Weck-Hanneman (1984) highlighted that until the moment of the writing of their paper, all the quantitative literature on the informal economy was looking at different indicators of this phenomenon in an attempt to infer the size and evolution of it, except for the CDA proposed by Tanzi (1980) that took indicators and determinants of IE into consideration. However, it only accounts for taxes as the sole determinant of informal activities. The authors argue that several variables can affect the informal economy simultaneously, such as burdens on the official economy; this variable is composed of taxes and social security contributions; tax morality; low awareness and trust in the tax system lead individuals to feel burdened, and thus they avoid to paying taxes or underreport the true value of taxes; government-imposed restrictions; the rise in the expected punishment by the participants in the informal economy leads them to avoid working in this sector and vice versa; structural factors are essential to account for because some variables have a different effect on economic sectors, industries and workers and lastly, labour market conditions play an essential role in the decision to engage or not to engage in these activities; hence, lower working time in the official economy. Makes the opportunity to work in the informal more attractive. This can be inferred from the low official participation rate.

The usual practice in econometrics suggests regressing the previous determinants (x_t) on the informal economy (I_t) as the dependent variable. Assuming a linear relationship between the regressors, this can be written as $I_t = \sum_{i=1}^{n} \alpha_i x_{it} + \varepsilon_t$, where α_i are the determinants coefficients to be estimated. Unfortunately, this procedure can't be followed in the case of the IE because this phenomenon is unknown. One solution to this problem is by reversing the estimation process. Based on the information on determinants taken from the economic literature, assumptions can be made about their weights (with $0 \leq \alpha_i \leq 1 \; and \; \sum_{i=1}^{n} \alpha_i = 1$), making it possible to infer the size and behaviour of informal activities. Although this solution can overcome the previous problem, it is unpractical, and the yielded estimations are not reliable in the case of policy formulation because the effect of every determinant is country-specific, and it's expected to differ by country.

In light of the idea that several determinants influence the informal economy and, in turn, its presence affects some macroeconomic indicators, another solution that is possible and somewhat more suitable is the adoption of unobserved variables theory. This method allows the estimation of parameters that link determinants to the informal economy and the latter's effect on the indicators. The first paper in the literature to use this statistical approach to investigate the determinants of the informal economy was written by Frey and Weck-Hanneman (1984). The authors argue in this paper that unobserved theory is more suitable and superior to the previous approaches because it takes into consideration multiple determinants that lead to the existing and multiple effects of the informal economy. In contrast, all the existing methods proposed to measure the size of the informal economy consider one indicator to capture the impact of IE, where its effect may show up simultaneously in the product, labour and money markets. Furthermore, and perhaps most importantly, they did not consider the causes of the informal economy or include just one as the case in the CDA, which is an unreal assumption according to economic theory. The authors applied the multiple causes multiple indicators (MIMIC) model, a particular model of the LISREL model proposed by Jöreskog and Goldberger (1975), to a pooled cross-sectional time-series data of 17 OECD countries throughout 1960 to 1978. The abstract model proposed by the authors consists of the following determinants and indicators:

- the selected determinants are

- The burden imposed by the government: this variable consists of objective taxation measured by the share of taxes in GDP, perceived taxation measured by the increase in the share of taxation, and the

burden of regulations proxied by the share of government employers in total employment. The general hypothesis is that an increase in this variable will lead to an increase in IE.

- Tax morality: this variable measures the readiness of individuals to switch from official to informal activities. this variable was measured using the following questions “Do you think that governments waste a lot of money?”, “Do you think that government is untrustworthy?” and “Do you think that government does not care much what people like you think?”.

- Unemployment rate: this variable is argued to be one of the leading causes of working in the informal economy. The authors argue that increasing the unemployment rate would lead individuals to search for another income source; thus, a positive impact is expected.

- The last determinant is the level of development: the authors argue that in countries with low per capita income, individuals are more intuitive to participate in the informal economy.

According to the authors, fluctuations in the size of the informal economy can be reflected in the following markets:

- Production market: increase in the size of informal activities may cause depression in the official economy; thus, a negative sign is expected.

- Labour market: it is argued in the paper that an increase in individuals’ participation hours in the informal economy leads to fewer working hours in the official one, which results in low participation rates in the official economy. Vice versa, high official participation rates indicate low engagement in informal activities.

- Monetary market: as suggested by the monetary approach, the aggregated money indices are affected by the development of the informal economy. Therefore, the usual hypothesis is adopted is tested.

After selecting the determinants and indicators based on theoretical reasoning, the theoretical model was presented and tested. The results showed that taxes and government burden positively affect the IE size, and it was the same case with the impact of tax morality. Unexpectedly, indirect taxes and social security contributions were statistically insignificant, and this result was explained by one of the following reasons: individuals do not fully perceive these components or see a specific return. The

same case is true for the unemployment rate; it was found statistically insignificant. Concerning the indicators, the male participation rate was the essential indicator with the expected signed. Finally, the study concluded by giving the estimated size of the 17 OECD countries over the study period.

Aigner, Schneider, and Ghosh (1988) aimed to estimate the size and evolution of the informal economy in the USA from 1939 to 1982. The authors re-estimated several variants of the original model of Frey and Weck-Hanneman (1984) using 15 different variables (12 cause variables and five indicators). The first variable is the tax burden. It was approximated using six variables; namely, the average marginal tax rate on personal income, adjusted marginal tax rate on personal income, the overall average marginal tax rate on personal income, the overall average tax rate on labour's marginal product, the weighted average tax rate on interest income and the ratio of total income tax payments after to adjusted gross income. The second variable is tax morality. It was measured with three different series of data. The first is taken from Hansen (1983), the second from a Harris poll and the last one from the election survey conducted by the Centre for Political Studies in Michigan. The last cause variable is the intensity of regulations measured using three different datasets taken from Penoyer (1981). For the indicators of growth rate in the gross private product, non-labour force participation rate, and the ratio of currency to M2, are used by the authors.

To find a better combination of exogenous variables and check for the effect of every determinant, the authors ran several regressions using previous estimations of Feige (1979) and Tanzi (1980) as dependent variables. The results of this exercise revealed that models behaved differently in terms of impact and statistical significance. Hence, it is imperative to test a variety of linear combinations to find the optimal model. As suggested, several DYMIMIC models were estimated. The empirical findings showed that the tax morality variable and tax burden were found to have a significant positive effect in all the variant models.

Interestingly, the regulation variable had the wrong sign, which was found statistically insignificant in the models. Moreover, the size of IE was found to be expended in times of war. Finally, the authors were able to produce a time series of the informal economy in the USA from 1939 to 1982. The average size of the IE was found to fall between 6.98% and 28.63%.

As in the case of all previous approaches, the Frey and Weck-Hanneman (1984) approach was tested by the author scholars and academics. Helberger and Knepel (1988) re-estimated the original

MIMIC model using the same original data and made some post hoc tests to check the stability and robustness of the obtained results. The authors found the same results when re-estimating the original model and taking two decimals. However, the estimated coefficients of change and the goodness of fit indicators were reduced when taking the six decimals. Further, the authors criticised the choice of Frey and Weck-Hanneman (1984) to keep the insignificant variables in the estimation model where only three were found to be significant. After estimating the size of the IE using only the three significant model results changed.

Moreover, the procedure followed to transfer ordinal results to cardinal by arbitrary selection of selecting two previous estimations was criticised because changing these values would lead to different estimations. Finally, the intertemporal stability of the coefficients was tested by dropping one observation. Surprisingly, after dropping just one observation, none of the causal variables were found to be significant.

Furthermore, the authors made some remarks on selecting some variables as determinants or indicators, i.e., they argue that fewer official working hours can be seen as a determinant of the IE activities rather than an indicator. The same was stated in tax morality because this variable can be seen as an indicator of IE rather than a determinant because there is no solid theoretical foundation on which this variable is considered a pure determinant. Finally, the authors concluded their critics by questioning what is measured by the proposed model. Is it only the informal economy? Or something else is measured and argued that only the tax variable might directly relate to the informal economy.

Loayza (1996) investigated the determinants and effects of the informal economy using an endogenous growth model, then carried out an empirical exercise in Latin American countries. In the beginning, the author proved that first, taxes positively impact the size of IE. Secondly, the larger the services produced by the government that are available for the informal economy, the latter shrinks. Thirdly, the IE decreases when the enforcement force size increases because more enforcement increases government institutions' quality. For the second part of the paper, the author constructed a theoretical MIMIC model to test the previous findings on a panel of Latin American countries. In addition to taxes and the intensity of regulations imposed on the labour market proxied by the Rama (1995) index, the author added the quality of government institutions measured using the average of three variables released by the ICRG, namely, the quality of bureaucracy, corruption, and the rule of

law. Loayza (1996) argues that good government institutions are associated with high expected penalty rates; thus, individuals are less motivated to engage in formal activities, which automatically reduces the IE size. Unlike the previous literature, the author selected a new group of indicators, namely the VAT evasion rate and the percentage of non-agricultural workers not covered by social security. As expected, the tax burden and labour market restrictions were verified. The quality of institutions was found to have a significant adverse effect on IE. The VAT evasion rate was found to play a good indicator, followed by the second indicator.

One of the first studies to employ the MIMIC approach to investigate the informal economy in Canada was written by Tedds (1998). The paper used various statistical techniques to investigate the effect of different determinants and indicators and the size and development of the IE in the country over the period from 1976 to 1995. To construct the theoretical model, the author proposed to test 9 causal variables, namely total federal tax revenue, the ratio of total goods and services tax revenues to disposable income to disposable income, total provincial sales tax revenue, the total number of self-employed persons, the total number of self-employed men, unemployment rate, the ratio of the number of public employees to the total employed persons, real annual disposable income per member of the labour force, nominal exchange rate and CPI. Moreover, three indicators were chosen: real GDP, male labour force participation rate, and currency outside the bank. As a first step, the author tested the stationarity proprieties of the series and the possibility of cointegration between the time series. Next, several models were tested based on different variable combinations, but only the best three models were reported and later used to estimate the IE. In two of the models, the author constrained currency as the scale variable. As anticipated, all the indicators have the correct sign and are found statistically significant. Finally, the size of the IE was found to vary between 2% and 16% of the official GDP over the study period.

Giles (1999) employed CDA and the model approach to estimate the size of IE in New Zealand from 1968 to 1994. The use of two macro approaches is to better understand the main determinants of the IE and confirm the inferred results. Focusing on the MIMIC model, the author proposed several determinants that are expected to contribute to the evolution of this phenomenon, such as the degree of regulation, unemployment, income effect, development of tax laws, inflation, and measures of the tax burden. For the indicators, three were used, namely, real GDP growth, the ratio of currency to M3 and the male labour force participation rate. Although Frey and Weck-Hanneman (1984) argued that the

latter variable is negatively correlated with the size of the IE, Giles (1999) argues, based on audit records in New Zealand, that this variable is positively associated with the IE, and he constrained it to unity. Before the estimation process, all the time series were tested for unit root tests and normalised. The results showed that the IE positively and scientifically affects the formal economy in all the estimated models. Turning to the determinants, they all have the anticipated sign, but some lack statistical significance. Remarkably, the impact (positive) of inflation was almost twice the effect of regulations on the IE. Another remark is that unemployment had a positive but insignificant influence. Unfortunately, this variable was added to one model only. Therefore, this result is inconclusive. Finally, the author estimated the size of IE to vary between 6.8% and 11.3% of official GDP over the study period.

Tedds and Giles (2000) conducted an empirical investigation to compare the size of the informal economy in Canada and New Zealand using the same estimation methodology and over a similar period. The authors compared the two most used approaches, CDA and the model approach, specifically the MIMIC model. The MIMIC model specification used can be found in Tedds (1998) for the case of Canada and Giles (1999) for New Zealand. It must be noted that the determinants and indicators are noted the same in the two models, according to the authors. This is due to economic and social differences between the countries. The results showed that the growth rate of the Canadian informal economy was much higher than the New Zealand informal economy.

Moreover, the two informal economies exhibited cyclic behaviour. This led the authors to investigate the relationship between the formal and informal economy in both countries using causality analyses. The empirical results showed a unidirectional Granger causality from the formal economy to the informal one, with weak reverse causation in the author's direction. This result was explained by the individual's behaviour when the formal economy goes through contraction; they are motivated to engage in informal activities either by working in it or baying their goods and services from it to stay on the utility function.

Dell'Anno (2003) paper aimed to estimate the size and development of the Italian IE from 1962 to 2001, provide a literature background, and verify critics of the MIMIC approach. The author included six variables as determinants and two others as indicators in the construction of the MIMIC model, which is used later to estimate the size of the IE. The explanatory variables chosen are tax

burden measured by the total taxes plus social contributions over the GDP, real government consumption as a proxy of all government activities (the positive effect is expected), unemployment rate, self-employment, the efficacy of juridical system index and index of illegality. The last two variables were added as a proxy to the rule of law and to capture the sociological features and aspects of the system for the suppression of crime. Moreover, the author chose real GDP as the scale variable and constrained it to minus one assuming there is a negative relationship between the formal and informal economy.

Furthermore, the author tested several models based on the statistical significance of every variable and the goodness of fit of the hole model. But before that, the author paid intention to the data characteristics by testing the multinormality of data, the existence of unit roots, and independence to adopt the best estimation methodology and avoid miss leading results. The obtained results were in line with the literature. i.e., unemployment rate, self-employment and the efficacity of juridical system index; although they have miner effect, they positively increase the size of the IE. Finally, the best fit model was used to estimate the IE in Italy and fluctuated between 10% and 36% over the study period. In the same year, Dell'Anno and Schneider (2003) conducted a study on the main determinants and size of the IE in 21 OECD countries from 1989 to 2003 with a special intention to the Italian case. For the case of the OECD countries, CDA and DYMIMIC approaches were used. The results indicated that the top three countries with large IE sizes over the study period were Greece, Italy, and Spain/ Portugal.

Another panel study was conducted by Bajada and Schneider (2005), but this time the study focused on 17 Asian-pacific countries with a specific intention to the Case of Australia. The authors started with the case study of Australia employing the MIMIC approach and the CDA from 1968 to 1996. First, the CDA results indicated that all the variables have the expected signs. Interestingly, the authors added the welfare variable to the exogenous variables and found it had a negative effect on the fluctuation of the currency demand, suggesting that unemployed individuals that receive welfare benefits while working in the informal economy trade-off work in this sector for more leisure welfare benefits relative to their disposable income increase. In addition, the size of the Australian economy was found to have an average of 14.5% of the official GDP. Secondly, the authors constructed a MIMIC model to check the robustness of the previous results. Doing so, the authors selected, in addition to the tax burden, disposable income, welfare benefits and a dummy variable to capture the impact of GST introduced in 2000. Moving to the indicators, the authors chose to use only two

indicators, namely, currency holding and GDP, with the former constrained to unity. The empirical results suggested that indirect taxes were the leading cause for individuals to practice informal activities. In comparison between the size of IE produced by the CDA and MIMIC approach, the former yielded lower estimation than the MIMIC approach. However, the results were similar.

After investigating IE in Australia, the authors moved to the case of 16 Asian pacific countries from 1989 to 2001. As the authors stated, this exercise aims to compare the size of the IE in these selected countries. The results indicated that the largest IE size is in Thailand is 51.9% of official GDP, followed by Siri Lanka 43.7% and the Philippines, 42.6% of official GDP. Interestingly, when comparing these results with the results of the OECD countries, we find that the IE is more spread in the Asian countries.

One of the most cited papers in IE literature is the paper of Schneider (2005), where he used the largest database to estimate the IE in 110 countries over the world. This exercise produced a piece of important information on how this phenomenon is spread in the world. Due to the heterogeneity of the countries used in the study, the author proposed grouped themes by economic status, i.e., developed and undeveloped countries. First, the following determinants were used in developing countries: direct and indirect taxes over GDP, state intervention (proportion of public employments to the total employment), unemployment ratio, and GDP per capita income. Concerning the indicators, employment ratio, the annual rate of GDP and rate of currency per capita were used with the rate of GDP as the scale variable constrained to -1. The results showed that all the variables were statistically significant, and the model performed very well in terms of goodness of fit indicators. As expected, the two tax variables are the most influential variables, followed by state intervention and the unemployment rate. In the case of transaction countries, the same model previous model was used on this sample, and all the variables were found to be statistically significant with the right theoretical sign. The results also indicated that the tax burden variables are the essential factors of the unemployment rate (unlike in developed countries) and state intervention.

Furthermore, 21 highly developed countries were selected due to more data points and, most importantly, the availability of two additional determinants, tax morale and social security burden. The empirical results for this group of countries indicated that all seven variables were statistically significant with the anticipated sign. The most influential variables were tax and social security burden

followed by tax morale, which had the most quantitative effect. Finally, after the estimations, the author concluded that the average size of the informal economy in the developing countries is the highest (41% of GDP), followed by transition countries (38% of GDP), and the smallest average size is in the highly developed OECD countries (17% of GDP).

One of the papers that criticised the model approach, especially the application of the MIMIC model, was written by Breusch (2005). The author criticised, in general, the approach and three applications of it made by Tedds and Giles (2000), Dell'Anno (2003), and Bajada and Schneider (2005). The argues that there is no well-founded economic theory that guides the selection of causes and indicators of the IE. Moreover, the author replicated the three studies mentioned earlier and found a divergence in practices between themes and, more interestingly, some changes made on the data that were not documented in the paper. After one year, Dell'Anno and Schneider (2006) wrote a response paper to the critics made by Breusch (2005)and concluded that the MIMIC approach is one of the best approaches to investigate the determinants and evolution of the IE.

Wang et al. (2006) used the MIMIC approach to estimate the size and development of the IE in Taiwan from 1961 to 2003. In terms of causal variables, taxes log real government consumption, unemployment rate, inflation and the crime rate were used. Concerning indicators, log real GDP and currency ratio with the former selected to be the scaled variable assuming a positive relationship between formal and informal economy. Before the estimation of the model, the data were tested for the existence of unit-roots. Due to the economic situation in Taiwan, the author estimated two additional sub-series, the first from 1961 to 1988 and the second from 1989 to 2003. First, the results of taxes, the empirical results suggested that these variables have a significant adverse effect on the size of IE, which is contradictory with the existing literature. Unfortunately, the authors did not explain this result; they indicated that this effect is insignificant at the 1% level. The most influenceable determinant in the three models is log real government consumption; an increase in this variable leads to a rise in the IE.

Interestingly, inflation had a significant positive effect on the IE in the general sample and the first sub simple, but an insignificant negative effect in the second sub ample. The same result was found in the case of unemployment concerning the indicators. Only in the second sub-sample, the currency ratio was found to be significant. Finally, the calibration procedure revealed that the size of IE in Taiwan

had a structural breakpoint around 1988. When comparing the average of the IE before and after 1989, there is a significant difference between them, especially in the trend and behaviour.

In another paper, Dell'Anno, Gomez-Antonio, and Pardo (2007) investigated the determinants and evolution of the IE in three Mediterranean countries France, Spain and Greece, for 1968S1 to 2002S2. The paper had several proposals; the main one is to investigate the most important causal variables in every country and compare them in addition to comparing the size and evolution of this phenomenon in these three countries; these countries were selected because they have almost the same geographical, social and economic situation. The authors proposed the same general MIMIC model and continued to eliminate the insignificant variables from the model to find a suitable model for each country. The general model had the following determinants: direct and indirect taxes, social security contribution over GDP, public employment over total labour force, unemployment rate and self-employment over the labour force. For the indicators in the model, real GDP per capita was selected as the scale variable and constrained to -1, labour force participation rate and currency ratio. All the data were checked for non-stationarity proprieties and multinormality distribution assumption before the analyses. Starting with the results of France, the main determinants were self-employment, followed by unemployment and direct taxes. The size of the IE was found to vary between 8% of GDP and 37% of GDP, with a continuous decrease over the study period. Moving to the results of Spain, the primary determinant was the state intervention in the economy followed by unemployment and indirect taxes. The size of the IE in Spain was found to vary between 2% of GDP and 32% of GDP, with an increasing trend over the period under investigation. Lastly, social security contribution was the main determinant in most models, followed by the unemployment rate. The size of the informal activities is estimated to fluctuate between 4% of GDP and 32% of GDP with a generally increasing trend, especially in the last years of the period under investigation. Finally, the paper concludes with some policy implications for each country to help to reduce this phenomenon in these countries.

Moreover, in the same year, Dell'Anno (2007) conducted another research on the IE size in Portugal from 1977 to 2004. As usual, the author started by given a literature review on the existing estimates and justified the purpose of his study. The author included tax burden, subsidies, social benefits paid by the government, unemployment rate, and self-employment in terms of the determinants. With respect to the indicators, real GDP and labour force participation rate were included with the former as the scale variable constrained to -1. According to the author, subsidies are an

important factor in the analyses of informal activities and can have an ambiguous effect. On the one hand, the government's rise in subsidies increases the cost of being informal; thus, a negative relationship is expected.

On the other hand, subsidies could discriminate between enterprises and introduce distortion to the competition, motivating some enterprises to switch to the informal economy; thus, a positive sign is expected. It must be noted that before the estimation, the data were tested for stationarity proprieties. The modelling results showed that the main causal variable was the government intervention in the economy followed by social benefits, unemployment rate and self-employment with a positive influence on the IE size. Interestingly, subsidies were found to have a positive effect on the size of the IE but were statistically insignificant. Lastly, the author estimated the size of the IE in Portugal to vary between 29.6% of GDP and 17.6% of GDP with a decreasing trend, except for 1992 to 1994.

aimed to analyse the determinants of the IE in Turkey and its neighbour countries from 1999 to 2005 using the DYNAMIC model. The authors included the following causal variables as the main determinants: direct and indirect taxes as a percentage of GDP, unemployment rate, state employment over total employment, GDP per capita and lagged dependent variable. In terms of indicators, change in currency per capita, employment ratio of the total population ages between 18-64 and GDP growth rate. The empirical results showed that all the variables have the right expected sign and are highly significant. The main determinant is the tax burden followed by the unemployment rate and GDP per capita. Finally, after the calibration procedure, the Turkish IE fell between 32.1% of GDP and 35% of GDP over the study period. Another interesting finding is that the size of the IE in Georgia is considerable; it almost reached 70% of GDP in 2005, and the country with the smallest IE size is Iran, with an average of 20% of GDP.

Buehn and Schneider (2008) estimated the size of the French IE by developing a MIMIC model which estimates the cointegration equilibrium relationship and error correction short-run dynamics from 1981Q1 to 2006Q4. The model constructed by the author included tax and social contribution burden, unemployment rate, regulation and working hours as causal variables in addition to GDP and M1 as indicators with the former indicator as to the scale variable. Starting with the data stationarity proprieties. The author found that all the variables are integrated into order one, which raises the probability of the series co-integrating with each indicator. The causal series were found to be co-

integrated with each indicator. After this result, the author's estimated the short-run MIMIC model using the first difference series in addition to long-run error correction terms. This exercise showed that tax burden, unemployment rate, regulation and the error correction term from cointegration relationship between the causes and M1 to be statistically significant with the anticipated sign. The authors also estimated the same model using the original time series to estimate the long run MIMIC model.

In comparison, between the long-run model and the short run mode, two important results emerge. First, the unemployment rate in the short run has a statistically significant effect on the size of the informal activities, where this effect is negative in the long run. Second, the impact of working hours, in the long run, is more important and statistically more significant. Finally, the authors estimated two series of the IE in French using the long-run MIMIC model and short-run MIMIC model. The results of the short-run MIMIC indicated that the size of IE fluctuated between 12.88% of GDP and 15.93% of GDP with a stable, increasing trend over this period.

In addition to the previous study, Dobre and Alexandru (2009) carried out an empirical study in Asia. However, this study considered only the case of Japan and over a long period 1980Q1 to 2008Q2. The causal variables used in this MIMIC model were: direct and indirect taxes, social security contributions, the proportion of government employees to the total labour force, unemployment and self-employment. In terms of indicators, real GDP, civilian labour force and currency ratio were used, with the first indicator being the scale variable assuming a negative relationship between it and the IE. The results showed an insignificant relation between IE and civilian labour force and a positive and significant relation between currency ratio and the IE size. Concerning the determinants, exciting and contradictory results were found, the direct taxes were found to negatively affect the IE size.

Further, unemployment and self-employment were found insignificant but with the right singed. Surprisingly, the authors kept the insignificant determinants when estimating the size of the informal activities, which is an unusual practice in the econometric theory. Finally, the estimation revealed that the size of IE in Japan varied between 9.6% of GDP and 14% of GDP over the period under investigation.

Macias and Cazzavillan (2010) conducted a research paper to investigate and measure the size of the IE in Mexico from 1970 to 2006 through a model approach. The theoretical part of this paper included a discussion on the proposed estimation methods and the reasoning behind selecting the

causal variables and indicators used in the MIMIC model. In terms of causal variables, taxes, inflation, salaries, government intervention and the unemployment rate were selected. In the author's opinion, the inflation rate was added as a proxy for macro stability, and it is noted that the Mexican economy knows a high inflation rate in the '80s, which may have been a significant factor to rise the of informal activities. In addition to the latter variable, the author argues that due to the fixed salaries for several years and the continuous decrease of purchasing power, I motivate people to engage more in informal activities; thus, a negative relationship is anticipated. In terms of indicators, just two were used M1 to M2 and real GDP, with the latter as the scale variable. Unfortunately, no testing of the data characteristics was documented in the empirical part. The results indicated that inflation, government consumption and taxes were statistically significant and had the right anticipated sign. In addition, the salaries variable was, in fact, negatively related to the IE size, which confirms the author's hypothesis. Lastly, the author estimated the size of the informal economy had an upward trend over the study period.

Schneider et al. (2010) made a global estimation of the informal economy for 162 countries from 1999 to 2007. The countries in the sample were categorised into sub-samples to reduce heterogeneity between the countries. Starting with the developing countries. The causal variables included were direct taxes over total taxes, final government consumption over GDP, fiscal freedom, state regulation, unemployment rate and GDP per capita. As for indicators, the authors used GDP per capita growth rate, labour force participation rate, and C/M1 as indicators. In Eastern European and Central Asian countries, government size, fiscal freedom index, business freedom index, unemployment rate, inflation rate and openness. In terms of indicators, GDP per capita, the growth rate of the total labour force and M0/M1. Finally, the next exogenous was used for OECD countries: total tax burden, fiscal and freedom indices, regulatory quality index, and unemployment rate. As for indicators, they used GDP per capita, labour force participation quota and M0/M2. The results for the developing countries were in line with the economic theory except for unemployment. Moving to the results of the Eastern European and Central Asian countries. All the causal variables were found to have the expected theoretical sign and are highly significant. Finally, OECD results also were found to be in line with the economic theory. One of the interesting findings is that the unemployment rate is a more important causal variable in OECD than in developing countries. Another finding is that in 2007 the size of IE in

OECD countries was 19.4% of official GDP, in developing countries was 28.3% of official GDP and in Eastern European and Central Asian countries was 41.1% of official GDP.

Ruge (2010) conducted an intensive investigation of the determinants and indicators of the IE in 35 countries through structural equation modelling. The author constructed his model with 11 unobservable variables and 58 indicators. Unlike the previous MIMIC models, Ruge (2010) argues that the causal variable by themselves is latent variables, therefor he constructed causal variables using reflective modelling technique. In building his model, the author Firstly constructed the following ten causal latent variables:

- Wealth and development level is reflected by: GDP per capita, human development index and Gini coefficient.
- The administration system is reflected by: regulatory system, business regulation and system, bureaucratical quality business start-up and additional 14 indicators.
- Constitutional trust and values are reflected by: the rule of law, democratic accountability, political participation, regime durability and other additional 11 indicators.
- Tax and social security payments are reflected by: total tax revenue, tax and social security contributions, fiscal freedom and additional seven indicators.
- Tax complexity and surveillance are reflected by: costs exp and import, tax payments per capita, tax compliance and other seven variables.
- Tax moral reflected by: bribe acceptation, government benefits.
- Labour market regulations are reflected by: costs dismissal, labour freedom index, central bargaining and hiring and firing rate.
- Unemployment is reflected by: unemployment rate.
- Participation rights are reflected by: participation rights all, participation rights female and participation rights male.
- Labour wages are reflected by: minimum wage and productivity wage.

As for the indicators, the author used informal economy survey, corruption index, cash quota and tax survey, which are somewhat different from the usual indicator variables used in literature, except cash quota. Before the empirical estimation, the author documented that he changed the original time series by averaging them to eliminate the time effect. The results showed that the size of the informal

economy is determined by a better administrative system, higher wealth and development level, the extent of labour market regulations and lower taxes and social security payments.

Klarić (2011) aimed to estimate the size of the informal economy in Croatia using the MIMIC approach over the period from 1998Q1 TO 2009Q3. In terms of determinants, direct taxes, indirect taxes, social security and unemployment were added to the model. in respect to indicators, GDP and M1 were used. In the empirical part of the paper, the author started by examining the stationarity proprieties of time series; then, he moved to the modelling phase. The results showed that the size of the IE has been decreasing over the study period.

Efendic, Pasovic, Schneider, and Montenegro (2011) conducted a theoretical and empirical investigation on the determinants and evaluation of the Romanian IE through structural equation modelling, especially the MIMIC model from 1990 to 2009. The author constructed his theoretical model using the following causal: tax burden, direct taxes, indirect taxes, corruption index, GDP per capita, unemployment rate, and net investment over GDP. In addition to the following indicators real GDP, population activity rate and M1 over M2. The author started the modelling procedure without testing the tile series proprieties. The results showed that the main causes were the unemployment rate followed by direct and indirect taxes. Finally, after the calibration procedure, the size of the Romanian IE was found to vary between 33.59% of official GDP and 36.9% of official GDP, with a relatively constant positive trend over the study period.

Buehn and Schneider (2012) aimed to investigate the size of the IE economy in a panel-based study. In addition to the usual causal variables, the authors aimed to investigate the influence of enforcement on the evolution of IE activities. In terms of causal variables, taxes and social contributions, the intensity of regulations, government effectiveness index in addition to official economy reflected by openness, GDP per capita and inflation rate. Regarding indicators, M0 over M1, labour force participation rate, the growth rate of the total labour force, GDP per capita, and GDP growth rate of GDP per capita. In the empirical part of the study, the authors estimated four different models, each one including a different set of enforcement variables. The first model tested if the high share of subnational government employment affects the IE. The other models included sub-national government expenditures, which is a variable that measures individual's perceptions about the aspiration of public sector employees to follow regulations. The results showed that two out of these

four models confirmed that higher enforcement decreases IE size, meaning that the closer the distance between government authorities and economic agents and the frequent face to face contact, the higher likelihood of detecting informal activities. The study also found that the informal economy is very high in Sub-Saharan African countries (37.6% of GDP), and the lowest average was found in high-income OECD countries (13.4% of GDP).

Barbosa, Pereira, and Brandão (2013) aimed to estimate the size and development of the IE in Portugal from 1977 to 2011 using the MIMIC model. The general MIMIC theoretical model proposed by the author included: ratio of public employment over total labour force as a proxy for economic freedom; total tax burden measured by direct and indirect taxes and social security contributions; Subsidies; social benefits paid by the government; self-employment; unemployment rate. In terms of indicators, the model included just two real GDP and labour force participation rates. The empirical results showed suggested that the most important causes included in the model were the unemployment rate followed by subsidies and economic freedom; all the former variables have a positive effect on the IE size. The calibration procedure showed that the size of IE in Portugal has been decreasing between 1977 and 2011, except form 2000 it had an increasing trend, moreover it fluctuated between 52.27% of official GDP and 13% of official GDP.

Ogbuabor and Malaolu (2013) investigated the determinants and size evolution of the IE in Nigeria between 1970 to 2010 by adopting the MIMIC approach. The authors included the most used exogenous variables in economic literature tax burden, real government consumption and unemployment rate, inflation, interest rate and trade openness. As for the indicators, the real GDP and the aggregate M1 were used. Before the estimation, the authors tested the non-stationarity of the time series and the possibility of cointegration between these series. The results suggested that the causal variables are co-integrated with GDP. In light of this result, the authors continued to estimate two MIMIC models, one in the long run and the other in the short run, by taking the first difference of the original time series, starting with long-run results. Inflation, interest rate, and the unemployment rate were found to have a significant negative effect on the IE size, with the latter causal variable is the most influential variable, while tax burden and real government consumption positively affect the IE size. Moving to the short-run estimations. None of the variables was found significant. Finally, the author used the long run estimation in the calibration procedure to estimate the size of the IE, which was found to hovered between 53.6% and 77.2% of official GDP over the study period.

Bounoua et al. (2014) analysed the determinants and evolution of the shadow economy in Algeria from 1990 to 2009. The econometric analysis was based on multiple indicators multiple causes model. The study showed that public expenditure, inflation rate, unemployment rate and guaranteed national minimum wage are the leading causes of the shadow economy; all the later variables are negatively related to the shadow economy except the public expenditure. The estimated size of the shadow economy varies from 41.68% in 1991 to 46.43% in 2009. However, some remarks can be observed in this study; first, they chose to constrain the GDP per capita to -1, which means a negative relation between official and unofficial economy without justifying why. Second, the authors combined the direct, indirect taxes, and social security contribution in one variable, which can cause a problem in the estimation because the effect of these three variables on the shadow economy is steel ambiguous, Frey and Weck-Hanneman (1984) found that direct and indirect taxes have a positive impact on the informal economy in the main time security contribution have a negative impact, while Corina and Andrie (2011) found a negative impact of direct taxes on the shadow economy and a positive impact of indirect taxes on the shadow economy.

Trebicka (2014) aimed to estimate, analyse and measure the size and evolution of the IE in Albania using the MIMIC model. The author's general model consisted of government employment to the total labour force, taxes over GDP, subsidies over GDP, Social security paid by the government over GDP, self-employment ratio to workforce and unemployment rate as a causal variable, in addition to GDP and currency in circulation as indicators. The time series were transformed by taking the first difference to eliminate non-stationarity. After the model estimation, only the unemployment rate and subsidies ratio were found significant causal variables. Unfortunately, the paper did not provide an estimation of the IE size in Albania.

Nchor and Adamec (2014) investigated the determinants of IE and its development using the MIMIC model between 1983 and 2013 in Ghana. The author’s general MIMIC model proposed by the authors included variables such as direct and indirect taxes, GDP per capita, government consumption, unemployment rate and business regulations, and the labour participation rate, GDP per capita growth, and cash outside the banks. No prior testing was done on the data. The results indicated that all the causal variables are statistically significant, except for business regulations. Besides, except for GDP per capita, all the variables positively impact the IE size. In conclusion, the study found that the IE size

in Ghana fluctuated between 32% and 60% of official GDP, and it has a decreasing trend over the study period.

After one year, Nchor and Adamec (2015) conducted another investigation on the size and trend of the IE in selected African countries; the authors used multiple indicators multiple causes model (MIMIC); the results found the IE in Kenya is caused by the size of government, GDP per capita, the rate of unemployment and the deposit interest rate. In Namibia, it is caused by the size of government, the level of unemployment and the level of GDP per capita. Ghana's shadow economy is caused by the size of the government, the unemployment rate, direct and total tax rate. In Nigeria, it is caused by the size of government, unemployment rate, quality of public services, business regulation and total taxes. The effect of the later causes varies from one country to another; for example, an increase in the size of government by one percentage causes an increase in IE in Kenya and Nigeria but decreases the IE of Namibia and Ghana. The study estimated the average of IE from 1990 to 2012 in Kenya, Namibia, Ghana and Nigeria as 33.7%, 29.1%, 36% and 47%, respectively.

Schneider, Krstić, Arsić, and Ranđelović (2015) investigated the sources and size of IE size in Serbia and other countries neighbour countries Estonia, Czech Republic, Bulgaria, Latvia, Lithuania, Poland, Slovenia, Hungary and Slovakia from 2001 to 2010 using the MIMIC model. The authors tested a variety of causal variables such as the ratio of direct taxes over GDP, indirect taxes over GDP, Marginal income tax, effective average tax rate, regulatory quality index, the rule of law, corruption index, self-employment and unemployment; in addition, the usual indicators GDP per capita, Cash per capita growth and employment rate. The results indicated that indirect tax, effective average tax rate, self-employment, the rule of law and unemployment were statistically significant; all these variables have a positive sign, except for corruption, which is the most crucial source of informality. Also, the calibration procedure suggested that the size in Serbia is decreasing from 33.2% of official GDP in 2001 to 30.1% of official GDP in 2010.

Gasparėnienė, Remeikienė, and Heikkila (2016) investigated the relationship between IE and its determinants in Ukraine from 2005 to 2012. This investigation showed that the Ukrainian IE is colossally related to its determinants such as tax burden, the participation rate of working-age people, import of goods and services, overall employment rate and GDP. Interestingly, the increased

employment rate increases the scope of the IE; the authors argue that this is a result of newly recruited workers spending a portion of their wage on informal goods and services.

Hassan and Schneider (2016a) carried an essential theoretical and empirical investigation on the determinants of and development of the IE in Egypt from 1976 to 2013 using monetary approach and MIMIC approach. First, the authors selected a group of causal variables such as tax burden, institutional quality, size of the agricultural sector, unemployment rate, self-employment. Concerning the indicators, real GDP, currency in circulation and total employment were selected to reflect the size of the informal economy. The authors tested the data for non-stationarity and multinormality distribution, and then they continued to the estimation step. The results of the MIMIC model suggested that all the causal and indicator variables have the right expected sign, except for unemployment and self-employment, which were statistically insignificant with the right theoretical sign. The most important source of informality is tax burden and institutional quality. The study concluded that the size of the IE economy was decreasing over the study under investigation, and it hovered between 55% and 27% of official GDP.

Later in the same year, Hassan and Schneider (2016b) analysed the size and development of the IE using a panel-based study including 157 countries all over the world from 1999 to 2013 utilising structural equation modelling, especially the MIMIC model. The general MIMIC model was constructed from the tax burden, regulatory burden, unemployment rate, self-employment rate, economic freedom and business freedom index as causal variables, in addition to GDP growth, currency and labour force participation rate as reflective variables. The estimation results for the total sample size showed that regulatory burden and unemployment rate positively affect the IE scop, and they are highly significant across all three models, followed by tax burden and economic freedom index. However, the business freedom index was excluded from the models. Further, in the reduced sample, self-employment was added as a causal variable, and it was statistically significant. Finally, the average size of the IE of the 157 countries averaged over 1999 to 2013, too, is 33.77% of official GDP; for the 117 countries including self-employment, 32.75% of official GDP. The authors also found that an increased burden of taxation combined with labour market regulations and institutional quality were driving forces of the IE.

Goel and Nelson (2016) wrote a fascinating paper synthesising in it the IE causal variables in literature and at the same time addressing related modelling issues and uncertainty. To this end, the authors gathered three cross-national IE estimations and employed various determinants suggested by the previous studies over hundreds of models. According to the authors, market entry cost and legal entry barriers (e.g., bureaucratic delays, environmental regulations, licensing requirements, etc.) are reasoned by economic theory to be key causes for enterprises to operate informally; unfortunately, the empirical validation of the underlying hypotheses have had to rely on imperfect measures, which is one of the factors that lead to mixed results in the empirical literature. To overcome this uncertainty and improve the literature on the reasons for informality, the authors adopted modelling uncertainty and sampling variation. Empirical results, based on hundreds of models specifications, indicated that start-up producers, property registration and business start-up are important factors to the scope of IE. Tax code complexity is found to motivate enterprises rather than tax rates and overall taxes. For other variables, procedural simplicity is found to be a robust way to control IE growth. Finally, the authors found that the determinants of the IE size differ from one country to another.

Yap, Sarmidi, Nor, and Said (2017) analysed and estimated the scope of the IE in Malaysia using a state-level investigation including 13 states by means of the MIMIC model for 2006 to 2013. In constructing the theoretical MIMIC model, the authors included the following causal variables tax revenues per state on the GDP per state, the ratio of non-tax revenues to GDP per state, the ratio of non-tax receipts to GDP per state, the ratio of state government operating spending to state GDP, state unemployment, self-employment per state, portion of low-skilled labours to total labours, portion of rural population to the total population and rural labours to the ratio of the total labour; and the following indicators growth rate of state GDP per capita, the growth rate of the total state labours and state labour market participation rate. Several important findings were obtained from this investigation. First, the rural labour force and rural population have an important positive effect on the scope of the IE. Second, advanced and smaller states have minor informality than other states. Third, crime rate and primary sector production positively impact the IE size.

Pasovic and Efendic (2018) aimed to estimate the size and evolution of the IE in Bosnia and Herzegovina from 1998 to 2016, employing the MIMIC model. The theoretical model consisted of the agricultural sector, taxes, unemployment rate and subsidies as causal variables, and GDP and M1. Before the estimation step, the stationarity and cointegration proprieties were tested to avoid spurious

regression and test the cointegration probability between the series. The results showed that the agricultural sector, taxes, and unemployment positively impact the IE's size and are the main causal variables. Finally, the scope of the IE was found to hover between 43% and 30% of official GDP over the period under investigation.

Medina and Schneider (2018) estimated the shadow economy for 158 countries all over the world during the period 1991 to 2015, by the multiple indicators multiple causes (MIMIC), the Algerian shadow economy was estimated to vary between 38.88% and 23.98% as the smallest percentage with an average of 30.86% and stander deviation of 5.47%. As stated before, this kind of study does not provide the knowledge of the relation and impact for every determinant on shadow economy for each country.

Kori (2018) found that an increased budget deficit and urbanisation rate are the driving forces of the shadow economy. They are positively related to it. The results showed that the hidden part of the economy in Algeria constitutes 47.4% of the official GDP in 2016 from 1970 to 2016. However, there are many observations; the main observation in this study is the authors chose to use only causal variables budget deficit to measure the size of the government, which is unusual. In the literature, the researchers used government spending (Dell'Anno, Davidescu, and Balele, 2018; Macias and Cazzavillan, 2010), government consumption (Dell'Anno, 2003; Wang et al., 2006) and employees in the public sector (Schneider, 2002; Tedds, 1998) and urbanisation; the second observation is the author constraining GDP to 1 which means that he assumes a positive relationship between the official economy and the IE without justifying why. Plus, in the empirical part, the author did not test the data for stationarity which can cause a spurious regression.

Dell'Anno et al. (2018) aimed to analyse the Tanzanian IE from 2003 to 2015 and test the statistical relationships between the shadow economy and its determinants using the MIMIC approach. The authors constructed their model using tax burden, government spending, inflation rate, unemployment rate, openness and regulatory quality as causal variables and real GDP per capita income and currency ratio as indicators of the IE size. The study showed that the main causes were inflation, unemployment and government spending, positively related to IE. The authors estimated that the IE ranged from 52% to 61% of official GDP.

Zikalala and Sacolo (2018) conducted one of the few country-based investigations on the IE scop in the Kingdom of Eswatini from 1999 to 2016 using the MIMIC model. The selected causal variables were direct and indirect taxes, unemployment, self-employment, agricultural sector and regulations; in respect to the indicators, GDP per capita, money growth and employment rate were selected as reflective variables. The paper does not document any pre-tests on stationarity and distribution of the data. The results suggested that indirect taxes was the main causal variable followed by the agricultural sector and self-employment. In conclusion. the IE size varies between 39% and 35% of official GDP with a decreasing trend.

Franić (2019) investigated the determinates and evolution of the IE in Croatia using quarterly data from 2004 to 2017, employing the MIMIC approach. The included exogenous variables in the theoretical model were tax burden, employee cost, social security benefits, government rating, unemployment and average net wage, in addition to GDP and cash in circulation. It must be noted that the author chose to estimate a growth model. Therefore, all the variables were growth rates series. According to the empirical results, tax burden, unemployment rate, and average net wage were the leading causes and are robust across different model specifications. In addition, the size of the IE was found to fluctuate between 7.22% and 7.89% of official GDP.

Dybka et al. (2019) paper aimed to propose a new approach more systematic and superior to most of the adopted approaches to estimate the size of the IE, which are the CDA and MIMIC approaches. The authors proposed a hyper procedure to address the critics of the former approaches. Furthermore, they propose a new identification procedure to the MIMIC model and the issue of selecting an external IE value to calibrate the relative size is overcame. Besides this, the group of causal and indicator variables used in this study are unique to some degree, including variables related to the electronic payment system; rather than assuming the non-existing of taxes in the calibration, it is proposed to use the values at their lowest, which is more realistic, overcoming the problem of miss specification and finally avoiding the controversial assumption of velocity. The results suggested that unemployment, taxes, tax time are positive and significant causal factors; finally, the size of IE ranged between 2.8% and 29.9% of official GDP in the selected 43 countries.

A recent study that investigated the determinants and size of the IE in Algeria was conducted by Ziad and Dahmani (2019) using a MIMIC model from 1970 to 2017. The theoretical model includes

taxes, unemployment rate, wages and salaries, government spending, SMIG, GDP per capita and inflation, and GDP, currency outside the banks (scale variable) and final household consumption. The data was not tested for stationarity proprieties and multinormality distribution nor cointegration. The results indicated that unemployment is the primary causal variable followed by government spending and inflation. All the variables are positively impacting the IE scop for study. Finally, the size of the informality was found to hover between 15.05% and 40.70% of official GDP with a decreasing trend in the last years.

In one of the most cited papers in recent years, Medina and Schneider (2019) conducted a study investigating the determinants and size evolution of the IE worldwide, including 157 countries from 1991 to 2017, producing the largest database of the IE until now. Furthermore, the paper also provided a theoretical and empirical analysis for the interaction between the formal and informal economy, especially in Pakistan. The authors divided the sample size into two sub-samples, namely developing countries and high developed OECD countries, to account for heterogeneity between these countries and avoid biased estimations. The authors based their estimation on the MIMIC approach and constructed a general model including tax burden, institutional quality, openness and unemployment. For the indicators, currency to M2 ratio, labour force participation rate and a measure of GDP. Six specifications were tested for the total sample and the two sub-samples. Starting with the results of the total sample. All the causal variables were found to have the expected theoretical sign and were statistically significant in most models. All the statistical indicators were satisfactory. Next, the results of the developing countries showed that openness, GDP per cap, size of government and fiscal freedom are significant in all models included in. unemployment rate was found insignificant in all the models. Interesting results were found in the last sample; openness tare and government size were found insignificant at 5% level in all the specifications. Unemployment rate and corruption, however, were found significant in all the models included in the second part of the empirical investigation, namely the interaction between Pakistan's official and informal economy. The authors employed an ARDL approach and found that in the long run, the IE positively impacts the size of the economic growth, where it negatively affects the short-run dynamics.

Soares and Afonso (2019) employed the CDA and model approaches to investigate the main determinants and the size of the IE in Portugal from 1970 to 2015. In his paper, the authors mainly aimed, first, to analyse the leading causes of the IE and development, secondly, to compare the results

of several approaches and finally, to investigate the relationship between formal and informal economy throughout Granger causality method for the goal of proposing economic policies to enhance the economic situation in Portugal. According to the author, several variables were tested in the MIMIC model, but only the direct and indirect variables, final government consumption to GDP ratio, unemployment rate and disposable income, were statistically significant. Only M1 and GDP per capita were used in terms of indicators, with the latter as scale variables assuming positive signs. Before the estimation, the data were tested for stationarity proprieties and multi-normality. Next, the author tested various models and found that the two indicators are consistent in all of them. However, this is not the case for the causal variables, where some were found statistically insignificant. The most important cause was found to be the direct taxes in all models. After estimating the size of IE, the author used it in a growth model to analyse the relationship between formal and informal economies and to infer the Granger causality direction. This exercise showed a bidirectional Granger causality between the two economies, a significant finding, especially for policymakers. Finally, the size of the informal economy in Portugal is estimated to fluctuate between 6% of GDP to 25% of GDP over the study period, with an upward trend in the last years.

Davidescu and Schneider (2019) analysed the determinants and indicators of the IE in Romania using the MIMIC model for 2000 to 2015. From the possible sources of informality, the authors selected tax burden, government consumption, government employment, self-employment, unemployment, part-time employment and quality of institutions. With respect to the indicators, real GDP (scale variable), currency ratio to M1 and labour force participation rate were selected. Due to the small number of observations, the non-stationary was not tested for. The empirical results showed that indirect taxes, unemployment rate, self-employment and regulatory quality are the primary sources of informality whit unemployment being the most important and only regulatory quality has a negative sign. Finally, the IE size was estimated to fluctuate between 26% and 37% of official GDP, decreasing over the last years.

In a recent study, Makananisa et al. (2020) estimated the size and evolution of the South African informal economy from 2004 to 2018 using the model Approach and CDA. As determinants, the authors considered tax burden, business regulations, unemployment, self-employment, government employment, house debt, and the mining sector's size. The usual hypotheses were tested for taxes, business regulations, unemployment and self-employment. For the rest of the causes, the authors argue

that the expected influence of the government employees is ambiguous because some empirical studies found a positive sign (mainly due to corruption) were other studies found the negative sign, as for the size of the formal mining sector it is expected to have a negative sign that's because individuals are motivated to work and sell their findings in the black market rather than constructing a legal mining company and pay taxes. Regarding the indicators, nominal GDP, official labour force and currency ratio were used, with the first indicators constrained to -1. Surprisingly, the authors documented that the data were transformed to achieve normality assumption and stationarity, but no further explanation was given on how they did it. The results indicated that all the causal variables were statistically significant and had the right theoretical sign in the two methods. The authors concluded their empirical study by comparing the CDA and MIMIC model results and found that the estimations are exceptionally homogeneous and yielded almost the same average (22.47% for CDA and 25.45% for the MIMIC).

2.2. Discussion on the revealed determinants and indicators of IE

One of our main goals in summarising the above literature is to account for causal and indicator variables. Analysing and estimating the size and evolution of the IE. Getting a broad idea of how scholars and researchers have approached this problem.

Several significant results can be retrieved from this exercise. First, the number of studies devoted to analysing the determinants and scope of IE know an increasing trend over the years, which reflect the importance of this phenomenon. Second, the development of econometrics and statistical software had a positive impact on the quality of models and approaches used to study the IE. Third, there is a literature gap in studies empirically analysing this phenomenon in Algeria. Finally, although there are many empirical studies, some causal variables are still found ambiguous in terms of the effect on the scope of IE.

2.2.1. Determinants and indicators revealed by the Indirect approach

Academics and institutions frequently use two groups of surveys to analyse the determinants or motivations and size of the IE activities. The first group of surveys targets households and individuals, where the second group focuses on firms and company managers. The first set of surveys generally concentrate on finding the impact of socio-demographic variables (e.g., age, gender, the level of

education, working skills etc.), socioeconomic variables (e.g., income level, household size etc.) and spatial characteristics (e.g., whether the responding lives in urban or rural areas). In addition to tax morality, the expected punishment and other factors will be discussed in detail next. The second group of surveys defer in the structure of questions asked; the main goal is to know if firms are engaged in IE activities, how they are affected by the IE's size, and what level economic policies made by their governments impact them.

These surveys produce micro-level estimates, which can be used to examine the structure and determinants of the IE. According to the household or individuals' surveys, the following social demographics significantly impact the individual's choice to work in the informal economy.

- **Age:** it was found that age significantly impacts individuals' decision to participate in IE activities. In their study, Feld (2005) study found that individuals mainly drive IE activities in the end and at the beginning of their official working lives; therefore, age is a determinant of IE. This result was validated by studies conducted in Denmark, Norway, and Sweden.
- **Gender**: as found in Henley et al. (2009) survey done in Brazil, females are more engaged in IE activities because they work in small enterprises. However, Bellache (2010) found that men are more likely to work in the informal economy than women in Algeria because women prefer to work at home rather than join an informal enterprise.
- **Marital status**: Being married also is a significant factor to engage in IE activities (Angelini and Hirose, 2004).
- **Education level**:
- **Work skills**: less-skilled workers are more engaged in the IE than skilled workers who temporarily work in this sector until they find an opportunity to work in the formal economy (Bellache, 2010; Feld, 2005).

Besides the above socio-demographic variables, the studies also found that the following socioeconomic and spatial characteristics have a significant impact on the decision to engage in IE activities:

- **Income:** Formal income influences the tendency to engage in informal activities is another essential result found by the researchers. According to the study survey, most of these activities are carried on in the construction, agriculture, and fishing sectors. According to Schneider's (2009) survey, 90% of individuals buy goods and services from the IE because they are much cheaper.

- **Household size:** single employees (and widowers or divorced) are six times more likely than married employees to belong to the informal group.

- **Living in an urban or rural area:** A survey conducted by Angelini and Hirose (2004) in rural and urban areas of Indonesia revealed that determinants of IE in rural areas are not the same in urban areas. Starting with the urban survey. This survey targeted two main sectors manufacturing industry and the accommodation services industry. The empirical results showed that most workers have tertiary education; this reflects the limited availability of skilled jobs in the IE. 70% per cent of the informal workers were married. The age of workers in informal urban activities ranged from 20 – 40 years. Moving to the urban survey. This survey deliberately targeted farming, retail trades and fishing industries. The age of working individuals was the same as in the urban area. More interestingly, the ratio of married individuals was 93%, higher than the urban per cent. The survey revealed that more than 53% of workers had primary education. Thus, education levels are higher in urban IE and significantly lower in rural IE.

Besides the above variables, the studies also found that High Taxes and social contributions motivate individuals to work in the IE sector. Schneider (2009) found that 73% justify their work in the informal economy by high taxes and security contributions. Another interesting reason is that informal firms offer workers; thus, employment in this sector is easy. In the economic model of behaviour, individuals act as if they compare the benefits and costs of alternative actions. The incentive to work in the IE is more potent for individuals when:

- The cost of working in the official economy is high;
- The cost of working in the IE is low;
- The lower the psychological barriers are of switching from the formal to the IE.

More interesting, the more individuals are sure of their ability to self-insure against income risk, the less they contribute to social security.

The second group of surveys targets firms in which to estimate the size of IE, the company managers are asked to answer a well-structured questionnaire. Due to their unique position, this method assumes that company managers are the most likely to know the volume of wages and business that goes unreported (Putniņš and Sauka, 2015). Many studies adopted this method, e.g., Putniņš and Sauka (2015) applied it in three countries, namely Estonia, Latvia and Lithuania, with over 500 firms included in the survey. The results showed that companies that are disgruntled with the tax system and /or

government policies are more intuitive to engage in IE activities. Relatively new small firms are more likely to engage in IE activities in comparison to larger old companies. The perceived likely hood of being caught and the expected penalties for being caught are the sole motive for tax evasion and misreporting levels in this study.

There are two main reasons for tax evasion and participation in IE activities. The first reason is based on rational choice models of decision. In this model, firms or individuals compare the benefits of tax evasion in the form of tax saving to minimise costs for firms and income saving for individuals against the likely hood of getting detected by authorities and getting a penalty. Thus, the lower the probability of getting caught and receiving the expected penalty, the higher is the intuitive to engage in IE activities. In other words, attitude towards risk-taking, the detection rate, type and size of penalty navigate the participating rate in IE activities. The second set of reasons is related to the tax system's justice, i.e., attitudes towards the tax spending mechanism, the fairness of imposed taxes, and how much firms/ individuals trust the government. Furthermore, social norms such as moral convictions and ethical values significantly affect the size of work done in the IE.

Frey and Weck-Hanneman (1984) stated that in addition to tax burden and intensity of regulation, the expected punishment by those working in the IE (e.g., individuals or firms) is significant. The cost of being detected by the authorities and the size of the punishment were significant factors that drive the incentive to work in the IE.

2.2.2. Determinants and indicators revealed by the Indirect approach

To summaries, the CDA was widely used by scholars and academics all over the world. Over the last forty years, several variants of the Tanzi (1980) model were proposed to overcome some of the issues in the original model. To overcome these, they proposed substituting original variables with other variables that they saw to better fit the theory and country under investigation, or sometimes just because the data is unavailable. In a study done by Mehnaz and Qazi Masood (1995) in Pakistan, the bearer bonds were added to currency held by individuals because they argued that these bonds serve to be a vital source of carrying transactions in the informal economy. In addition, they used total taxes to gross domestic product (GDP) as the only determinant of IE activities. For south Africa, Saunders and Loots (2005) used the ratio of notes and coins holdings to M1 as the dependent variable. As independent variables, in addition to interest rate, real per capita income and taxes, they added the ratio

of government revenues to GDP and the ratio of final consumption expenditure to GDP ta capture the changes in payments and money holding patterns. Fethi et al. (2006) used real currency to M2 as an indicator instead of nominal currency to adjust the data for the impact of inflation. They also added inflation as an independent variable in the model, and it was found to negatively affect the currency holding habit of individuals in Cypriot. According to Zanganeh (2007), per capita currency is the best indicator for the Iranian case, and he kept all the usual variables.

Furthermore, AnaMaria et al. (2009) and Dell'Anno and Davidescu (2019) added remittance as an independent variable n the model. The authors argued that this variable has a significant long-run effect on the currency demand function for two reasons. First, this variable is directly and strongly related to informal activities because individuals are usually engaged in "smurfing", separating transfers into different accounts or smaller packages, to avoid reporting and satisfy local necessities such as taxation on larger quantities of money. The second reason is the massive immigration of Mexicans to the developed world, especially the United States. This caused remittance magnitude to surpass foreign direct investment.

Moreover, one of the most essential papers in CDA literature is Ahumada et al. (2007). In this paper, it was proven that the CDA has internal consistency. According to the authors, many empirical studies that tried to measure the size of IE are inconsistent with the method itself. As mentioned before, to find the size of IE, the estimated illegal currency is multiplied by income velocity, which is assumed to be the same in the formal and informal economy. That paper demonstrates that this equality is only valid when the income elasticity is found to equal one, or the results are needed.

Further, several studies proposed a new perspective to eliminate the issues in the original CDA. Pickhardt and Sardà Pons (2006) proposed a modified CDA model using the Taylor series to estimate parameters. This approach does not require the assumption of base year where the IE is equalled to zero, nor does it assume the equality of income velocity in the two economies. Thus, overcome two of the main shortcomings of the original CDA. Where Greenidge et al. (2009) implemented the modified equation of Bajada and Schneider (2005) with a further modification. Rather than estimating a simple model, a general unrestricted error correction model with several lagged terms, the authors applied the method generally to a specific approach (GETs) to eliminate all statistically irrelevant variables, thus reducing the model to a more precise congruent one. In more recent studies, Dybka et al. (2019) made

many changes in the model by including variables related to the electronic payment system; rather than assuming the non-existing of taxes in the calibration, it is proposed to use the values at their lowest, which is more realistic, overcoming the problem of miss specification and finally avoiding the controversial assumption of velocity.

2.2.3. Determinants and indicators revealed by the model approach

1. Tax burden and social security:

This variable is essential theoretically and empirically; from the collected sample of articles, it is included in 46 out of 48 studies; the two studies that were not included in our country-based studies estimated the size of Algerian IE, which is a fundamental observation.

The widely held belief is that an increase in the tax burden creates a strong motivation to participate in IE transactions (Buehn and Schneider, 2012), and hence a positive indication is predicted. This variable is included in all CDA and MIMIC models, except when the data for this variable is not available. From the previous empirical literature, the tax burden was proxied using different indicators such as tax time Dybka et al. (2019), the ratio of direct taxes to GDP, the ratio of indirect taxes to GDP, tax rate (e.g., Aigner et al. (1988)), the share of total taxes in GDP, and several other tax variables (see Aigner et al., 1988; Giles, 1999). Another used index to capture the effect of taxes is fiscal freedom Dell'Anno et al. (2018). Tax morality, this variable measures the readiness of individuals to switch from official to informal activities. this variable was measured using the following questions "Do you think that governments waste a lot of money?", "Do you think that government is untrustworthy?" and "Do you think that government does not care much what people like you think?".

However, from Table 4 the expected sign for this variable is negative. Moreover, social security contributions are also treated as a tax burden, e.g., Dell'Anno (2007) and Dell'Anno et al. (2007) added this variable as an explanatory variable but found it statistically insignificant, after that it was joined with direct and indirect taxes, which raised their statistical significance and effect. An important question that can arise from the use of different proxies of the tax burden does different tax variables lead to different results?

Yes, in terms of statistical significance and the estimated effect but not on the sign, for example, the estimation results of Schneider (2005), marginal tax burden and effective tax rate were found to have roughly the same effect while indirect taxes had a higher effect.

Our sample suggests that taxes have a statistically significant positive effect in 84.09% of the studies, except in studies of Wang et al. (2006) and Yap et al. (2017), which had a significant negative effect. Interestingly, no study found a nonsignificant negative effect, and few studies found a positive nonsignificant effect of taxes on IE size.

Table 4
Empirical description of the tax burden effect results.
Source: Authors own construction.

	Significant	Non-significant	Total
positive sign estimated	37 [84.09%]	5 [11.36%]	42 [95.45%]
Negative sign estimated	2 [4.54%]	0 [0%]	2 [4.54%]
Total	39 [88.63%]	5 [11.36%]	44[100%]

In summary, this variable is important when analysing the scope and development of the IE; the expected sign for is positive and the tested hypothesis:

The higher the tax burden, the higher the IE, ceteris paribus.

2. Regulation burden:

This variable was introduced first by Frey and Weck-Hanneman (1984), suggesting that the rise of the public burden will lead individuals to engage more in the IE. The number of laws and regulations generally measures this variable. Unfortunately, data unavailability is a common problem in these studies, especially in the early studies on IE, leading researchers to find other proxies to count for the impact of this variable. Frey and Weck-Hanneman (1984) measured the regulation burden by the ratio of government employees to the total employees. Loayza (1996) used Rama (1995) index to capture the effect of the regulatory burden; the results suggested that the latter positively influences IE size. Dell'Anno (2003) suggested that public sector size and degree of regulation are two faces of the same coin; the author suggested that the size of the public sector measured by real government consumption is a good proxy for the state activities, hence the degree of regulation. The latter was found to have a significant positive effect on the IE scope.

On the contrary, Tedds (1998) and Giles (1999) suggested that this variable has a negative effect on the size of informality, and this hypothesis was validated by Giles (1999) in the case of New Zealand. In panel-based studies, the problem of data scarcity is less critical. Schneider and Buehn (2012) and

Schneider et al. (2010) measured the intensity of regulations with three indexes, namely business freedom, economic freedom and regulatory quality; the latter variables were found to have a negative and statistically significant effect on the IE, which is in line with the expected theoretical sign. In another multiple-country study, Quintano and Mazzocchi (2014) used other indexes such as quality of administration index taken from the quality of government institute; transparency, corruption, accountability, business regulatory environment index taken from the world bank.

Some of the rarely used proxies were the quality of public services index used by Aspilaire (2014); Hassan and Schneider (2016a) Used the polity V index, which reflects the quality of democratic institutions for Egypt; Zikalala and Sacolo (2018) employed the Ibrahim Index of African governance in the case of Kingdom Eswatini; Franić (2019) used the rating of government index in the case of Croatia.

In summary, the sign and proxy for this variable is controversial. Theoretically, the two signs have a justifiable explanation. On one side, the more state regulation to fight tax evasion or avoidance in the presence of low corruption levels can reduce the intuition of individuals to engage in informal activities because they wight the probability and cost of being detected and punished is exorbitant; Hence a negative relationship is expected. On the other side, the increase of state regulations and intervention in the official economy means: (a) more bureaucratisation in the economy; (b) high bureaucratical economy means that bureaucrats' have more power for decisions which increases the level of corruption; (c) more state intervention needs to be financed by a complex tax system, which unbalances the allocation of resources and create a constant rise in taxes and this will increase the burden on individuals forcing them to switch to the IE (Dell'Anno, 2007).

From the gathered literature, 33 studies included the state burden or government intervention as a causal variable. It is found that in country-based studies, 9 out of 23 (39.13%) investigations used the share of public employees to the total employment as a proxy for state regulations; 7 out of 23 (30.43%) studies used some government expenditure (e.g., final government expenditure, real government expenditure, etc.) where the rest 8 of 23 (34.78%) studies used different indexes generally to reflect the quality of public services or administration. As for panel-based countries studies, business freedom, economic freedom and regulatory quality are frequently used indexes (80%), except for two studies (20%).

Furthermore, studies dedicated to investigate this point, such as Bounoua et al. (2014) and Kori (2018) used public expenditures to capture the state intervention in the official economy. Bounoua et al. (2014) found this variable to have a negligible positive effect, where Kori (2018) found it the second most important motivational causal variable.

In conclusion, when accounting for the impact of the burden of state regulation using a quality of regulation index, a negative sign is expected (hypothesis one) between this index and the IE size. On the contrary, a positive sign is anticipated when using some government intervention index (hypothesis two). Hence the following two hypotheses are expected.

Hypothesis One: the more state intervention, the greater it is intuitive to participate in the IE.

Hypothesis two: the better the quality of regulations, the less intuitive to participate in the IE.

3. Unemployment rate:

One of the original causal variables in Frey and Weck-Hanneman (1984) model is the unemployment rate. Studies found that this variable positively affected the size of the IE and explained this result by the number of "official" unemployed individuals working in this economy. Other studies found a negative relation between the latter variables; The broad unfavourable economic condition, which should or might influence both official and IE, explains this link. As a result, a negative association is discovered.

In our sample, 90.24% (37/41) of the studies included this variable as a causal variable in their model specification, which theoretically indicates this variable's importance. From Table 5, this variable is significant in 86.48% of the studies, while it is positive and significant in 62.16% of them. As a general observation and empirically unemployment rate tends to have a positive effect on the IE size.

Although the positive effect may seem the dominant result, some studies found that controversial results using a different group of variables and periods, for example, Tedds (1998) included unemployment rate as a causal variable in three estimated MIMIC models in the case of Canada, in one of the models it was found to have a significant negative effect on the IE. However, when the author added the ratio of state employees to the total employee, the unemployment becomes positive and significant at a 5% level. Moreover, Wang et al. (2006) found that the unemployment rate has different results when splitting the period under investigation into two sub-periods.

Table 5

Empirical description of the unemployment rates effect.
Source: Authors own construction.

	Significant	Non-significant	Total
positive sign estimated	23 [62.16%]	2 [5.40%]	25 [67.57%]
Negative sign estimated	9 [24.32%]	3 [8.11%]	12 [32.43%]
Total	32 [86.48%]	5 [13.52%]	37 [100%]

For enstance, Bounoua et al. (2014) and Kori (2018) found that unemployment significantly affects the IE scope. Finally, the unemployment rate is an important variable theoretically and empirically. the general tested hypothesis is:

the higher the unemployment rate is, the higher the size of the IE is.

4. Self-employment

Theoretically, many small businesses, self-employees, and independent professionals imply a large size of informal activities. These workers can tax evade with ought being caught or punished. Moreover, since they work closely with their consumers, they may collude to avoid paying taxes. Furthermore, they find it very easy to recruit informal workers with less labour cost than the official companies. Therefore, self-employment is expected to have a positive influence on IE.

Empirically as shown in Table 6, this variable is included in 11 out of 44 studies (25%). This finding is explained by the unavailability of long time series for this variable, which leads, unfortunately, to too few studies examining its effect. Moreover, it is found positive and significant in 45.45% of the studies, and the same ratio of studies found insignificant positive meaning that 90.91% of the studies the dominant sign is positive, which confirms the theoretically expected sign.

Table 6
Empirical description of the self-employment effect results.
Source: Authors own construction.

	Significant	Non-significant	Total
positive sign estimated	5 [45.45%]	5[45.45%]	10 [90.91%]
Negative sign estimated	1 [9.09%]	0 [8.11%]	1 [9.09%]
Total	6 [54.54%]	5 [45.46%]	11 [100%]

In Algeria, this variable was not accounted for in the previous literature due to insufficient time-series data to conduct an empirical investigation. Finally, the expected sign for self-employment is positive; hence the tested hypothesis for this variable is:

Hypothesis: the larger the number of self-employees, the large the size of the IE is.

5. The income per capita:

This is one of the original causal variables of Frey and Weck-Hanneman (1984) model; initially, the purpose of adding this variable is to account for the level of development. According to Schneider (2005), this variable, in addition to unemployment, reflects the formal economy's status and expects a negative relationship between GDP per capita and the IE size. as shown by Quintano and Mazzocchi (2014), individuals are much more motivated to perform in the informal activities to live. As a result, a negative connection is discovered. Another research conducted. Buehn and Schneider (2012) proposed another reason for this connection: when the economy is thriving, people are more willing to engage in the official economy rather than the informal activities. Another research conducted by Ángel, Gómez, Alanon, and Gómez-Antonio (2005), discovered a favourable association among personal income and the magnitude of the IE. Researchers argue that increased money encourages consumers to buy products and services from both economies.

Based on our sample as shown in Table 7, 22 out of 43 studies accounted for the effect of the GDP per capita in 60 % of them, it is found to have a significant adverse effect, and in 30% of the studies was found to have a significant positive effect. These findings favourite the negative sign over the positive, especially that no study found an insignificant negative effect.

Table 7
Empirical description of the GDP per capita effect results.
Source: Authors own construction.

	Significant	Non-significant	Total
positive sign estimated	6 [30%]	2 [10%]	8 [40%]
Negative sign estimated	12 [60%]	0 [0%]	12 [60%]
Total	18 [90%]	2 [10%]	20 [100%]

In the case of Algeria, Bounoua et al. (2014) and Kori (2018) used guaranteed national minimum wage as a causal variable. The results indicated that this variable was found insignificant in Bounoua et al. (2014); on the contrary, Kori (2018) found it to have a significant negative effect. However, GDP per capita was not used in any model specification.

6. Inflation rate:

One usually added causal variable is the inflation rate to account for the general macroeconomic stability (Macias and Cazzavillan, 2010). The general expected sign for this variable is positive. According to Schneider et al. (2010), if the wages are sticky and inflation rates begin to increase, individuals are motivated to engage in informal activities to compensate for income lost. Also, inflation raises the production cost, and as an attempt to reduce it, businesses avoid paying other costs such as taxes. Furthermore, a high inflation rate raises discount rates (Goel and Nelson, 2016).

In 13 out of 44 studies, from the gathered literature, inflation is added as a causal variable in 58.33% of the studies found a significant positive effect (see Table 8), and just three studies estimated a significant negative effect. Moreover, in just two studies, a positive nonsignificant impact is estimated.

Table 8
Empirical description of the inflation rates effect results.
Source: Authors own construction.

	Significant	Non-significant	Total
positive sign estimated	7 [58.33%]	2 [16.67%]	9[75%]
Negative sign estimated	3 [25%]	0 [0%]	3[25%]
Total	10[83.33%]	2 [16.67%]	12 [100%]

In Algerian, the results are contradictory. Kori (2018) estimated a significant negative effect, while Bounoua et al. (2014) investigation showed a significant positive effect. In conclusion, the theoretically expected sign is positive for this variable, and the empirical findings support this. Hence, the general hypothesis to be tested is:

Hypothesis: higher inflation rate motivates an increase in the size of IE.

1. Size of the agricultural sector:

This variable is exciting, and it was found to have a positive effect on IE size, especially in African countries such as Morocco and Egypt. Although the low number of studies that included agricultural sector size as a source of informality, it is found to have a significant positive effect. According to Hassan and Schneider (2016a), this sector is dominated by informal workers due to weak governance and control, which create a perfect environment for informal workers. Therefore, researchers in countries where the agricultural sector has a significant role should investigate its interaction and IE.

Although the agricultural sector plays an essential role in the economy in Algeria, and it is unregulated by the government authorities as it should, which makes it an important source of informality, no researchers have explored this. It is overlocked in the empirical studies.

In addition to the previous causal variables, scholars added other variables such as:

- Corruption: this variable is considered theoretically as the IE's twin. Although these two variables are positively correlated in economic theory, our sample of studies found heterogeneous results. For example, Medina and Schneider (2019) found a significant positive effect, Efendic et al. (2011) and Aspilaire (2014) found an insignificant positive effect and Dell'Anno and Schneider (2003) found a negative effect;
- Subsidies: although Dell'Anno (2007) indicated that this variable has a conflicting impact on because, one side, only formal activities registered by the government have the right to subsidies, which raises the cost of being informal, on the other side, unfair subsidies allocation could unbalance competition pushing some enterprises to switch to the IE; nevertheless, we found two studies Aspilaire (2014) and Trebicka (2014) estimated a significant positive effect, while Dell'Anno et al. (2007) and Pasovic and Efendic (2018) found the same sign but statistically insignificant; and
- Social benefits: this variable, as the previous one has an ambiguous effect, on the one hand, it increases the cost of being informal for individuals; on the other hand, staying informal while registered unemployed formally provides the opportunity to benefits from social benefits; hence a positive relationship is expected. Social benefits were found to have a positive and statistically significant effect by Dell'Anno (2007) and an insignificant positive influence by Barbosa et al. (2013).

Turning to the variables used to reflect the size and development of the IE, there is a general agreement on some indicators. In the first model proposed by Frey and Weck-Hanneman (1984), they argued that the IE size could affect three indicators simultaneously, namely production market measured by GDP, labour market measured by labour force participation rate and the last indicator is the monetary indicators generally reflected by currency outside the banks.

First, production market indicators: some studies used some kind of GNP derivative to reflect the development in this market. But, in the majority and recent studies uses some GDP variant. When

employing Structural Equation Modelling (SEM), a scale factor must be fixed in calculate the other parameters as a proportion of the selected scale variable. The formal economy, as measured by Gross domestic product, is used in the majority of research on this topic. Unfortunately, the link between the IE and formal economy remains equivocal; some research discovered a negative association, while others discovered a positive correlation.

A positive relation is expected when the informal and formal economy is complimentary. This effect is evident in developed countries where formal enterprises purchase goods, labour-power, and services from informal enterprises to reduce costs, especially in times of crisis. Hence, the IE has a positive effect on the formal economy.

Now, an adverse effect is expected when the informal and formal economies are substitutional. In other words, they are counter cyclic to each other. In times of contraction in the formal economy, individuals and enterprises switch to the IE to reduce the burden of regulations and taxes. In the same way, when the economy is booming, they switch back to the formal economy and carry their work as usual.

Generally, the production market index is usually the scale variable in studies adopting the model approach. This assumption is criticised by many scholars (Breusch, 2005; Helberger and Knepel, 1988) because constraining this variable to one or minus one impacts the sign of causal variables, meaning constraining the scale variable with the wrong sign will produce wrong sign in the causal variables. To overcome this problem, scholars, e.g., Dell'Anno (2003), first the authors assume a positive relation and estimate the model if the causal variables, especially the tax variable, have the right theoretical sign, which means the positive is the correct sign. In the other case, if the causal variables have the wrong theoretical sign, the sign of the scale variable is reversed. Another practice is to used monetary indicators as scale variables because the positive expected sign is validated by economic theory and numbers of empirical investigations.

From our sample, the formal economy reflected by GDP is used in 38 out of 42 studies. In these studies, 22 of them used GDP as the scale variable, 8 used currency and 3 used labour force participation rates. The rest of the studies used Tedds and Giles (2000) different indicators as scale variables or did not precise which indicator is constrained to unity.

In the 22 studies that used GDP as a scale variable, half of the theme constrained to (-1), for example, in Portugal, Romania, Kingdom of Eswatini, which assumes a negate relation between the informal and formal economy. The other half constrained it to (1), for example, in Mexico, Malaysia and Bosnia and Herzegovina.

In the end, the GDP is the most used indicator as a scale variable. Unfortunately, the type of relationship between the two economies is ambiguous; hence the expected sign could be positive or negative. Although Schneider et al. (2010) argued that the expected sign depends on the level of economic development, it is based on the empirical investigation to extract the correct sign.

Second, the monetary index is used in 36 out of 42 studies. In these studies, it is used as a scale variable in 8 studies. Interestingly, although the theoretical sign is expected to be positive, several studies, for example, Dell'Anno (2003), Quintano and Mazzocchi (2014) and Nchor and Adamec (2014) found a significant negative effect.

Third, the labour force participation rate is included as an indicator of the labour market in 21 out of 42 studies. In these studies, only 3 of them used it as a scale variable. The estimated sign is contradictory; for example, Tedds (1998), Schneider (2005) and Buehn and Schneider (2008) found a significant negative effect between this variable and IE, while Dell'Anno (2007), Yap et al. (2017) and Medina and Schneider (2019) estimated a significant positive effect. Furthermore, it was excluded for statistical significance in many studies Efendic et al. (2011), Hassan and Schneider (2016b) and Zikalala and Sacolo (2018).

Other studies like Loayza (1996) used non-agricultural workers not covered by social security as a scale variable and tax evasion as the second indicator. Dybka et al. (2019) used electricity consumption and previous estimations using the CDA approach as a scale variable. Ziad and Dahmani (2019) reflected the IE size currency as the scale variable and final household consumption as the second indicator.

Finally, in the Algerian studies, the results are different. Bounoua et al. (2014) constrained GDP per capita to (-1), where Kori (2018) chose to constrain it to (1) and used currency outside the bank as a scale variable; in the same, he found the GDP statistically insignificant.

2.3. The existing literature on IE in Algeria and their limitations

As aforementioned, despite the growing debates in the last decades of the IE and how to estimate it, we find a relatively small number of studies in Algeria that tried to measure the size and evolution of this phenomenon. The Table 9 below summarises the studies, which estimated the size of IE in Algeria.

Table 9
Review of Algerians informal economy estimates.
Source: Author's own construction.

Authors	Study period	Methodology	Estimation (Average)
Country based estimates			
Boudlal (2012)	1970-2010	CDA	24.5% of GDP
Bounoua et al. (2014)	1990-2009	MIMIC	44.72% of GDP
Bouriche and Bennihi (2020)	1970-2016	MIMIC	31.9% of GDP
Panel based estimates			
Elgin and Oztunah (2012)	1960-2008	DGE	33.09% of GDP
Alm and Embaye (2013)	1994-2006	CDA	48.09% of GDP
Quintano and Mazzocchi (2014)	1995-2010	SEM	39.4% of GDP
Medina and Schneider (2018)	1991-2015	MIMIC	30.86% of GDP
Abd El Aziz and Zaki (2019)	2000–2017	MIMIC	19.98% of GDP
State level estimates			
CNES (2004)	2001-2010	Household survey	40.13% of GDP
Adair and Bellache (2009)	2007	Household survey	19. 9% of GDP
Smaili (2019)	2017	Household survey	46.16% of GDP

Unfortunately, some of the previous studies have theoretical and methodological issues, especially macro-economic studies. On one side, the studies that adopted the direct approach uses one central database gathered in 2007 and only included Bejaia and Tizi Oouzou. In addition to the well-known shortcomings of this approach (see chapter one), the sample size is gathered can't represent the overall Algerian economy. Furthermore, the statistical modifications made on the original data is no well documented; besides, there is a lack of pre-tests.

On the other side, First, from a theoretical point, some inconstancies are found; for example Boudlal (2012) did not specify if he includes or excludes oil-tax revenues from his tax variables, knowing that Algeria is an oil-rich country. If the author did add oil taxes, the results would be miss

leading. The author assumed in his estimation that the velocity in both formal and informal economies is the same. In contrast, according to Ahumada et al. (2009), this assumption is not valid, and the estimated results should be corrected; Bounoua et al. (2014) chose to use GDP per capita as the scale variable while in many studies this variable is added as the causal variable to accounts for the effect of the official economy. The latter variable was constrained to (-1), which means the informal and formal economy are complementary without justifying why. Second, the authors combined the direct, indirect taxes, and social security contribution in one variable, which can cause a problem in the estimation because the effect of these three variables on the shadow economy is steel ambiguous, Frey and Weck-Hanneman (1984) found that direct and indirect taxes have a positive impact on shadow economy in the same time security contribution have a negative impact, while Corina and Andrie (2011) found a negative impact of direct taxes on the shadow economy and a positive impact of indirect taxes on the shadow economy.

In contrast, Kori (2018) chose to use only to causal variables budget deficit to measure the size of the government, which is unusual. In the literature, the researchers used government spending (Macias and Cazzavillan, 2010), government consumption (Dell'Anno, 2003; Wang et al., 2006) and employees in the public sector (Schneider, 2002; Tedds, 1998) and urbanisation; the second observation is the author constraining GDP to (+1), which means that the formal and informal economy are substitutional without justifying why. Moreover, in the empirical part, the author did not test the data for stationarity which can cause a spurious regression. In the most reason study made by Ziad and Dahmani (2019), the obtained results added more uncertainty on the causal variables.

Secondly, from a methodological point Boudlal (2012), Bounoua et al. (2014), Kori (2018) and Ziad and Dahmani (2019), in other words, all the previous studies in Algeria, did not report the tests of stationarity or co-integration, which leads to spurious regression. Also, none of the previous studies checked the data for multinormality, which is essential when using a maximum likelihood estimator. Furthermore, for Boudlal (2012) case, he did not correct his estimations as proposed by Ahumada et al. (2007). Therefore, further studies are needed to examine the determinants and evolution of the IE in Algeria.

After collecting theoretical and empirical literature on the IE, especially in the Algerian case. It is clear that there is no perfect approach to investigate the scope and source of informality; instead, there is a

battery of different approaches. Some of them are micro-based investigations, and the other ones are macro-based investigations. The choice of which approach a researcher adopts is affected by several factors such as the purpose behind the study, scope of the study, time and financial resources, and other reasons.

As a result, and for the first time our study carries an empirical investigation with special consideration to the Algerian data features (e.g., stationarity, multinormality, structural changes, etc.), the purpose of the current study is to examine the sources of informality that are responsible for the development of the IE size and calculating its scope employing the Currency Demand Approach (CDA) and structural equation modelling, specifically the multiple indicators multiple causes (MIMIC) from 1980 to 2017. In doing so, the research employs Hassan and Schneider (2016a, p. 2) "The IE reflects mostly the legal economic and productive activities that, if recorded, should contribute to the national GDP." Accordingly, any unlawful activities are thus prohibited, such as smuggling, criminal acts, and human trafficking.

The CDA and MIMIC approaches are selected for several reasons most important one is using two different approaches to compare and validate the obtained results, in addition to other reasons such as: (a) Despite their detractors, these methods are thought to be better compared to previous indirect methods; (b) the MIMIC approach employs the idea of unobservable variable, which is appropriate with the nature of IE; and (c) it considers multiple determinants and multiple indicators to reflect the scope of the IE at the same time, allows researchers to choose a diverse range of determinants and indicators depending on the characteristics of the economic system under research and the availability of information.

First, the proposed theoretical model of CDA is:

$$\ln C/M1_t = \alpha_0 + \alpha_1 \ln(1 + Tax)_t + \alpha_2 ln\, nGDP_t + \alpha_3 \pi_t + \alpha_4 R_t + \varepsilon_t \qquad (21)$$

Where: $\ln C/M1_t$ is the natural logarithm of currency normalised by money supply; $\ln(1 + \text{Tax})_t$is the natural logarithm of (1 + total tax outside oil tax revenues normalised by GDP. This variable is considered the most important determinant of IE in the currency demand approach. Literature confirmed that a higher rate of tax burdens leads individuals to avoid paying taxes through informal economic activities. Therefore, a higher tax rate is expected to increase the informal economy ($\alpha_1 >$

0);

$\ln nGDP_t$ Is the natural logarithm of the real non-oil GDP this variable was chosen instead of GDP to catch the development of the official economy by taking out the repeated oil shocks, which may lead to misleading results. A positive relationship is expected between non-oil GDP and C/M1($\alpha_2 > 0$);

π_t Is the inflation rate. This variable has a negative influence on the currency ratio if individuals substitute currency for interest-bearing assets to prevent the inflationary erosion of their purchasing power ($\alpha_3 < 0$);

R_t Is the nominal deposit interest rate. An increase in this interest rate decreases the currency ratio due to the increased opportunity cost of holding money rather than deposits ($\alpha_4 < 0$);

ε_t Is the error term.

Second, deciding which factors to be included in this investigation is a significant difficulty, particularly given the number of research studies that conclusions are contentious. As a result, and in order to attain objectivity, over a hundred research that explored the causes and range of IE were collected and processed in order to extract information on the causative variables and indicators used to indicate the IE magnitude. Following this activity, it was discovered that researchers employed various combinations of IE causes and indicators. Previous research has identified the primary drivers as tax burden, government interference in the economy, institutional quality, self-employment, and unemployment rate. In addition to these explanations, researchers have offered additional dependent on the region under consideration.

In addition to GDP, money supply, and employment data, this research considers the tax burden, quality of institutions, the status of the formal economy reflected by GDP per capita and unemployment, the share of the agriculture sector, and the quality of institutions as factors of the IE. As a result, the typical theoretical model is a MIMIC (5-1-2), as seen in Figure 5

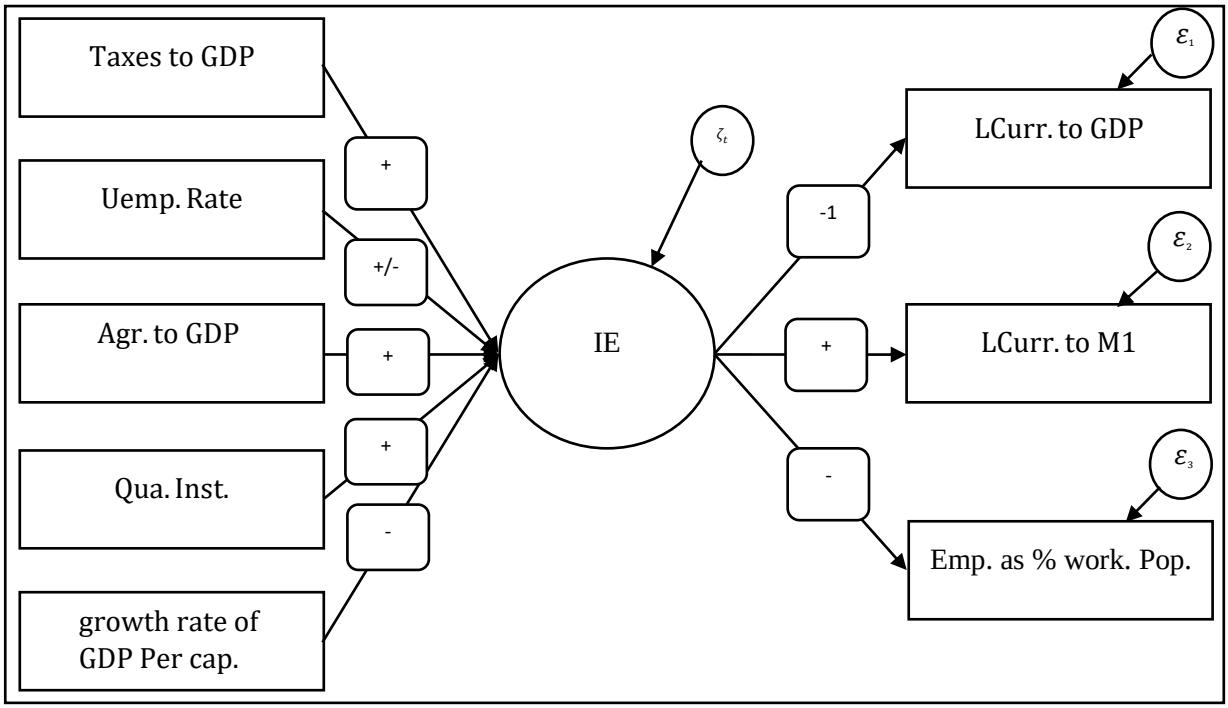

Figure 5 The theoretical MIMIC model proposed.
Source: Author's own construction.

In summary

In this chapter, the existing literature on IE is collected, summarised, and discussed to get a broad idea of how the previous studies approached this phenomenon and what methods were used. Because the primary goal of this study is to investigate the source of informality in Algeria, only the studies that fall in line with the primary objective were included, especially the studies examining the size and development of this phenomenon in Algeria. From this literature, it is found that there are some contradictories between theoretical and empirical studies. Moreover, the number of country-based studies in Algeria is small relative to other countries, and most estimations are panel-based estimations.

Hence, after the most used determinant and indicators of the IE and the approaches adopted by the researchers, besides the issues that faced them, the current study employs two of the most used approaches, namely the CDA and MIMIC approach to investigate the size and evolution of the IE in Algeria.

Chapter 3

DETERMINANTS AND SIZE OF THE IE IN ALGERIA

3.1. Currency Demand Approach (CDA)

3.1.1. Theoretical model and Data

As aforementioned, the current study employs the Currency Demand Approach (CDA) as one of the two approaches to measure the size and evolution of the Algerian IE over the period of 1980 to 2017. The latter is selected due to the availability of data, which is a common problem in macroeconomic estimation, especially in developing countries. For this purpose, a variant of the Tanzi (1983) model is employed.

In the last years, different groups of variables were added to the original CDA model of Tanzi (1983), resulting in a large number of exogenous variables to select from them. In line with the theoretical and empirical literature, the following variables are added to the model.

(1) Taxes: from the previous chapter, it is clear that taxes are one of the primary determinants of informality; this variable is expected to influence the IE size positively, reflecting the individual's behaviour to avoid paying taxes by moving their activities to the IE resulting an increase in its size. The total tax revenues outside oil tax normalized by GDP (Figure 6) is added to the model to account for this effect.

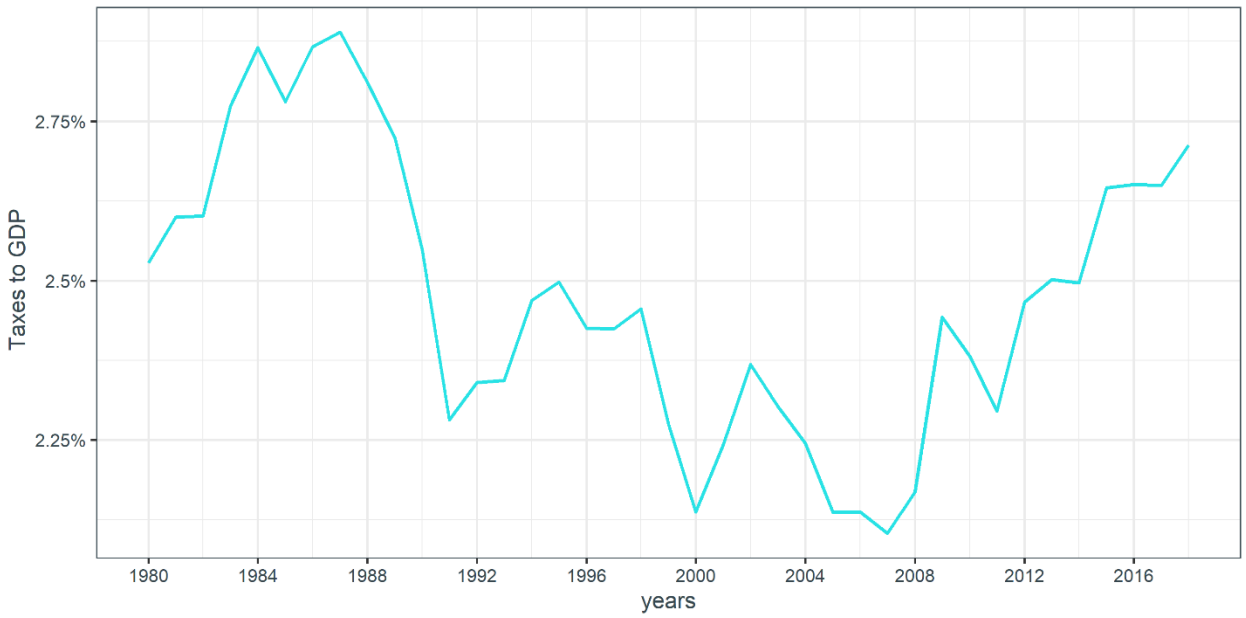

Figure 6 the evolution of taxes from 1980 to 2017.
Source: national office of statistics

As shown from the figure above, the ratio of non-oil taxes to the GDP is relatively small compared to other taxes. The highest percentage was in 1987 (2.89%), and the highest percentage was in 2007 (2.10%). The figure shows that this variable knows a fall after 1989 and did not recover from until 2008 after this year, the non-oil taxes know a constant increase.

(2) Income: Income: this variable was added originally in Cagan's (1958) model as one determinant affecting the demand for currency. A positive relationship between this variable and the demand for currency is expected. This variable is chosen instead of the usual GDP measurements to capture the development of the official economy by taking out the repeated oil shocks, which may lead to misleading results. The trends and development of this variable over the study period are shown in Figure 7.

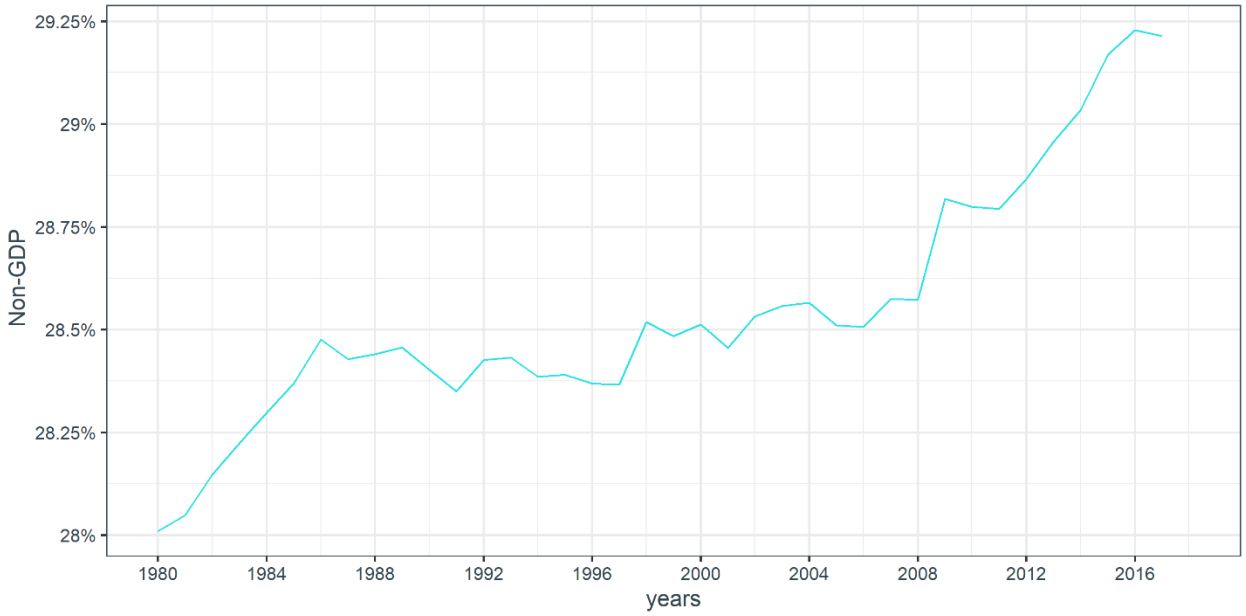

Figure 7 The evolution of non-oil GDP from 1980 to 2017.
Source: national office of statistics.

Generally, this variable had an increasing trend over the period under investigation. The non-oil GDP ratio was at its minimum in 1980, and it is increasing slowly until 2008; after this year, the non-oil GDP know a significant rise, reflecting the Algerian government's policy to stimulate other economic sectors, especially the private sector.

(3) Interest rate on time deposit: According to Cagan (1958), this variable is a proxy for the opportunity lost when holding currency. The theoretically expected sign for this variable is positive. Following the literature and Tanzi (1983), this variable is added as a determinant for currency demand.

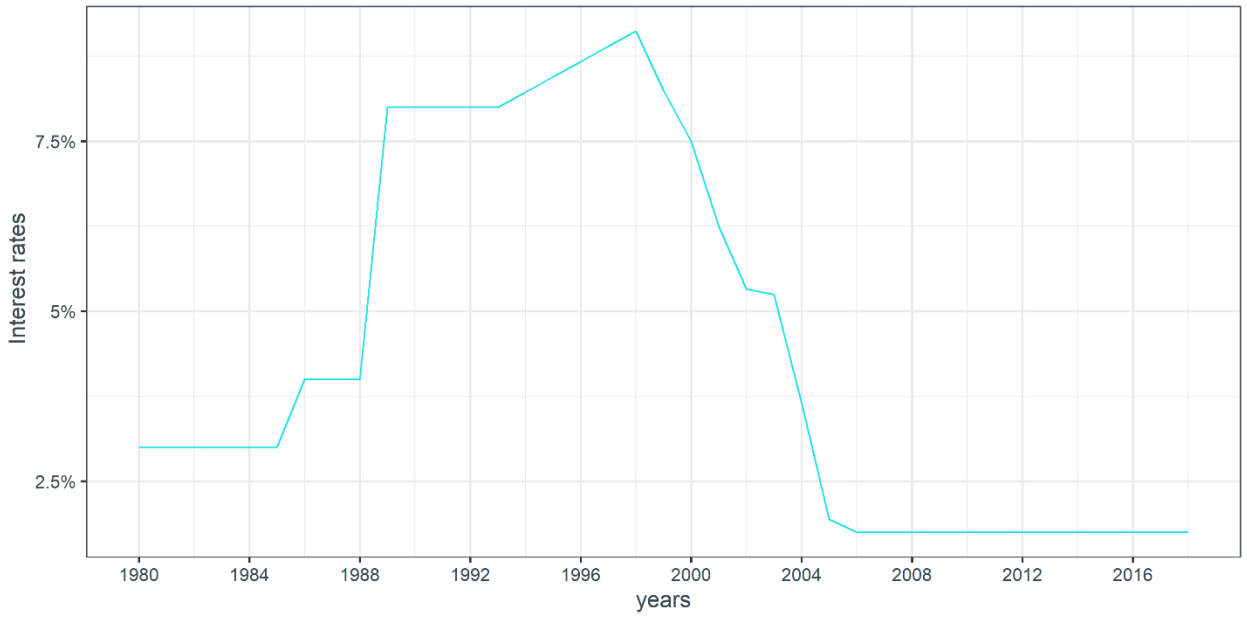

Figure 8 The evolution of the nominal interest rate from 1980 to 2017
Source: The Algerian central bank

As shown in Figure 8, the nominal interest rate in Algeria was at its highest in 1998 (9.12%). However, after this year the percentage know a continuous decrease until 2006, wherefrom this year on until 2007 the interest rate was stable at 1.75%.

(4) Inflation rate: this variable is the last exogenous variable in the proposed model. It is included to capture the effect of inflationary erosion of the purchasing power. According to economic literature, individuals substitute currency for interest-bearing assets to prevent the inflationary erosion of their purchasing power. Hence, a negative relationship is expected.

The below Figure 9 shows the evolution of the inflation rate over the period under investigation. The inflation fluctuation behaviour can be split into two sub-periods; the first from 1980 to 2000, in this period know, in general, a decreasing trend after it reached its highest percentage in1986.; the second period is from 2000 to 2017, the inflation rate started to increase again after it hit its lowest percentage.

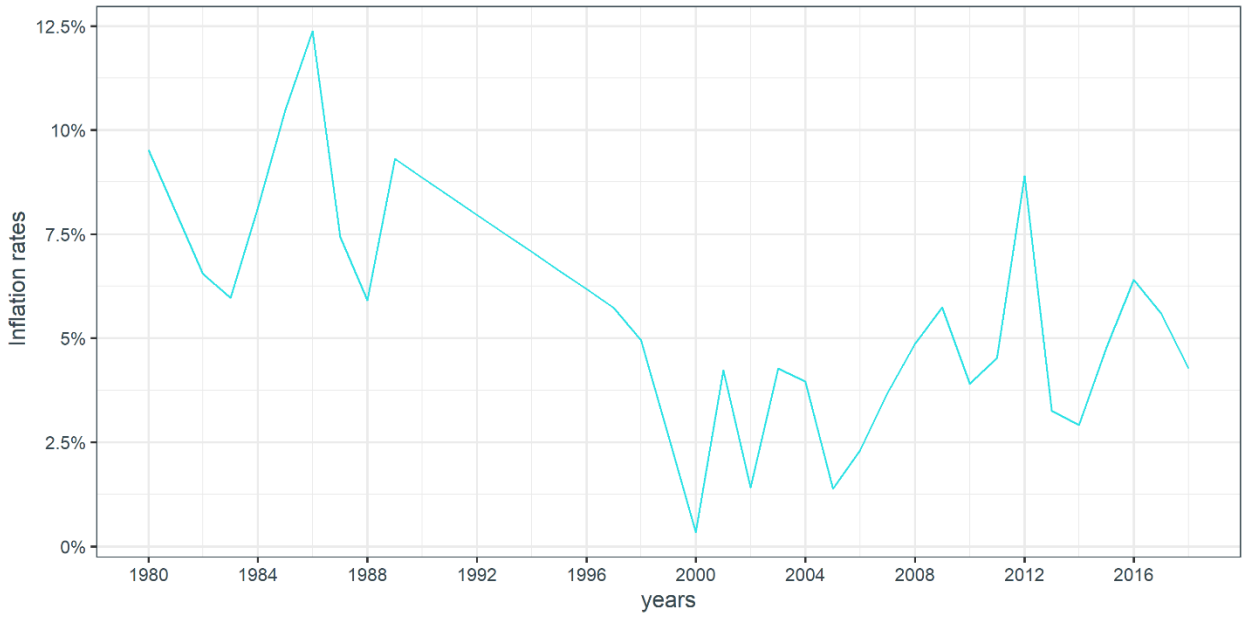

Figure 9 The evolution of the inflation rate from 1980 to2017.
Source: world bank

As for the dependent variable, the ratio of currency to M1 is used to reflect the behaviour of currency circulation. As shown in Figure 10 currency to M1 ratio fluctuated between 52% and 30% over the study period. After a decrease from 2003 to 2007 it started to increase again until 2016 and started to drop again.

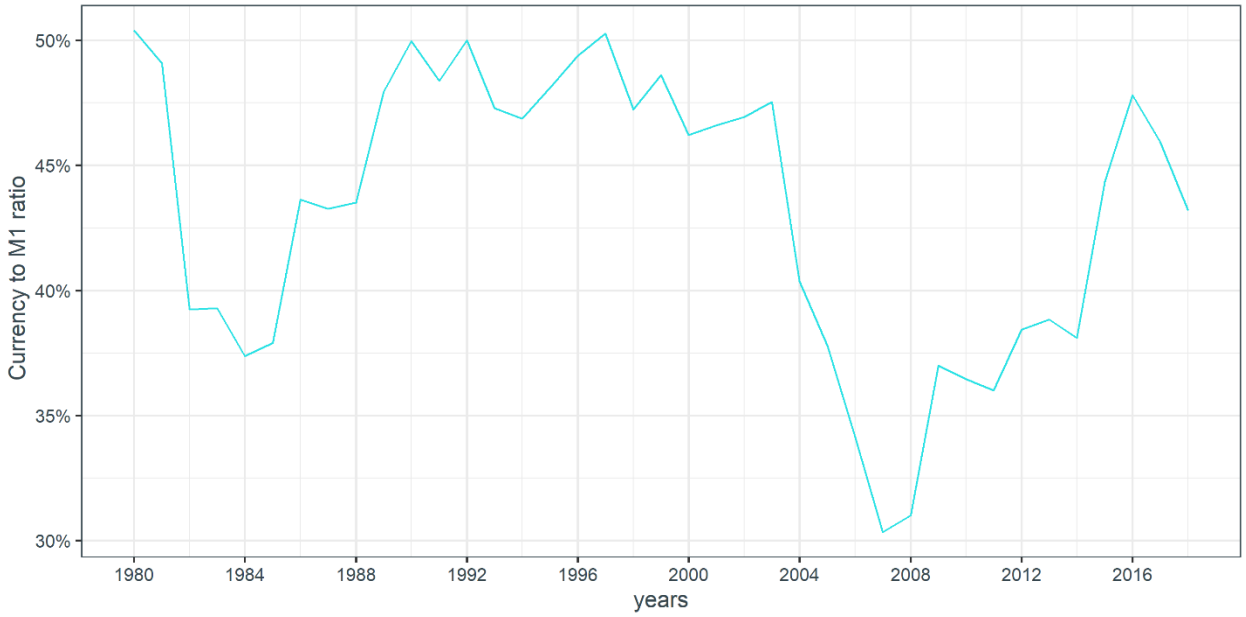

Figure 10 The evolution of currency to M1 ratio from 1980 to 2017.
Source: National office of statistics.

Consequently, the theoretical CDA model for the current study is written as followed:

$$\ln C/M1_t = \alpha_0 + \alpha_1 \ln(1 + Tax)_t + \alpha_2 ln\, nGDP_t + \alpha_3 \pi_t + \alpha_4 R_t + \varepsilon_t \quad (22)$$

Where: $\ln C/M1_t$ is the natural logarithm of currency normalized by money supply;

$\ln(1 + \text{Tax})_t$is the natural logarithm of (1 + total tax outside oil tax revenues normalized by GDP). It is expected to have positive sign ($\alpha_1 > 0$);

$\ln nGDP_t$Is the natural logarithm of the real non-oil GDP this variable is expected to have a positive sign ($\alpha_2 > 0$);

π_t Is the inflation rate. This variable is expected to have a negative sign ($\alpha_3 < 0$);

R_t Is the nominal deposit interest rate. This variable is anticipated to have a positive sign ($\alpha_4 < 0$); and ε_t is the error term.

Table 10 shows the statistical proprieties of the chosen variables to use in the CDA approach.

Table 10
Descriptive statistics of the CDA data; yearly observations.
Source: author's own construction

Variables	Mean	Median	Max	Min	Obs.
$\frac{C}{M1}$	43.20	44.36	50.40	30.34	38
$\frac{tax}{GDP}$	2.477	2.466	2.889	2.104	38
$nGDP$	2.606e+12	2.337 e+12	4.938 e+12	1.460 e+12	38
π	5.804	5.737	12.371	0.339	38
R_t					38

3.1.2. Method

Following the recent literature and data proprieties, the study adopts the autoregressive distributed lag methodology (ARDL) to catch in detail the dynamic relationship between the demand for currency and its ca. However, before applying the ARDL methodology the data was tested for stationarity using the Augmented Dickey-Fuller test, Philips-Perron test, and the breakpoint unit root test. These tests of stationarity are applied to ensure that the data do not have second-order integrated variables I (2).

The ARDL method was first introduced by Pesaran et al. (1996) and, later on, it was improved by Pesaran et al. (2001) by introducing another approach called "bounds testing approaches". The general form of the ARDL equation to test for co-integration in this paper can be written as follows:

$$D\ln\left(\frac{C}{M1}\right)_t = \alpha_0 + \sum_{i=1}^{p1}\alpha_{1i}D\ln\left(\frac{\mathrm{C}}{\mathrm{M1}}\right)_{t-i} + \sum_{i=0}^{p2}\alpha_{2i}D\ln(1+tax)_{t-i} + \sum_{i=0}^{p3}\alpha_{3i}Dln\,nGDP_{t-i} + \sum_{i=0}^{p4}\alpha_{4i}D\pi_{t-i} + \sum_{i=0}^{p5}\alpha_{5i}DR_{t-i} + \beta_1\ln\left(\frac{\mathrm{C}}{\mathrm{M1}}\right)_{t-1} + \beta_2\ln(1+tax)_{t-1} + \beta_3\ln nGDP_{t-1} + \beta_4\pi_{t-1} + \beta_{5i}DR_{t-1} + \varepsilon_t \quad (23)$$

Where: α_0 is the constant; α_j mean short-term dynamics; $\beta_r$are the long-term coefficients; D is the delay operator; ε_t is the random errors with mean zero. The lag length for each variable of the ARDL (P_1, P_2, P_3, P_4, P_5) is selected by the Schwartz Information Criterion (SIC), assuming a maximum lag length of 4 lags.

After using the bounds test on equation (2) which is based on the partial F-test under the null of no co-integration against the alternative hypothesis the existence of co-integration. The results revealed that the variables are co-integrated. therefore, the conditional ECM using the ARDL method can be written as follows:

$$D\ln(C/M1)_t = \alpha_0 + \sum_{i=1}^{p1}\alpha_{1i}D\ln\left(\frac{\mathrm{C}}{\mathrm{M1}}\right)_{t-i} + \sum_{i=0}^{p2}\alpha_{2i}D\ln(1+tax)_{t-i} + \sum_{i=0}^{p3}\alpha_{3i}Dl\,nGDP_{t-i} + \sum_{i=0}^{p4}\alpha_{4i}D\pi_{t-i} + \sum_{i=0}^{p5}\alpha_{5i}DR_{t-i} + \theta_1 ECM_{t-1} + \varepsilon_t \quad (24)$$

Where: ECT_{t-1} is the error correction term which measures deviations from the long-run equilibrium and θ_1 Captures the speed of correction to long-run equilibrium.

Following the stated steps in the previews section of the paper and using the long-run coefficient of the ARDL model. The size of the Algerian informal economy has been estimated over the period 1980 to 2019. Then the results were corrected using the suggested formula of Ahumada et al. (2009) as follows:

$$\frac{Informal\ economy_t}{GDP_t} = \left(\frac{illegal\ currency_t}{legal\ currency_t}\right)^{1/\beta} = \left(\frac{Informal\ economy_t}{GDP_t}\right)^{1/\beta} \quad (25)$$

3.1.3. Results

3.1.3.1. Unit root test

In the first stage, the data is tested for the presence of a unit root. The following Tables 11 and 12 shows the reported t-statistic of the ADF test and breakpoint unit root test. Respectively, while the null hypothesis is the presence of the unit root. The result of the ADF test shows that all the series are not stationary in the level. However, the breakpoint unit root test which is superior to the ADF because it takes into account the breaks in the time series suggested that some series are stationary in the level.

Table 11
ADF Unit root test.
source: Author's own calculation.

At level						
t-statistic	$\ln\left(\frac{C}{M1}\right)$	$\ln\left(\frac{tax}{GDP}\right)$	$\ln(nGDP)$	π	R_t	Polty4
C	1.9643	1.3239	0.0238	2.8714**	1.0020	1.0981
T&C	2.7926	1.0840	1.0851	3.4124**	1.6854	2.5179
None	0.5390	0.1544	2.9534	1.4802	0.6772	1.9335
At first difference						
t-statistic	$\ln\left(\frac{C}{M1}\right)$	$\ln\left(\frac{tax}{GDP}\right)$	$\ln(nGDP)$	π	R_t	Polty4
C	4.9804*	5.0391*	5.8875*	6.8212*	4.7024*	5.8307*
T&C	4.9318*	4.6157*	5.8679*	6.7100*	4.8728*	5.8307*
None	5.0421*	5.1072*	4.9310*	6.9027*	4.7629*	5.4108*

Notes: ***, **, *means statistically significant at 1%, 5% and 10% level, respectively. T&C is the model with a constant and trend; C is the model with constant only, and non represents the model without a drift and trend. The number of lags was determined using SCH criterion for maximum 11 lags to remove serial correlation in the residuals. The Philips-perron test was employed by means of Newey-west Bandwidth.

Table 12
Break point unit root test.
source: Author's own calculation.

At level					
t-statistic	$\ln(\frac{C}{M1})$	$\ln(\frac{tax}{GDP})$	$\ln(nGDP)$	π	R_t
C	5.55853*	3.1294	3.0955	4.704***	3.7178
T&C	4.3730*	4.5953	7.4630	5.2726	4.0866
None	3.0652	4.5209	3.9029	4.305***	4.7314**
At first difference					
t-statistic	$\ln(\frac{C}{M1})$	$\ln(\frac{tax}{GDP})$	$\ln(nGDP)$	π	R_t
C		5.6594*	7.5881*	7.5192*	7.8005*
T&C		6.6498*	7.4630*	7.9590*	7.6492*
None		5.7204*	7.4002*	7.2121*	5.5516*
Break year	2003	1987	1986	1989	1989

Notes: ***, **, *means statistically significant at 1%, 5% and 10%. T&C represents the model with a constant and trend; C represents the model with constant only and non represents the model without a drift and trend. The breakpoint selection is based on Dickey-Fuller min-t Lag length based on Schwarz criterion with max lags of 9.

In the second stage, the paper used the ARDL bounds test to examine the existence of the co-integration between the dependent variable and its explanatory variables. based on AIC criteria, the optimal max lag order was fixed at k = 4. Table 13 presents the test results.

Table 13
Bounds co-integration test.
source: Author's own calculation.

Calculated F-statistic		
11.0253*	K= 4; sample =39	
	The critical value bounds	
significance	I(0)	I(1)
10%	2.427	3.395
5%	2.893	4
1%	3.967	5.455

Based on the empirical findings shown in the table above the calculated F-statistic of ARDL bound testing is 11.0253 and it is greater than the critical value of 4, which indicates the existence of long-term co-integration relations between the variables.

3.1.3.2. Long run and short run and diagnostic results

Table 14 panel A provides the estimation result of long-run estimation, which is used to estimate the IE in Algeria during the study period. From the results provided taxes normalized by GDP and non-oil GDP positively impacts the dependent variable as follows, a one-percent rise in taxes will lead to a rise of 35% in the currency demand; a one-percent rise in non-oil GDP sector will augment the demand for currency by 34% and these two impacts are statistically significant at 5% level. Inflation has a non-significant impact close to zero on the dependent variable, and the last variable interest rate has a positive and significant impact on the dependent variable one-percent rise in its later will lead to a 6% rise in the demand for the currency which is incompatible with the economic theory. However, this impact is very small.

Panel B represents the short-run estimations. As it has seen the ECM is negative and statistically significant at a 5% level with a value of -0.6113This represents the adjustment needed to realize the actual equilibrium. The study model also shows a good fit, with the R-squared of 0.7605 (Adj-R2: 0.7381) implying that 74% variations in the dependent variable are explained by the model and the rest by other variables not included in the model.

Table 14
Long and short run estimates.
Source: Author's own calculation.

Panel A: ARDL (1,0,0,0,2) long run coefficients				
C	$\ln(\frac{tax}{GDP})$	$\ln(nGDP)$	π	R_t
-7.0382	0.3455	0.3354	0.0095	0.0647
(2.6349)*	(2.6803)*	(3.4352)*	(1.2090)	(9.3866)*

Panel B: short run coefficients			
Lag order	DR_t	Polity4	ECM(-1)
0	0.015	0.002	-0.6113
	(1.8111)***	(1.4349)	(-8.8545)*
1	-0.019		
	(-2.1512)**		

Panel C: Diagnostic statisticzl tests						
R^2	Adj-R^2	F-Sta	DW Sta	χ^2_{LM}	χ^2_{JB}	χ^2_{ARCH}
0.7606	0.7382	40.17[0.00]	2.0195	0.48[0.79]	1.99[0.98]	1.06[0.6]

Notes: ***, **, *means statistically significant at 1%, 5% and 10
values between (.) are calculated t-statistics
values between [.] are calculated p-values

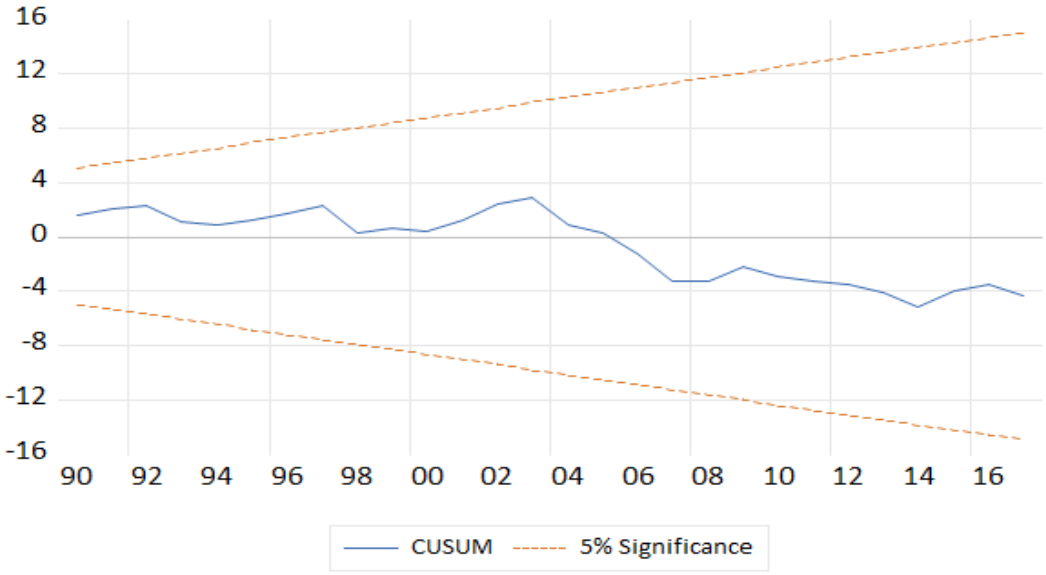

Figure 11 CUSUM.
Source: Author's own construction.

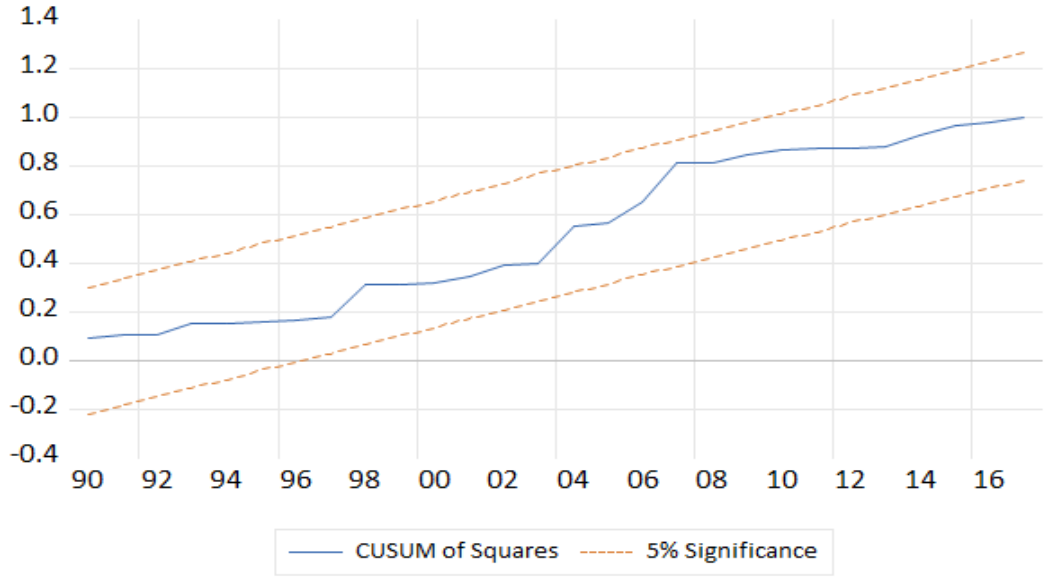

Figure 12 CUSUM of squares.
Source: Author's own construction.

The model also passes the test regarding serial correlation (Breusch-Godfrey Serial Correlation LM tests), normality (Jarque-Bera test), and heteroscedasticity (Breusch-Pagan-Godfrey test). And from figures 1 and 2 the model is shown to be stable over the study period.

The model also passes the test regarding serial correlation (Breusch-Godfrey Serial Correlation LM tests), normality (Jarque-Bera test), and heteroscedasticity (Breusch-Pagan-Godfrey test). And from Figures 11 and 12 the model is shown to be stable over the study period.

4.1.3.3. Algerian informal economy estimates using CDA approach

Using the long-run coefficients, the Algerian informal economy was estimated by the following equation:

$$\widehat{\ln\left(\frac{C}{M1}\right)_t} = -7.0382 + 0.3455 \times ln\left(1 + \frac{tax}{GDP_t}\right) + 0.3354 \times \ln(nGDP)_t + 0.0095\,\pi_t + 0.0647\,R_t + \varepsilon_t \quad (26)$$

The equation (06) is estimated twice to calculate $\widehat{\ln\left(\frac{C}{M1}\right)_t}$ and $\widehat{\ln\left(\frac{C}{M1}\right)_{wt}}$

where: $\widehat{\ln\left(\frac{C}{M1}\right)_t}$ is estimated with tax variable; $\widehat{\ln\left(\frac{C}{M1}\right)_{wt}}$ is estimated with tax variable steed to its minimum value keeping other coefficients unchanged.

To estimate the illegal demand of currency the following equation is applied:

$$C_{it} = e^{[(\widehat{\ln\left(\frac{C}{M1}\right)_t} - \widehat{\ln\left(\frac{C}{M1}\right)_{wt}}) \times M1]} \quad (27)$$

Where: C_{it} is the demand for illegal money

Hence, now the legal demand for money in the official economy can be estimated as follows:

$$C_{lt} = C_t - C_{it} \quad (28)$$

Assuming equal income velocity of money in both official and informal economies (Tanzi, 1983), the size of IE is estimated as follows:

$$IE_t = (C_{it} \times v_t)/GDP_t \quad (29)$$

The results of the above equation then were corrected using the proposed method by Ahumada et al. (2009) with β = 0.3354 for 1980 to 2019. The corrected estimates of IE in Algeria is depicted in figure 2 below.

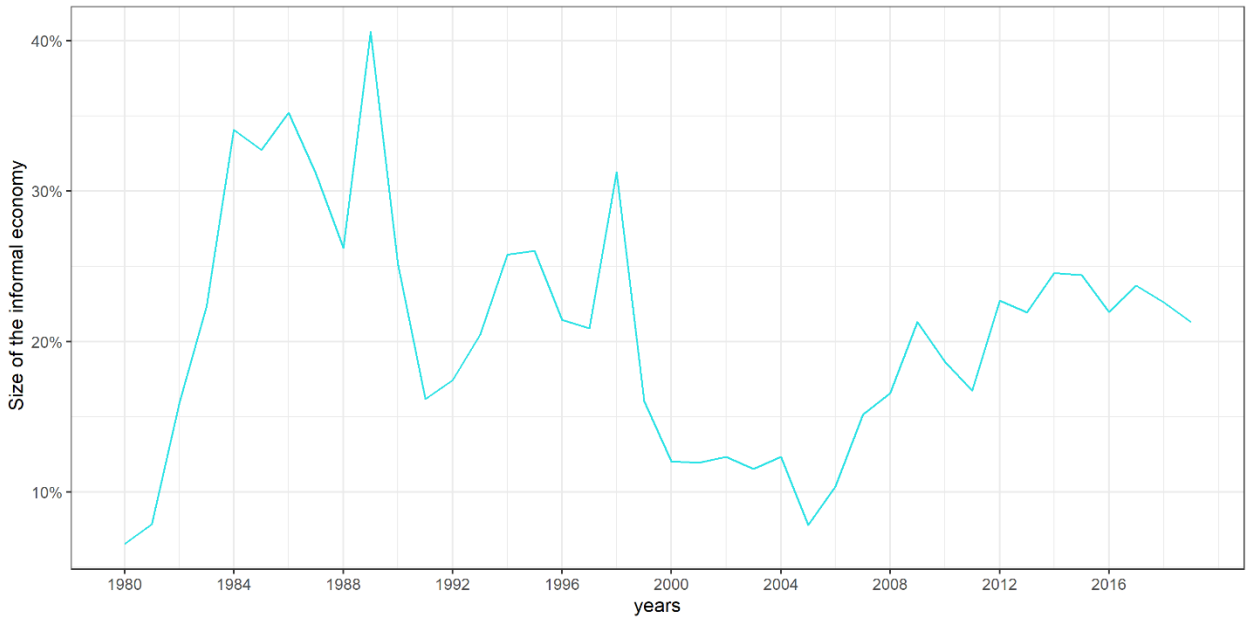

Figure 13 Algerian informal economy as percentage of official GDP CDA estimations
Source: Author's construction based on the CDA estimation.

From the Figure 13, the size and evolution of IE in Algeria is 21% of the official GDP. The IE in Algeria reached its highest percentage from 1984 to 1989, with an average of 33.33% of GDP; then, it decreased over the next three years. However, from 1992 to 1998 it started to grow again. The lowest average of IE was around 12%, and that is between 1999 and 2005. After that, the IE started to rise again and continued on that magnitude until 2019.

3.2. Multiple causes multiple indicators approach (MIMIC)

3.2.1. Theoretical model and Data

It is a great challenge to choose which variables to include in this study, particularly with numerous empirical researches obtaining controversial conclusions. Therefore, to attain objectivity, over a hundred studies that studied the determinants and extent of IE were collected and examined to recover critical pieces of information on the related source of informality and reflective variables that can be used to infer on the scope and magnitude of the IE. After examining the collected literature, it is observed that academics and scholars had employed and tested various combinations of MIMIC models. The principal causes in prior researches have been government interference in the general economy, tax burden, tax morality, unemployment rate, self-employment, and the quality of institutions. Besides the previous mentioned determinants, scholars have suggested several different

variables, and the selection between these variables is mainly based on the country's under study characteristics. In the current study, tax burden measured by the share of direct and indirect taxes to GDP, the quality of institutions, the status of the formal economy as reflected by unemployment and GDP per capita and, the share of the agricultural sector, the quality of institutions, are considered determinants of the IE, in addition to GDP, employment as indicators, and money supply. The theoretical arguments for choosing these variables are presented in the next sub-section.

3.2.1.1. The chosen determinants

A. **Tax burden (Taxes to GDP) :** In economic literature, an increase in the taxes stimulates a solid motivation to involve in IE activities (Buehn and Schneider, 2012); hence, a positive association is anticipated. To study this previous point, this variable is indicated as the aggregation of direct and indirect taxes as a percentage of GDP as a reflective variable for the tax burden, as displayed in Figure 14 below. The next hypotheses have been proposed:

Hypothesis one: More tax burden stimulates the growth of the IE's size, ceteris paribus.

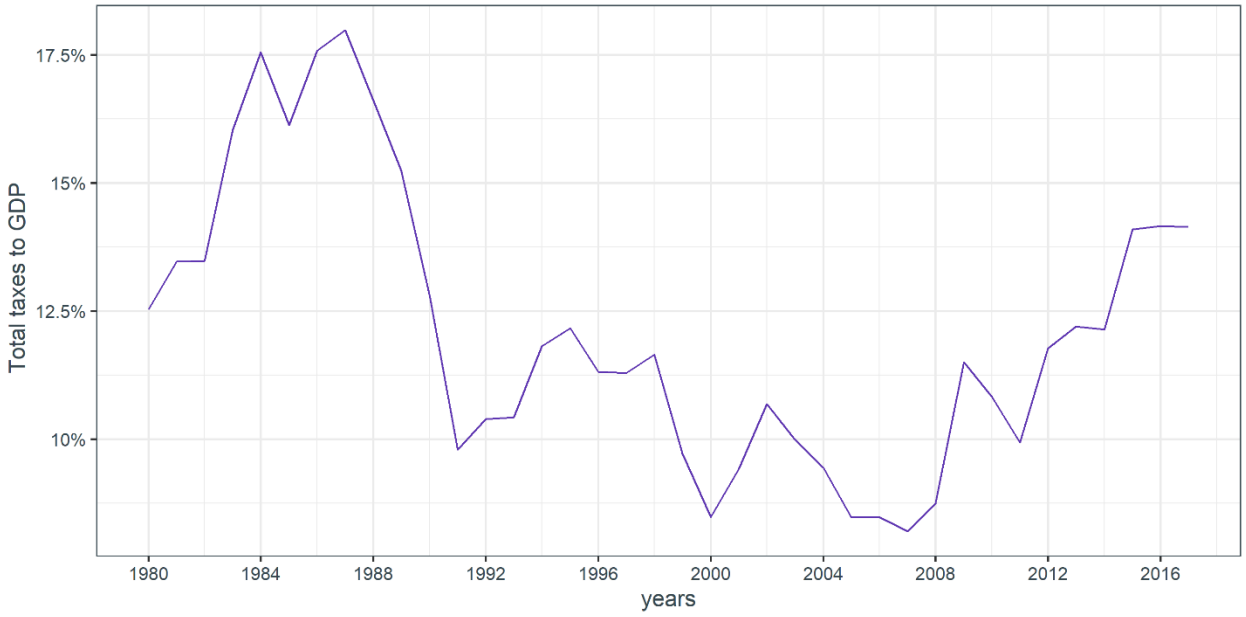

Figure 14 Tax burden as per centage of GDP from 1980 to 2017.
Source: National office of statistics.

from Figure 14, the total taxes to the GDP increased from 1980 to 1987. After that, it decreased intensively over the following four years. From 1991 to 2011 this ratio had, in general, as stable

average and started to increase from 2012. Although, this increase in percentage is bigger than that in the early 2000, it still lower that the ratio before the early 1990.

B. **The share of the agricultural sector (Agr. to GDP) :** As stated by Vuletin (2008), the agricultural sector's scope and IE are positively connected because to insufficient regulation and governance, particularly in rural regions. Several research throughout the world, especially in under developing nations, support this association. (Angour and Nmili, 2019; Hassan and Schneider, 2016a).

As a result, this variable has been added in the study model, measured as the value added by the agriculture as a percentage of the recorded GDP. The development of the size of this variable is displayed in figure 15. To this end, the next hypotheses have been proposed:

Hypothesis two: The increase in the agricultural sector will increase the scope of the IE, ceteris paribus.

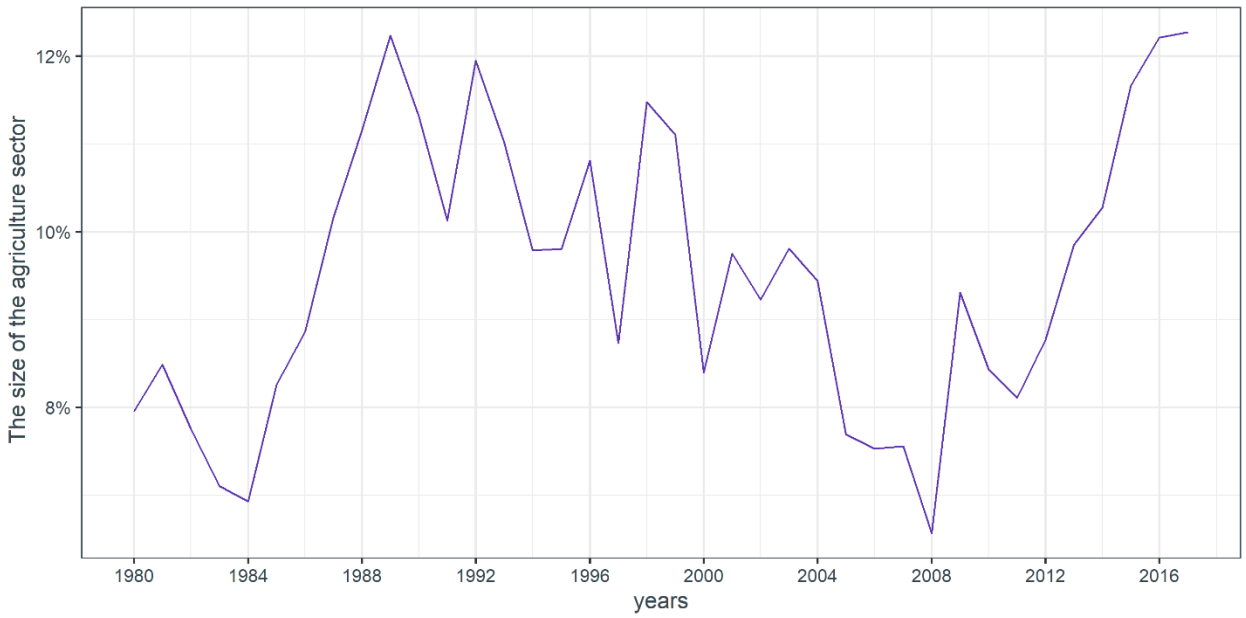

Figure 15 The size of agricultural sector as per centage of GDP from 1980 to 2017.
Source: world bank.

As shown in the Figure 15 above, the size of agriculture sector increased after 1984 to 1989, but after that its size started to decrease in terms of average, and this fall in size continued until 2008. Although it had a positive shock. Following the international crises, the size of this sector stared to increase again and reached its highest percentage in 2017 reflecting the government efforts in stimulating this important economic sector.

C. **Quality of institutions (Qua.Inst.):** In economic theory, there are a many research papers that links quality of institutions with the IE size, particularly in less developed nations (Loayza, 1996; Schneider et al., 2010). As found in a recent research paper that investigated this point made by Medina and Schneider (2018), quality of institutions has an important effect on the IE scope and development when the levels of corruption are high; In other terms, low degrees of corruption lower the magnitude of the IE, but high levels of corruption tend to modify this association (Bovi and Dell'Anno, 2010; Torgler and Schneider, 2007).

There is still a research gap about this issue in the Algerian context; to the author's knowledge, this factor has still not been included in IE models in Algeria. Earlier research focused with the magnitude and dynamics of Algeria's IE over looked the effect of this variable. To this end, our study incorporates institution quality into the theoretical model. The two cases presented above are studied in the context of Algeria, where corruption intensity is high. The latter is measured by the Bureaucracy Quality Index, which is taken from the ICRG database. the next hypotheses have been proposed:

Hypothesis three: better bureaucratic institutions tend to reduce the scope of the IE, ceteris paribus.

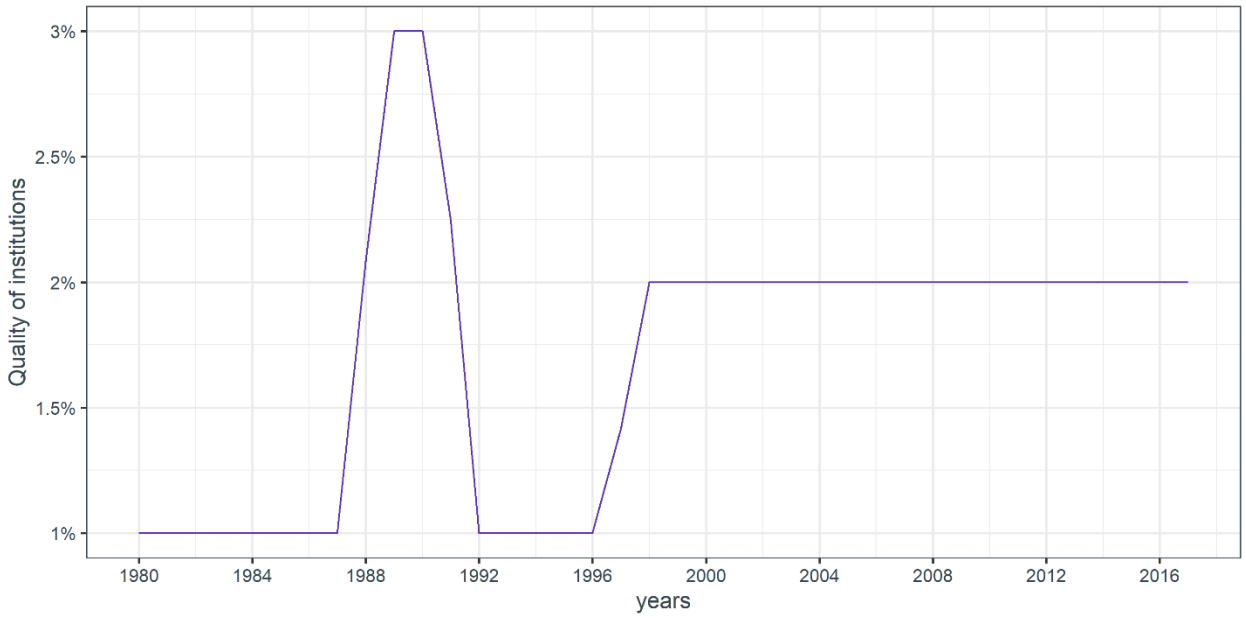

Figure 16 The evolution of quality of institutions index from 1980 to 2017.
Source: ICRG database.

From figure 16 above, the lowest score, which is 1, was in period from 1980 to 1987 and 1992 to 1996. The best score was from 1988 to 1990. However, over the last 18 years the score of quality of institutions in Algeria is 2.

D. **Per Capita Income (Growth rate of GDP Per cap.):** People in underdeveloped nations, as shown by Quintano and Mazzocchi (2014), are much more motivated to perform in the informal activities to live. As a result, a negative connection is discovered. Another research conducted Ángel et al. (2005), discovered a favourable association among personal income and the magnitude of the IE. Researchers argue that increased money encourages consumers to buy products and services from both economies. Buehn and Schneider (2012) proposed another reason for this connection: when the economy is thriving, people are more willing to engage in the official economy rather than the informal activities.

Because of the comprehensive interference among the informal and formal economies in Algeria, the GDP per capita growth rate is added to better capture the IE's influence on the formal economy in Algeria. the next hypotheses have been proposed:

Hypothesis four: The increase in GDP per capita will decrease the scope and development of the IE, ceteris paribus.

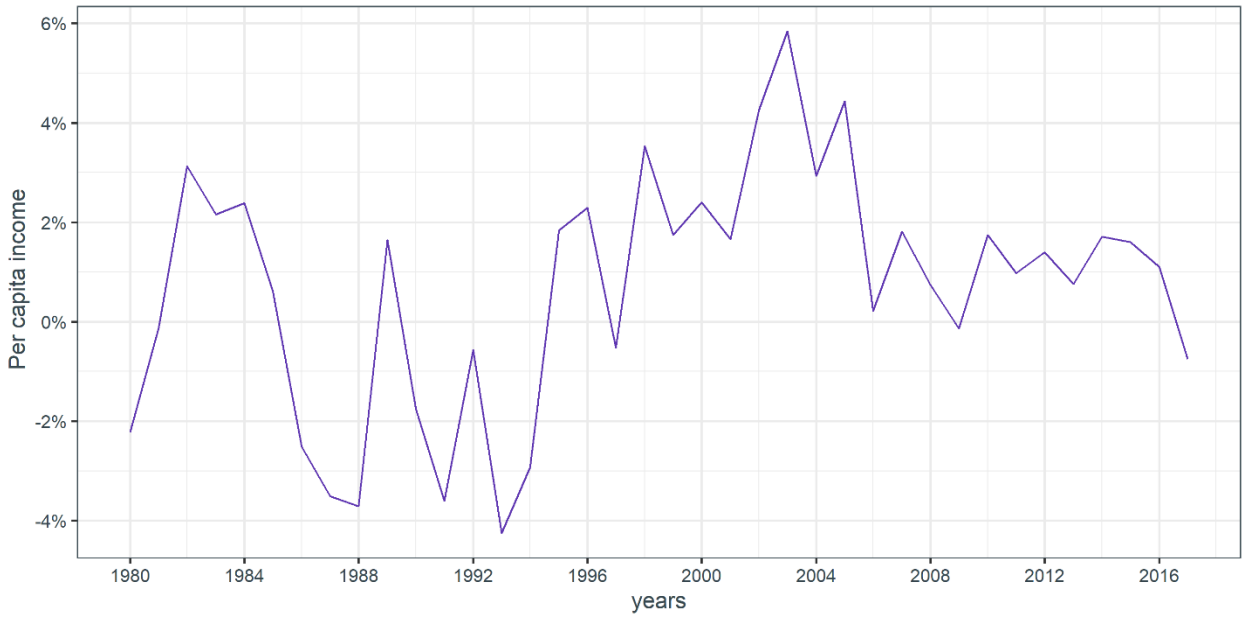

Figure 17 The evolution of per capita growth rate from 1980 to 2017.
Source: world bank.

As for the first indicator of the overall economy, per capita income, Figure 17 indicates that the overall growth of this variable has been enhanced over recent years. The lowest growth rates were

registered from 1986 to 1994. After this period, the growth rates increased and reached their highest in 2003 (5.8%). Unfortunately, it decreased after that but still had positive growth until 2017 when it registered a negative growth rate.

E. **Unemployment rate (Uemp.Rate):** Given the ongoing studies, the relationship among unemployment and the IE remains uncertain. According to certain research, there is a favourable association. According to Macias and Cazzavillan (2010) this is related to unemployment, which encourages people to look for work in the IE. Nonetheless, a few research have revealed a negative correlation. Hassan and Schneider (2016a) examined Egypt, whereas Macias and Cazzavillan (2010) examined Mexico. The widespread unfavourable economic condition, which should or might impact both the official and informal economies equally, explains this link. As a result, a negative association is discovered. The next hypotheses have been proposed:

Hypothesis five: more unemployment rates stimulate the scope of the IE, ceteris paribus.

Because previous research on this relationship were inconsistent in Algeria, this correlation between IE and unemployment warrants more empirical examination.

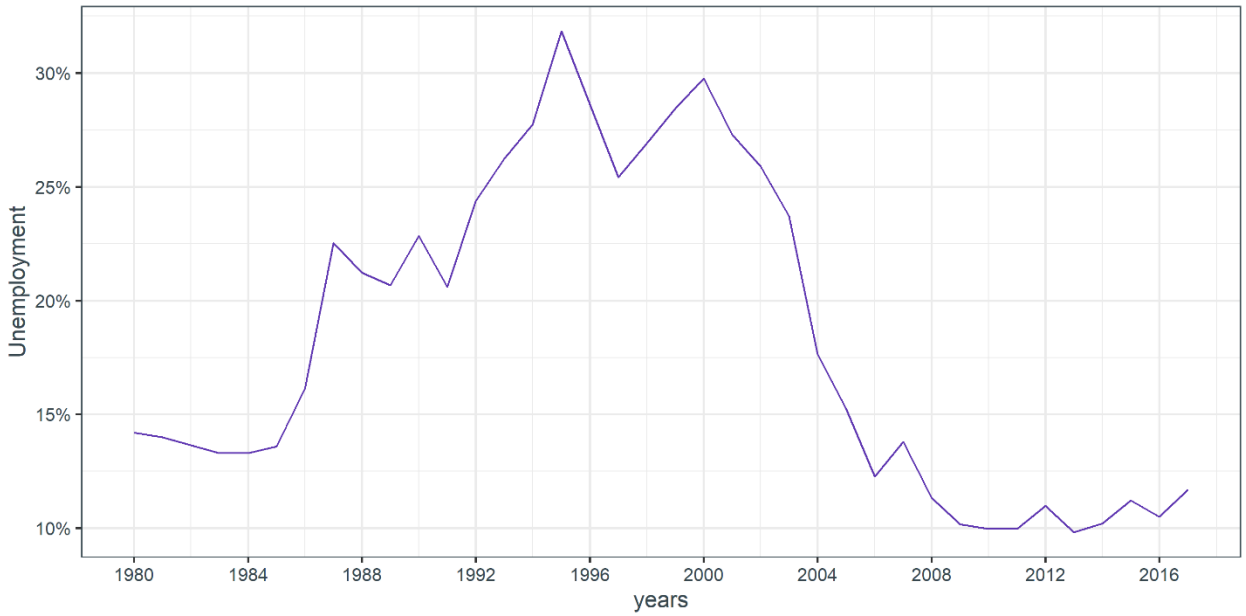

Figure 18 The evolution of unemployment rates from 1980 to 2017.
Source: world bank.

For the second indicator of overall economy, the unemployment rate. Figure 18 provides an important image of the development of this variable over the study period. The highest rates were

registered from 1985 to 2003, in this period the unemployment rate reached almost 35% in 1995. However, in the last years, the unemployment rates stabled between 10% and 12.5%.

3.2.1.2. Reflective Variables

a.**Development of production market (log current GDP):** When employing Structural Equation Modelling (SEM), a scale factor must be fixed in calculate the other parameters as a proportion of the selected scale variable. The formal economy, as measured by Gross domestic product, is used in the majority of research on this topic. Unfortunately, the link between the IE and formal economy remains equivocal; some research discovered a negative association, while others discovered a positive correlation.

The log of current GDP is used in our present research; in light of the findings of Schneider et al. (2010) underdeveloped economies, this relationship is negative. As a result, this parameter is set to be -1, and we use Dell'Anno (2003) approach to find the real sign of the association among the official and IE .The next hypotheses have been proposed:

Hypothesis six: low IE size leads to higher GDP, ceteris paribus.

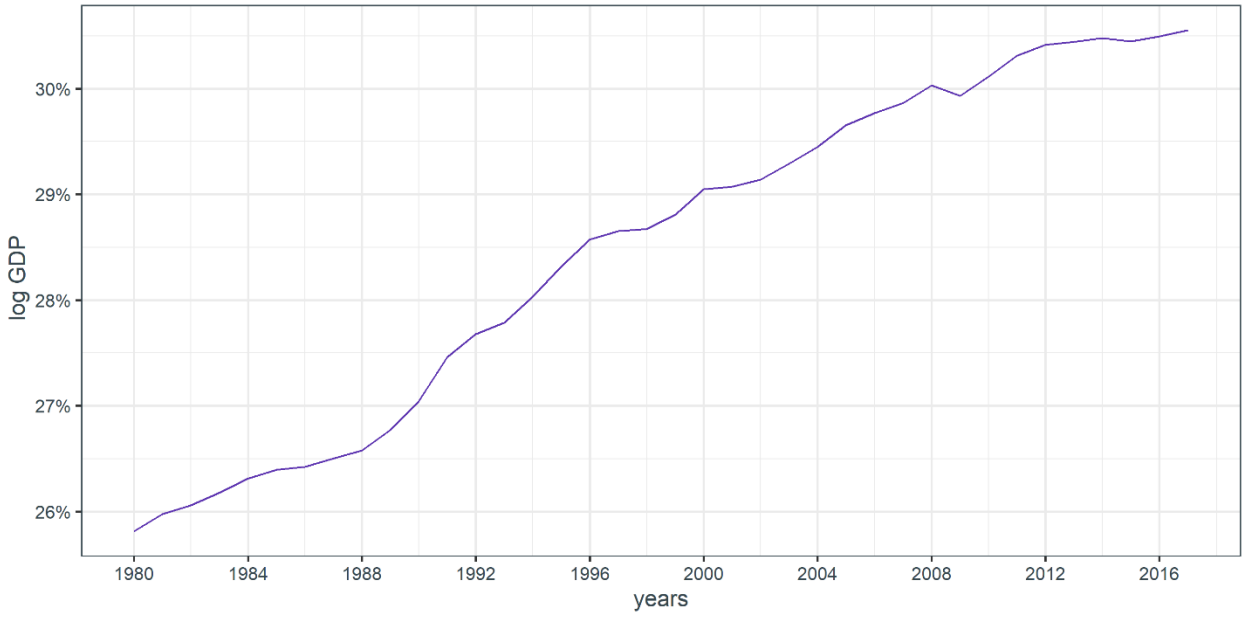

Figure 19 log current GDP from 1980 to 2017.
Source: world bank

From Figure 19 the GDP had a general increasing trend over the period under investigation, with a local decrease in 1986 to 1989 and after 2008 in 2009.

b.**Development of monetary market (LCurr.to M1):** Because those involved in the IE would not want to left no evidence of their activity in this economy, all dealings in this economy are conducted in cash. As a result, a positive indication is anticipated.

In light of the preceding statement, this research utilizes money to as percentage of M1 as a measure of the magnitude of Algeria's IE. The next hypotheses have been proposed:

Hypothesis seven: decreasing the scop of the IE will lead to less demand and use of currency individuals in the economy, ceteris paribus.

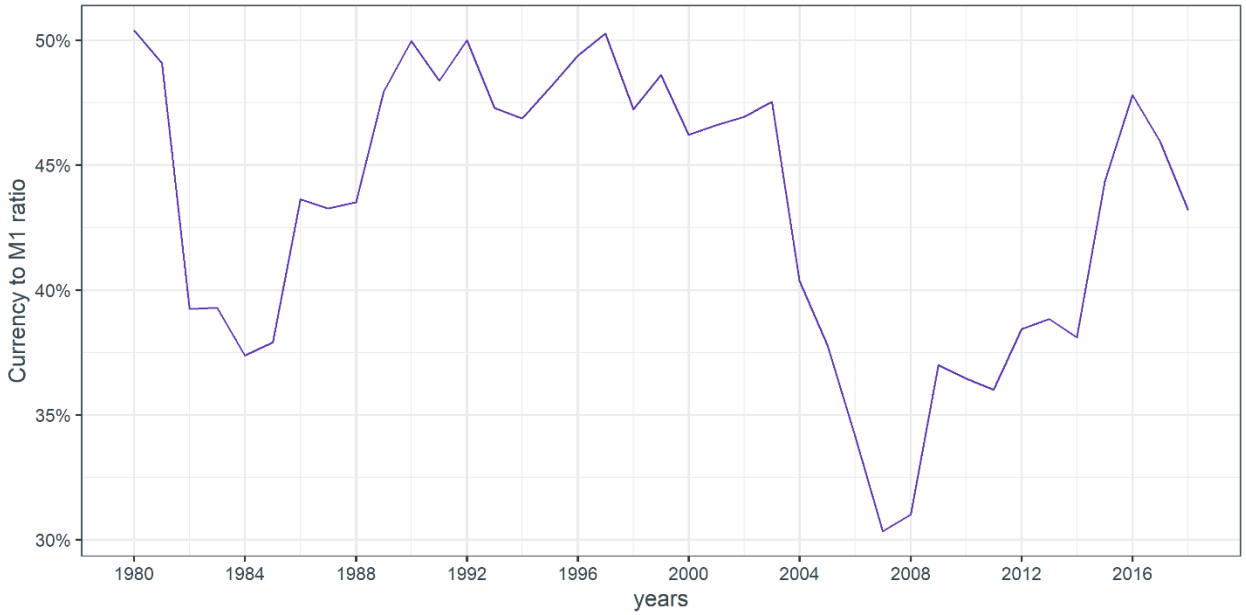

Figure 20 The evolution of currency to M1 ratio from 1980 to 2017.
Source: world bank.

As shown in Figure 20 the currency to M1 ratio decreased in 1984 to 1985 and started to increase again until 1990. After this period in generally had a stable ratio until 2003, where after this year this ratio know an intensive fall until 2007. Following this fall, the ratio of currency to M1 started to increase again until 2016.

c.**Development of the labour market (Emp. as % work. Pop.):** Numerous studies that have looked just at labour force participation rate as an indication of an economy's extent of regulation (Corina and Andrie, 2011; Dell'Anno et al., 2018). It is calculated by limiting the workforce to those of working age (15–64 years old). This association is judged to be favourable in the economic literature.

Employing overall participation rates in the formal economy, the present investigation tests this idea in the example of Algeria. The next hypotheses have been proposed:

Hypothesis hight: Less development of the IE size, the higher employment rates will be, ceteris paribus.

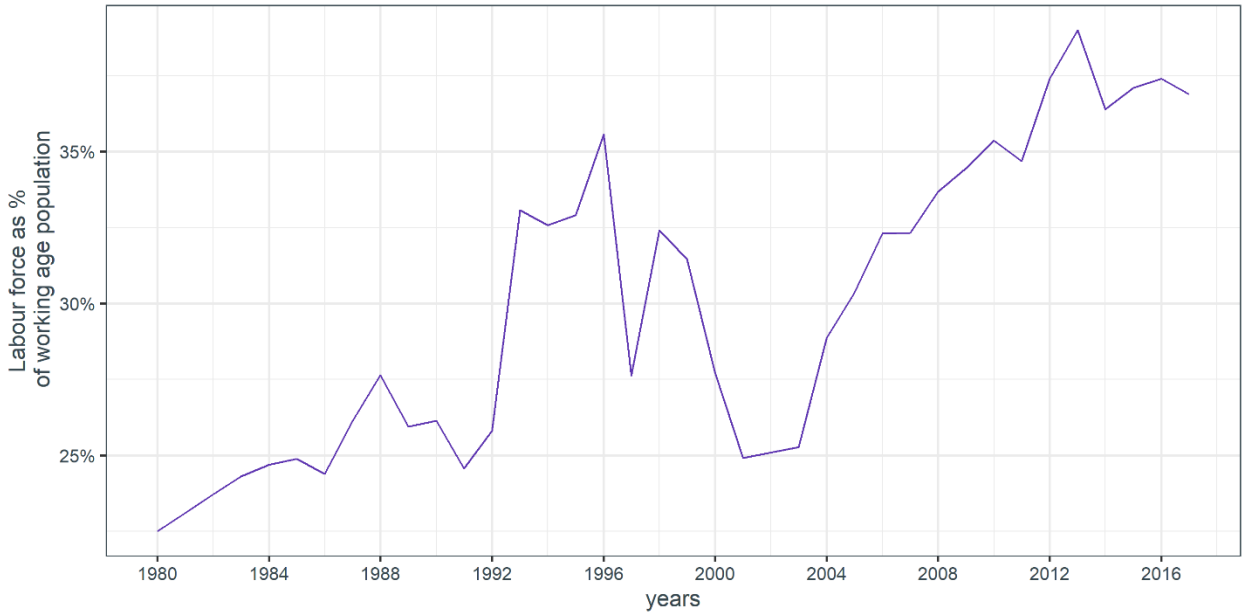

Figure 21 The evolution of employment rates from 1980 to 2017.
Source: world bank.

From Figure 21 above, the employment ratio in general had an increasing trend with local falls in 1991, 1997 and from 1999 to 2003. After 2003, this ratio had a positive trend and reached its highest percentage in 2013.

As a result, the current study's theoretical model is constructed using five exhibited causes, three manifested indicators, and one latent variable, the IE. As illustrated in Figure 22, the basic theoretical model is (MIMIC 5-1-3). In addition to the above reasons, a dummy variable to reflect the influence of the shift from socialism system to capitalism system, government spending, urbanization rate, and inflation were introduced. Nonetheless, they were not statistically significant.

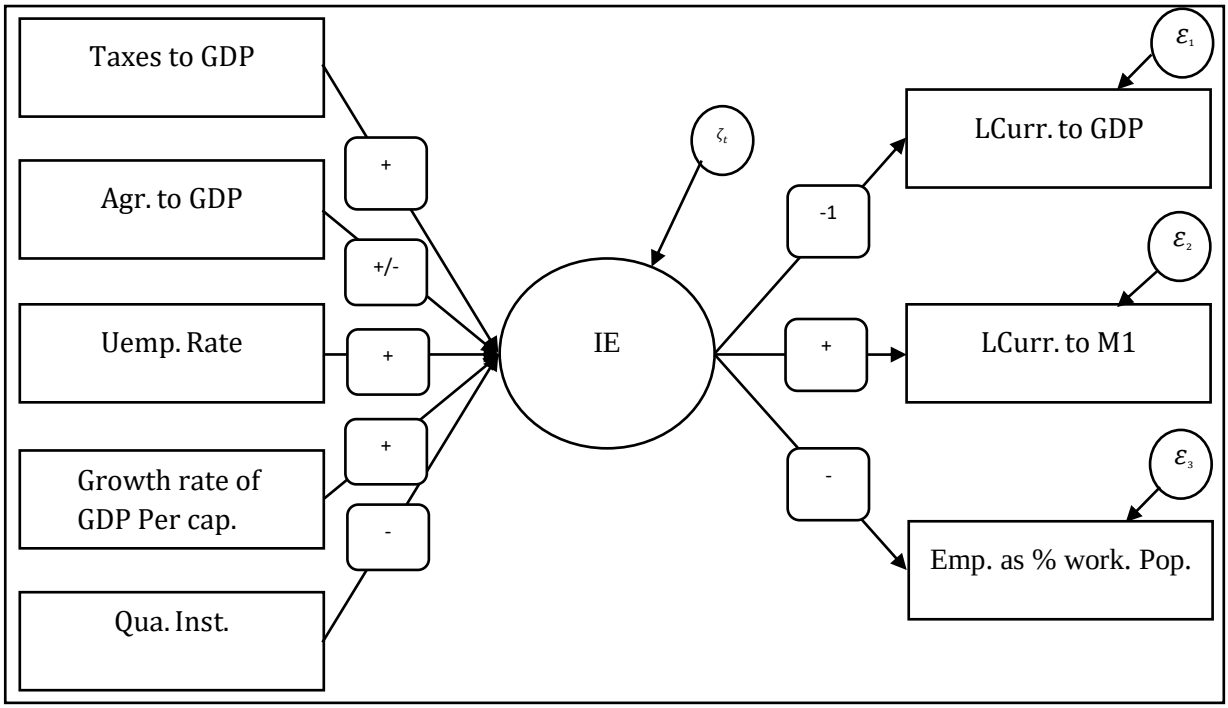

Figure 22 The theoretical MIMIC model proposed.
Source: Author's own construction.

Table 15
Descriptive statistics of the data; yearly observations.
Source: Authors own calculation based on the national office of statistics and world bank data

Variables	Mean	Median	Max	Min	Skew	Kurtosis	S-W	Obs.
Causes								
Taxes to GDP	3.87	3.01	6.49	1.99	0.44	1.68	0.874	38
Agr. to GDP	9.52	9.59	12.27	6.57	0.08	1.97	0.965	38
Uemp. Rate	18.34	15.71	31.84	9.82	0.32	1.60	0.890	38
Growth rate of GDP Per cap.	0.69	1.25	5.84	-4.25	-0.33	2.63	0.959	38
Qua. Inst.	1.70	2.00	3.00	1.00	0.08	2.37	0.769	38
Indicators								
LCurr. to GDP	28.49	28.74	30.55	25.74	-0.28	1.64	0.904	38
LCurr. to M1	3.76	3.81	3.92	3.41	-0.73	2.55	0.893	38
Emp. as % work. Pop.	29.97	29.60	39	22.51	0.17	1.60	0.916	38

Notes: all the Data displayed are in level. Obs.: is observations. S-W is the Shapiro-Wilk test normality

Table 15 gives descriptive statistic for the time series data utilized in the MIMIC model. Besides the unemployment rate, the mean and median are nearly identical throughout all variables. The

range of the following variable is also the longest in the dataset. This comment signifies that more research is required. Over all factors, the skewness and kurtosis values are within the reasonably expected range. According to the Shapiro-Wilk univariate normality test, only per capita income and agricultural sector are normally distributed (p-value > 0.05).

3.2.2. Method

The MIMIC model is a particular case of the Linear Interdependent Structural Relationships LISREL models. Jöreskog and Goldberger (1975) model is primarily composed of two distinct equations: the first is known as the measurement equation, and it correlates the unobserved variables with a collection of manifested indicators.

$$\eta = \gamma' x + \zeta \tag{20}$$

Where η is the latent variable, x is a $(1 \times q)$ vector of observable causal variables, γ is $(1 \times q)$ vectors of structural parameters, and ζ is white noise.

The causal link among the unobserved variables is defined by the second equation. The structural equation is the name given to the latter equation. There is just one unseen variable in the current investigation, and that is the IE size. It is supposed to be indirectly observable through a collection of the latter's indicators, capturing the IE's structural reliance on variables.

$$y = \lambda\eta + \varepsilon \tag{31}$$

Where y is a $(1 \times p)$ vector of observed indicator variables, λ is a $(1 \times p)$ vector of regression parameters, and ε is a $(1 \times p)$ The measurement error term is considered to be a matrix of white noise. It should be highlighted that the independence assumption among structural perturbation and measurement error is critical to assess dependability.

The MIMIC's advantages stem from its ability to assess numerous indications at the same time. According to Tedds (1998), in the context of the IE, the outcomes are expected to surface concurrently in several markets, along with the labour market, financial market, and industrial market. Furthermore, the causes are diverse and more complex than simply the tax rate. Further, this technique helps the researcher to select a variety of causes determinants and indicators based on the characteristics of the economy under investigation and the accessibility of data.

Numerous criteria were employed to evaluate the quality improvement in the empirical model. The goodness of fit indicators employed were chi-square, the Tucker–Lewis index (TLI), and the

Comparative Fit Index (CFI). Concerning the last two criteria, values closer to one indicate a good fit. the Standardized Root Mean Square Residual (SRMR) and Root Mean Square Error of Approximation (RMSEA) were used to assess the badness of fit. As stated by Hu and Bentler (1999) values less than 8% indicate reasonable adjustment.

Admittedly, this technique has certain issues when using the MIMIC method to determine the IE. Because the MIMIC methodology is a confirmatory instead of exploratory technique, the scholar is more likely to determine if a given model is efficient than to acquire an appropriate model. A further critique was given by Breusch (2005) and Helberger and Knepel (1988) concerning the stability of the predicted coefficients. They demonstrate that changes in units of measurement or sample size led to different estimations. Besides this, the researcher should determine a proper calibration procedure because the MIMIC model only provides an ordinal series. Over the years, scholars and academics have proposed numerous calibrations or benchmarking approaches to overcome the last and most crucial problem to convert the IE index to a series percentage of formal GDP.

Notwithstanding these shortcomings, the method is still preferred relative to other strategies. The adopted approach has been applied by economists to estimate the scope of the IE in the current decade and is yet applied today.

3.2.3. Results

3.2.3.1. Unit root Tests

Non-stationarity issues in macroeconomic time series can lead to erroneous inference. To prevent this problems, the research investigates non-stationarity with a variety of unit root tests widely used in econometric studies, including standard time series unit root tests like the Dickey and Fuller (1979) (ADF) unit root test and Phillips and Perron (1988) unit root test. In addition, Zivot and Andrews (2002) unit root test that allow for breaks at any point in the constant and/or trend to compensate for the inadequacies of the typical unit root tests utilized.

Table 16 The findings of stationarity properties based on the Augmented Dickey and Fuller, Phillips and Perron, and Zivot and Andrews unit root tests are shown. According to the first two tests, just per capita income is considerably stationary at 5% significance level, whilst however other factors become significantly stationary after taking the first difference of 5% significance level. The findings of the ZA break test confirm the variables' integration state. For all data, the observed time breaks occur during 1990 and 2003, coinciding with the shift from a socialism to a capitalist system and the

programs enforced by the International Monetary Fund in the early nineties. With the exception of per capita income, all variables are differentiable based on the prior results.

Table 16
Unit root tests.
Source: Author's own calculation.

Variables	At levels					
	Augmented Dickey-Fuller		Phillips-Perron		Zivot-Andrews	
	I&T	I	I&T	I	I&T	break
Taxes to GDP	1.118	1.256	-4.047	-3.985	-2.984	1998
Agr. to GDP	1.452	1.563	-10.542	-10.18	-3.464	2004
Uemp. Rate	1.987	0.6347	-3.579	-2.802	-3.001	1991
growth rate of GDP Per cap.	4.219	4.269	-23.567***	-23.325***	-5.982***	1994
Qua. Inst.	11.59***	7.979***	-13.553	-10.584	-3.860	1990
LCurr. to GDP	1.041	5.348	-0.879**	-0.715**	-2.478	1990
Emp. as % work. Pop.	2.816	1.475	-15.164	-4.287	-4.560	1999
LCurr. to M1	2.374	2.422	-8.578	-8.639	-4.161	2003
	First difference					
	Augmented Dickey-Fuller		Phillips-Perron		Zivot-Andrews	
	I&T	I	I&T	I	I&T	break
Taxes to GDP	8.126**	8.043***	-27.313***	-27.363***	-6.595***	1990
Agr. to GDP	14.123***	14.456***	-44.409***	-44.227***	-8.754***	1988
Uemp. Rate	6.449*	5.726**	-31.834***	-31.024***	-6.212***	1999
growth rate of GDP Per cap.	17.930***	18.639***	-42.765***	-42.091***	-8.949***	1986
Qua. Inst.	11.691***	11.945***	-17.458*	-17.450**	-4.82	1988
LCurr. to GDP	7.559**	6.008**	-22.424***	-21.284***	-5.559**	1987
Emp. as % work. Pop.	11.212***	11.577***	-42.925***	-42.921***	-7.771***	2002
LCurr. to M1	9.891***	10.340***	-31.442***	-30.094***	-5.853***	1985

*, **, *** are the 10%, 5%, and 1% significance levels, respectively.

Once checking for stationarity and defining the order of integration of the time - series data, the

MIMIC model can be estimated. Various models were tested and evaluated to determine the optimal model, beginning with the most baseline model (MIMIC 5-1-3) and excluding non-significant causes and indicators. Table 5 displays four of these models. The provided parameters are in standard form, and the multi-normality hypothesis is verified for in each specifications utilising multi-normality tests developed by Mardia (1974) and Henze and Wagner (1997). The findings demonstrate that the data are not distributed equally. As a result, robust maximum likelihood must be used.

Table 17

Model estimation results.
Source: Author's own calculation.

	Model one (5-1-3)	Model two (4-1-3)	Model three (5-1-2)	Model four (4-1-2)
Causes				
Taxes to GDP	0.523***	0.516***	0.505***	0.499***
	(4.562)	(4.42)	(4.475)	(4.354)
Qua. Inst.	0.534***	0.556***	0.477***	0.494***
	(5.507)	(6.357)	(4.79)	(5.544)
Uemp. Rate	0.0104		0.085	
	(0.939)		(0.749)	
growth rate of GDP Per cap.	-0.305**	-0.286***	-0.284**	-0.269**
	(-3.034)	(-2.891)	(-2.749)	(-2.648)
Agr. to GDP	0.365***	0.345***	0.361***	0.344***
	(4.693)	(4.568)	(4.573)	(4.562)
Indicators				
LCurr. to GDP	-1	-1	-1	-1
Emp. as % work. Pop.	0.222*	0.22*		
	(1.807)	(1.768)		
LCurr. to M1	0.39**	0.377**	0.347**	0.34**
	(2.460)	(2.459)	(2.28)	(2.296)
Fit indicators				
χ^2	18.71	16.74	6.28	4.73
	[0.07]	[0.05]	[0.28]	[0.32]
SRMR	0.08	0.08	0.059	0.051
RMSEA	0.14	0.152	0.085	0.07
	[0.10]	[0.08]	[0.33]	[0.27]
TLI	0.747	0.747	0.929	0.95
CFI	0.845	0.848	0.968	0.98
Df	26	19	20	14
R^2	0.865	0.864	0.761	0.76

*, **, *** are the 10%, 5%, and 1% significance levels, respectively. $\chi 2$ is Chi-square. In (.) are Z-scores. R2 is R-square. Df is the degrees of freedom which = 0.5 (q+p) (q+p+1)-j, where q is the indicators number, p is the determinants number, and j is the free parameters number.

Model 4 (MIMIC 4-1-2) is deemed the best model based on the selection criteria. Table 17 shows that the RMSEA is predicted to be 0.07 with a p-value larger than 5%. The two indicators' SRMRs are within the predicted range. CFI and TLI goodness of fit indices are judged to be 0.99 and 0.97, correspondingly, indicating that the model is quite well suited.

As shown in Table 17, all of the included added factors have had the correct predicted sign throughout the four models, and the majority of them are extremely significant, with the exception of unemployment and the employment-to-working-age population percentage, which is statistically significant at the 10% significance level.

Beginning with the causes, it is discovered that the tax burden has a favourable effect on the development of the Algerian IE. This effect is substantial at the 1% significance level in every models. In the chosen model, a one-percentage-point rise in the tax burden affects the volume of the IE by 0.52 percent, all else being equal. The agricultural industry is the second - leading cause. This has been proven to have a favourable effect on the IE. This influence is considerable at the 1% level for all four criteria. A one percent growth in agricultural sector raises the IE by 0.48 percent, all else being equal. Another significant factor is the quality of institutions. In other words, a one percent growth in the previous variable raises the IE by 0.31 percent. As previously indicated, owing to Algeria's widespread corruption, this factor does have a positive and significant influence at the 1% significance level. In all models Schneider (2005), GDP per capita has the anticipated sign for the reasons representing the condition of the official economy, and it is found to be significant at the 5% significance level. As mentioned, a raise in GDP per capita reduces the IE. This effect is projected to be 0.227 percent in the Algerian case. Lastly, throughout all models, unemployment is observed to have significant positive although non-significant influence on the growth of the Algerian IE. This suggests that unemployment has no effect on the IE in the country under study.

When it comes to the indicators, both have the correct sign. Only log currency normelized by M1 is statistically relevant at the 5% level. A 1% improvement in IE quality raises monetary demand by around 33%. It indicates that people utilize cash in their dealings in the IE The calculated model is depicted in Figure 23 below.

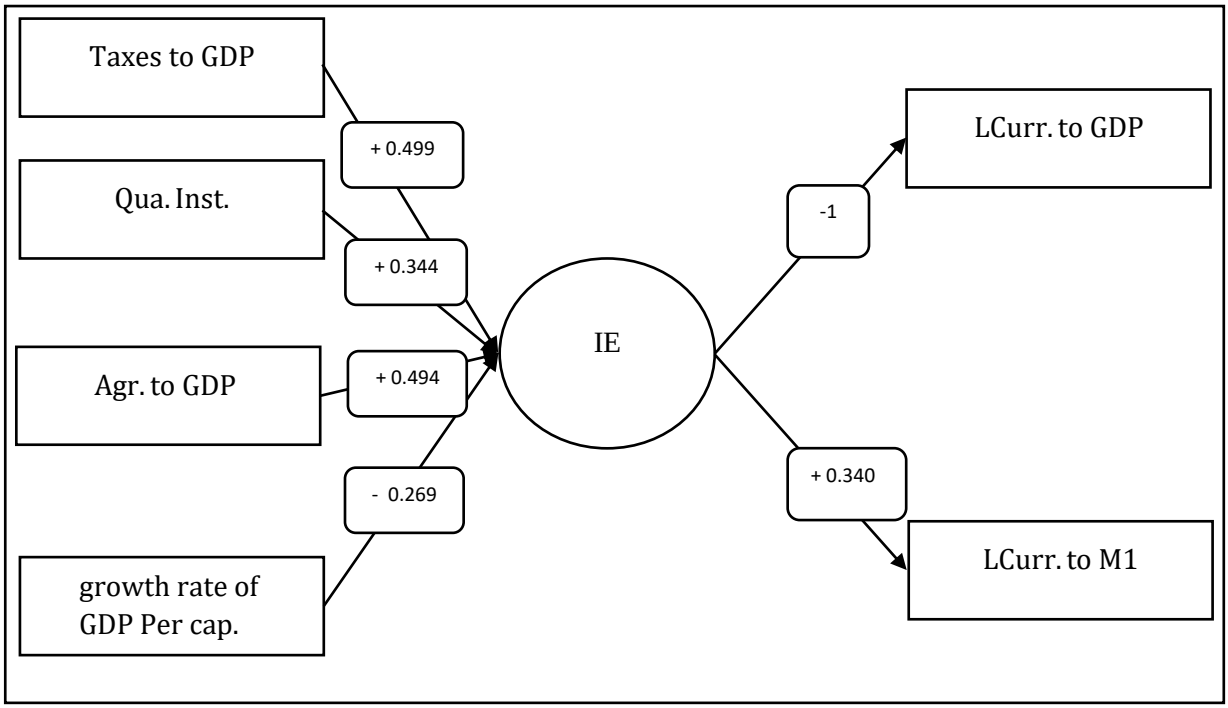

Figure 23 The empirical MIMIC model.
Source: Author's own construction.

3.2.3.2. The Size of the Algerian Informal Economy using MIMIC approach

Based on the above the structural equation of the selected model is written as:

$$\text{A.}\frac{\Delta\tilde{\eta}}{GDP_{2002}} = 0.499\Delta Tax\ burden + 0.494\Delta Agriculture + 0.344\Delta Quality\ of\ institutions - 0.269\Delta Per\ cap\ incom \quad (32)$$

The index of IE is calculated by structural equation (3) and the determinant variables are in the first difference; thus, the unobserved variable is estimated at the same level.

The magnitude of the IE is estimated utilizing equation adopting the technique of Dell'Anno et al. (2007) . (32). An exogenous value is required to obtain actual scope of the IE as a proportion of recorded GDP. To ensure honesty, we picked a year that meets two criteria. The first criterion is that numerous estimates are available, and the second is that they be near to one another. The year used as the baseline is 2002, when the IE is anticipated to be 31.9 percent of GDP (Medina and Schneider, 2018).

$$\frac{\tilde{\eta}_t}{GDP_{2002}}\left[\frac{\eta^*}{GDP_{2002}} \times \frac{GDP_{2002}}{\tilde{\eta}_{2002}}\right]\frac{GDP_{2002}}{GDP_t} = \frac{\hat{\eta}_t}{GDP_{2002}} \quad (33)$$

Where:

$\frac{\tilde{\eta}_t}{GDP_{2002}}$ Is the value computed using Equation 32.

$\frac{\eta^*}{GDP_{2002}}$ Medina and Schneider 2018 provide an external estimate of 31.9 percent.

$\frac{GDP_{2002}}{\tilde{\eta}_{2002}}$ Is the computed value using equation 32 in 2002.

$\frac{GDP_{2002}}{GDP_t}$ Is possible to translate the informal economy index as a shift from the baseline year in terms of current GDP.

$\frac{\hat{\eta}_t}{GDP_{2002}}$ Is the predicted IE expressed as a proportion of the reported GDP.

Figure 24 compares the estimated findings to prior estimates of the IE in Algeria using the MIMIC model. The latest estimate, as given, has the largest time period, spanning from 1980 to 2017. With the exception of Quintano and Mazzocchi (2014) estimates, the graphic suggests that the volume of IE began to increase in 2005.

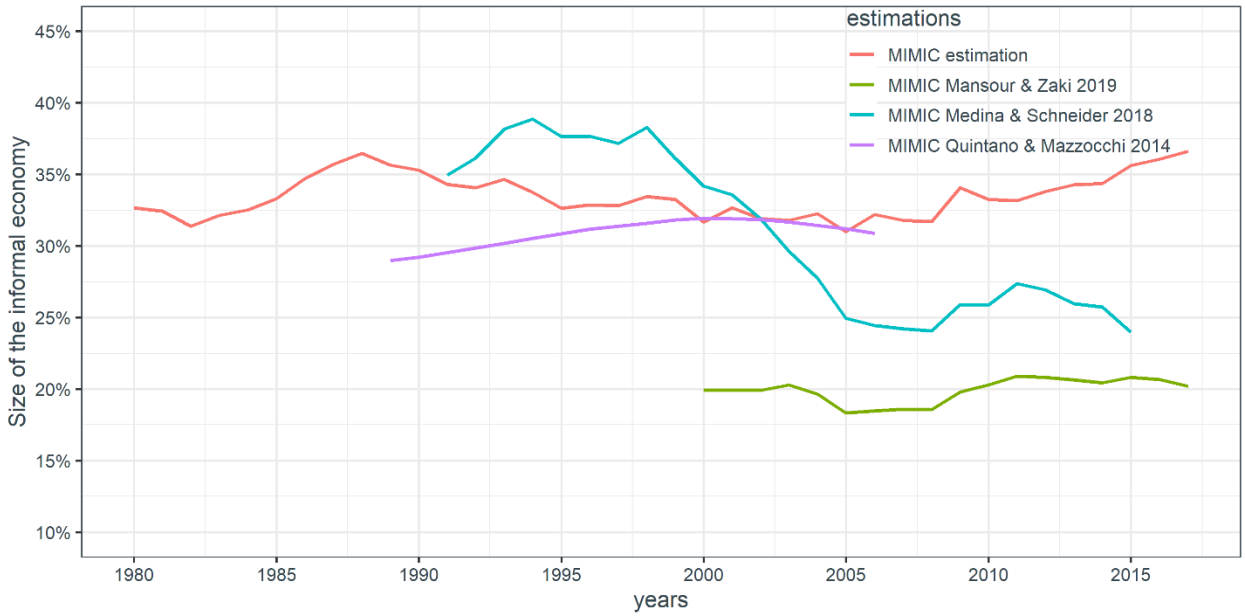

Figure 24 MIMIC estimation in comparison with other studies that used the same approach.
Source: Author's own construction.

Figure 25 depicts the expected magnitude of Algeria's IE from 1980 to 2017. It should be mentioned that the IE swings from 31 and 37 percent over this time frame, with a mean of 33.48 percent, with the greatest rate in 2017 and the smallest in 2005. The strucchange package developed by Zeileis, Leisch, Hornik, and Kleiber (2002) is being used to analyze the characteristics of the informal

activities, which performs the method given by Bai and Perron (2003). The findings indicate to five major breakpoints and two negative shocks that lowered the IE from 1994 to 2000. This period saw two major structural tax reforms, the first in 1992 and the second in 1994, as well as three positive shocks, the first in 1985 in conjunction with an oil price shock, and the second and third in a row beginning in 2007 in conjunction with the economic crisis of 2008 and lasting till the 2017. The MIMIC estimate agrees with our prior estimate based on the CDA with a linier association of 60% statistically significant at the 1% significance level.

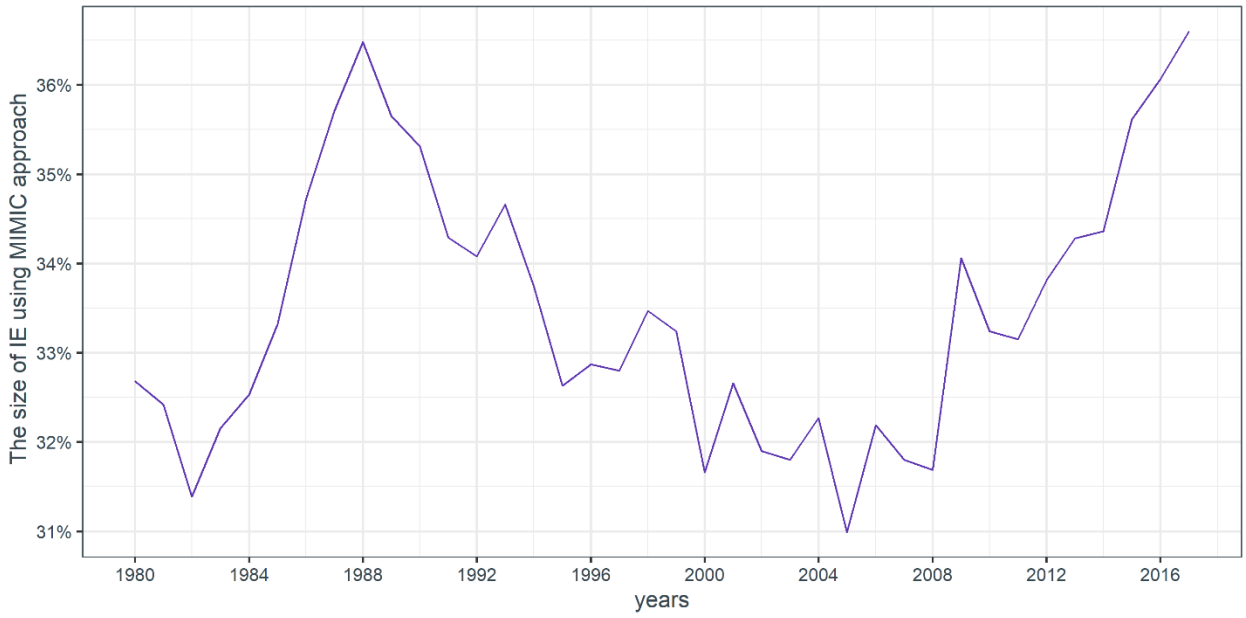

Figure 25 The size of the informal economy using MIMIC approach.
Source: Authors own construction.

3.2.3.3. Robustness Check

Many further investigations were carried out to ensure the findings' validity. Which included a stability analysis in which the time frame was changed by having dropped observational data at the begin and end of the period of study; evaluating the selected model without GDP per capita as a source of informality over the original period studied; re-estimating the four models employing data in standared form with; and re-estimating the MIMIC model employing the different factors in growth form.

As a first step, the results' stability was checked by removing data at the start of the original period; the outcomes are shown in Table A1. All of the factors are statistically significant throughout all sub-periods, as indicated. Nevertheless, once observations are dropped at the end of the

research period (Table A2), the model displays poor fitness and the Lurr to M1 becomes trivial, despite the fact that other causative factors remain statistically significant.

As a second step, determine whether the model has a recognition problem. Model four was re-estimated omitting GDP per capita for the original research period, 1980–2017; the reported in table A3. The findings revealed that the model omitting GDP per capita has an influence on the badness of fit criteria, with TLI and CFI increasing from 0.102, 0.65 to 0.07 and 0.051, correspondingly.

Finally, all models were re-estimated employing data in the standard form with to test the robustness of the calculated parameters. Model four is still the best model in Table A4. Moreover, all of the goodness of fit and badness of fit criteria outperform the initial Table A5 values. GDP per capita, on the other hand, is insignificant, as seen in the same table using data in growth form. Additionally, in compared to earlier model predictions, the TLI and CFI criterion are acceptable.

3.3. Discussion

After employing the two selected macro-approaches to investigate the determinants and evolution of the IE in Algeria, the results showed some significant results.

On the one hand, the results of the CDA approach were in line with the economic theory and the findings of the previous empirical investigations, except for inflation and interest rate. taxes are found to be a significant source of informality in Algeria, and a one per cent rise in taxes would lead to a rise of 35% in the currency demand. As stated by Buehn and Schneider (2012), the difference among total labour cost in the IE and income after removing taxes is an important point in pushing people to engage in the informal activities. Consequently, more taxes on individuals' revenue encourage people with low income to purchase goods and services from the IE. Over our selected period, the Algerian government made many changes and adjustments to the tax system. These changes are observed to impact Algerian IE, such as the 1987 tax reform and the National Committee for Tax Reform creation. This effort had a significant impact on reducing the IE size over the next five years, except in 1989 where the IE size know a pick in its size and almost doubled in size, reaching 40% of GDP; this can be explained by the Algerian government efforts to shift towards a market-based economy and to reform the structure of its economy. On the contrary, the 1992 tax reform stimulated the size of IE, and the social instability experienced during this period, the size of IE started to increase again. The 90s structural reforms, such as the structural adjusted program in 1994 and the tax system review, led to a decrease of IE from 1995 to 2005, except in 1998. After that, the IE in Algeria knows a continuous

upward trend in its size. Furthermore, the tax reforms over this period are ineffective and did not reduce the size of this phenomenon.

As suggested by Tanzi (1980), the development of the official economy positively impacts the size of the IE; hence, the second hypothesis of the CDA model is also verified. Accounting for the Characteristics of the Algerian economy, the non-oil GDP was selected to reflect the development of the formal economy. This result supports Bennihi and Bouriche (2019) findings on the impact of non-oil GDP on IE size in Algeria.

Surprisingly, inflation had no impact on the size of the IE in Algeria, which is contradictory with the model hypotheses and the preview studies (Dell'Anno and Halicioglu, 2010; Gamal et al., 2019). However, in literature, the impact of inflation on IE size is ambiguous it can also have a positive impact on IE because inflation wears down the actual value of nominal disposable income, which gives individuals the incentive to evade more taxes to restore their purchasing power and this was supported by studies of Buehn and Schneider (2012). Nevertheless, the study is not in line with these studies because the impact of inflation on IE was found positive but insignificant, making it very difficult to infer conclusions. Furthermore, the lack of studies on the relation between IE and inflation in the Algerian case limits the interpretation and calls for further investigation.

The model also produced a contradictory result concerning the impact of the nominal interest rate on IE, in which the results suggested a positive impact of interest rate on the Algerian informal. However, this result was also found by Boudlal (2012). One can explain this by the culture of individuals who prefer to invest their money to finance businesses or start their own informally rather than through banks due to the lack of confidence in the banks and their systems.

Taxes are a significant source of informality in Algeria, although they were measured differently. The CDA model estimated a one per cent rise in taxes would lead to a rise of 35% in the currency demand, where the MIMIC results revealed a one per cent growth in the direct and indirect taxes will lead to a rise in the scope IE by 0.52%. Hence, the tax burden is the most important source of informality in Algeria. The results found are supported by the economic literature and support the findings of Boudlal (2012) about the effect of the tax variable on the Algerian IE, while they contradict with the findings of Bounoua et al. (2014), Kori (2018) and Ziad and Dahmani (2019) who found the Tax variable does not affect the size of the IE in Algeria.

The agriculture sector is the second - leading cause. This has been proven to have a favourable effect on the IE. The agriculture sector has a favourable influence on the Algerian IE, as it has in Morocco, Yemen, and Egypt (Angour and Nmili, 2019; Medina and Schneider, 2019), Over the last years, the government has attempted to diversify its economy away from the hydrocarbons industry, and agriculture is one significant area on which the government may rely to minimize its reliance on oil industry exports. Present analysis shows that boosting the agriculture share resulted a growth in the IE; this is due to the fact that the vast majority of employees in the agriculture are undeclared labour, and there is- until today- no official and effective mechanism for managing this portion of labour in this significant sector, adding to the previous issue the problems raised due to bad bureaucracy in regulating this part of the economy.

The quality of institutions is the third most significant source of informality. As previously stated, due to Algeria's important levels of corruption, this factor has a considerable beneficial influence. Dobre and Adriana (2009) discovered this finding in the instance of Japan, which similarly has a high prevalence of corruption.

GDP per capita is shown to have the predicted sign in all models for the two measures of the economy at large. (Schneider, 2005), and it is statistically significant at the 5% level. As a result, partaking in informal activities is dependent on the IE's position. During a recession, people try to compensate for lost money in official activities by participating in the IE. However, if the economy recovers, these people will be less active in informal enterprises owing to increased prospects for revenue in the formal economy. where In Algeria, unemployment has a positive but non-significant effect on the size of the IE. When the work force in the IE is diverse, this modest statistically significant difference is discovered. A deeper examination at this labour force finds that some are technically jobless; others are housewives who are not part of the regular workforce, retired persons, foreigners, and those who work in both the formal economy and the IE. (Torgler and Schneider, 2007; Wang et al., 2006), It corresponds to the Algerian case Looking back at Algeria's unemployment history, it is clear that it was not steady, particularly in the 1990s. This is owing to Algeria's shift from a socialist to a capitalist economy, as well as economic changes that resulted in the closure of numerous enterprises and the layoff of roughly 2,000 people. Additionally, social and political volatility occurred throughout this time period, complicating matters even further. Since 2000, the Algerian government has decreased unemployment through recruiting in the government sector; this program has had a short-term impact on unemployment rates. That being said, in the long run, it is ineffective since the

government sector cannot keep up with the increase of the workforce. Furthermore, the rules put in place to balance the demand for employment and the supply of employment opportunities are ineffectual. This, in addition to the decline in purchasing power, has prompted many to engage in the IE.

As a result, all theories are proven (see Table 18). However, the second hypothesis, which asserts that a rise in unemployment rates would lead to an increase in the IE, is inconclusive due to a lack of statistical significance; this may be taken as a rise in unemployment rates does not definitely raise the IE in Algeria." The same outcome was discovered by Hassan and Schneider (2016a) in Egypt. Moreover, Medina and Schneider (2018) indicated that for emerging nations, the unemployment rate is a small relevant causative variable. Even though the discovered indicator is consistent with past findings, more research is required.

Table 18
Results of hypothesis testing.
Source: author's own construction.

Hypothesis	Expected sign	Result
Hypothesis one	Positive	Confirmed
Hypothesis two	Positive / negative	Positive insignificant
Hypothesis three	Positive	Confirmed
Hypothesis four	Positive	Confirmed
Hypothesis five	Negative	Confirmed
Hypothesis six	Negative	Confirmed
Hypothesis seven	Positive	Confirmed
Hypothesis hight	Negative	Confirmed

Taking a look at the estimation findings of the CDA and the MIMIC approaches. In Algeria, the average size of IE is considered to be 21 percent of official GDP, whereas the MIMIC method estimates it to be 33.48 percent of official GDP. Because the CDA model only accounts for one source of informality, it is understood as the lower bound of the IE, as opposed to the MIMIC model, which allows for additional determinants. This is plainly demonstrated in Figure 26 below. Furthermore, the correlation data revealed that the correlation coefficient is 60% and significant at the 1% level, confirming our findings even further.

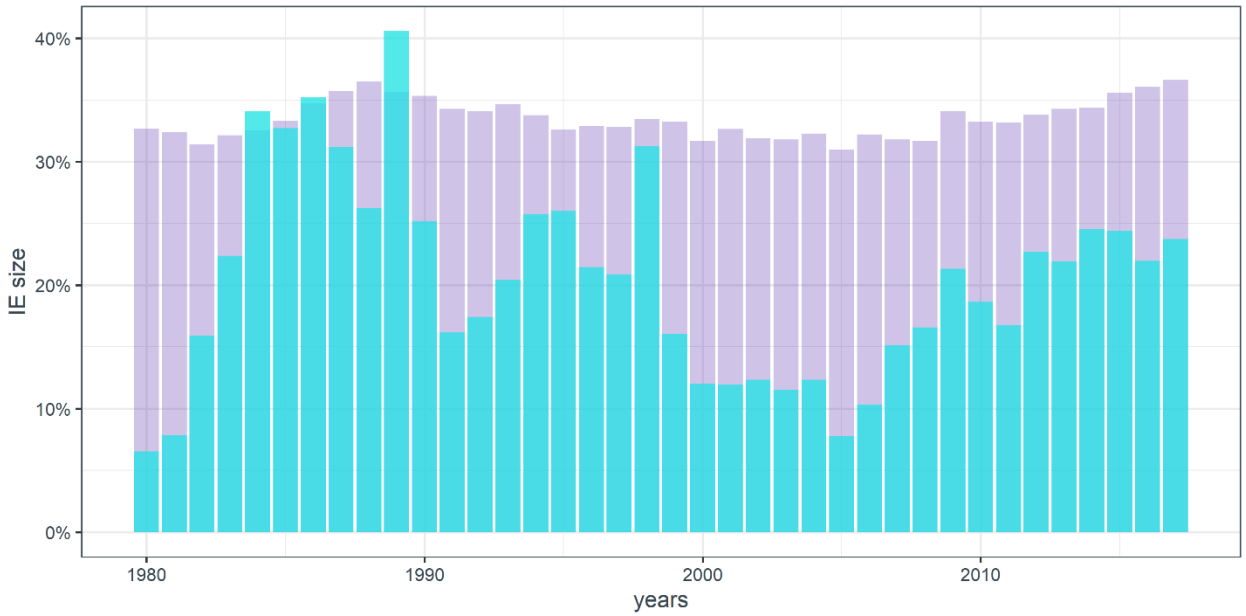

Figure 26 Comparison between the CDA and MIMIC estimations from 1980 to 2017.
Source: Author's own construction.

3.4. Interrelation among official and informal economy

3.4.1. Econometrical influence of the official economy on the IE

After estimating the size and evolution of the IE, the next logical thing is to investigate the Interrelation among official and informal economy in the case of Algeria.

For the purpose of measuring the influence and interaction between the official economy and the IE in Algeria, the study proposes the use of a growth model. The proposed model contains several exogenous variables employed in the economic theory, such as gross capital formation (gcf_t), government final consumption (gfc_t), inflation (π_t)[1], human capital reflected by secondary education (se_t), the scope of the IE measured by the second adopted approach in our study the MIMIC approach (ie_t) [2], and the GDP per capita in constant USD ($gdppc_t$) as the variable to be explained. All of the preceding factors were log transformed in accordance with economic theory. The model could be mathematically represented as follows:

[1] Due to the excessive serial correlation in the residuals caused by the inflation rate variable, it was removed from the original model.

[2] Other factors, such as inflation, population, and employment, were removed since their existence produced autocorrelation problem, which resulted in poor model performance.

$$\ln gdppc_t = \beta_0 + \beta_1 lnie_t + \beta_2 lngfc_t + \beta_3 lngcf_t + \beta_4 lnse_t + \varepsilon_t \quad (34)$$

Where $\beta_i\ i = 1,4$ are the model parameters to be estimated, β_0 is the intercept, and ε_t is the error term.

Notably, in a new research made by Mughal and Schneider (2020), it is revealed that in the short-run and long-run the it existence an asymmetric impact of the IE and on the official economy (OE). To accommodate for such asymmetrical impact, the growth model can be estimated using the autoregressive distributed lag (ARDL) approach established by Pesaran et al. (1996) which was then refined by Pesaran et al. (2001) by including bounds testing methodologies. As a result, equation (35) is written in the form:

$$\begin{aligned} D\ln gdppc_t = \alpha_0 &+ \sum_{i=1}^{p1} \alpha_{1i} D\ln gdppc_{t-i} + \sum_{i=0}^{p2} \alpha_{2i} D\ln ie_{t-i} + \sum_{i=0}^{p3} \alpha_{3i} Dln\ gfc_{t-i} \\ &+ \sum_{i=0}^{p4} \alpha_{4i} Dlngcf_{t-i} + \sum_{i=0}^{p5} \alpha_{5i} lnse_{t-i} + \beta_1 \ln gdppc_{t-1} + \beta_2 \ln ie_{t-1} \\ &+ \beta_3 \ln gfc_{t-1} + \beta_4 lngcf_{t-1} + \beta_{5i} lnse_{t-1} + \varepsilon_t \end{aligned} \quad (35)$$

Where: α_0 is the intercept term; α_j are the short-run dynamics coefficient; β_r are the long-run dynamics coefficients; D is the delay operator; ε_t is the white noise. The lag length for each factor of the ARDL model (P1, P2, P3, P4, P5) is selected based on the SIC with a maximum lag number of 4 lags.

The Autoregressive Distributed Lag approach necessitates all the added factors in the model to be at most I (1). Therefore, the unit roots tests of Dickey and Fuller (1979) and Phillips and Perron (1988) were employed to ensure the validity of this condition in our data . Furthermore, To test the cointegration among the model's variables, the bounds cointegration approach of Pesaran et al. (2001) is adopted, which in founded on the partial F-test under the null of $H_0: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$, which means the absence of cointegration, against the alternative hypothesis of $H_1: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$, which states the presence of cointegration. Accepting or rejecting the null hypothesis is founded on F- statistics. There is no cointegration when the F-statistic value is smaller than the lower threshold, but once the F-statistic value exceeds the amount of the upper bound value, this indicates that cointegration exists among the variables, and. The conclusions are confusing if the F-statistic falls in between top and the bottom bounds.

Secondary education and gross capital formation are supposed to show a positive trend, according to economic theory. Government consumption, on the other hand, is predicted to show a negative trend. With an absolute value of less than one, the ECT (error correction term) based on the statistical theory is expected to be negative and significant. As for our variable of interest, the research is divided on whether it should have a negative or positive impact on the official economy; so, we can predict either.

Table 19
Growth model unit root tests.
Source: Authors own construction.

Variables	At levels					
	Augmented Dickey-Fuller			Phillips-Perron		
	I	I&T	none	I	I&T	none
$lngdppc_t$	-1.0101	-1.5113	0.9529	-0.2455	-1.3032	1.1593
$lnie_t$	-1.2663	-1.3323	0.6978	-1.4250	-1.4344	0.7257
$lngfc_t$	0.3435	-2.0239	4.4844	0.2592	-1.6603	4.1285
$lngcf_t$	0.3955	-1.0543	1.4040	0.7487	-1.1065	1.9113
$lnse_t$	-4.9755***	-2.2578	3.3918	-4.9755***	-2.3948	2.1489
$d\pi_t$	-2.6517*	-2.9412	-1.0369	-2.6450	-3.0013	-1.0468
	First difference					
	Augmented Dickey-Fuller			Phillips-Perron		
	I	I&T	none	I	I&T	none
$lngdppc_t$	-3.2339**	-3.2865*	-3.0911***	-3.2961**	-3.3391*	-3.1119***
$lnie_t$	-6.5556***	-2.8230	-6.5344***	-6.5295***	-6.5208***	-6.5116***
$lngfc_t$	-4.8994***	-4.9536***	-3.6895***	-4.8970***	-4.9086***	-3.6121***
$lngcf_t$	-3.8449**	-4.3983**	-3.5393***	-3.8512**	-4.3030**	-3.5189***
$lnse_t$	-3.1475**	-3.8467**	-2.9143***	-3.1475**	-3.8467**	-2.9143***
$d\pi_t$	-8.5426***	-8.4394***	-8.6565***	-8.5426***	-8.4394***	-8.6565***

*, **, *** are the 10%, 5%, and 1% significance levels, respectively.

3.4.1.1. Empirical estimation

Table 19 displays empirical outcomes of the Augmented Dickey-Fuller and Phillips-Perron unit root testing. Except for the secondary education variables, which are stationary at level I (0), all of the variables are integrated of the first order I (1) at the 5% significant level; Consequentially, the Autoregressive Distributed Lag limits testing technique is appropriate for the study model estimation. Table 20 shows the outcomes of the limits test for cointegration; as shown in the previous table the upper critical value of F-statistic is 5.532, which is lower than the calculated F-statistic 6.6113 at 1% significance level; hence, the existence of cointegration is confirmed.

Table 20
Bounds co-integration test.
Source: Author's own calculation.

Calculated F-statistic		
6.6113		
	K=4; Obs.=34	
Significance level	I(0) bound critical value	I(1) bound critical value
10%	2.46	3.46
5%	2.947	4.088
1%	4.093	5.532

Panel 3 of Table 20 indicates that our estimated model managed to pass the normality test (Jarque-Bera test), heteroscedasticity test (Breusch-Godfrey Serial Correlation LM tests) (ARCH test), and autocorrelation problem (Breusch-Godfrey Serial Correlation LM tests). Furthermore, the CUSUM and CUSUM of squares graphs, which are shown in Figures 27 and 28, indicate that the model is steady. As demonstrated in Table 21 panels 1 and 2, the projected sign of gross capital creation and government final consumption is correct in the short and long term, however the expected sign of the secondary educational factor is incorrect. With the exception of secondary education, which is statistically negligible in the long term. All of the added factors in the model have a statistically significant influence on the official economy at a one percent significant level. As shown in short-run analyses, the empirical findings revealed that gross capital formation and final government consumption have the right theoretical sign.

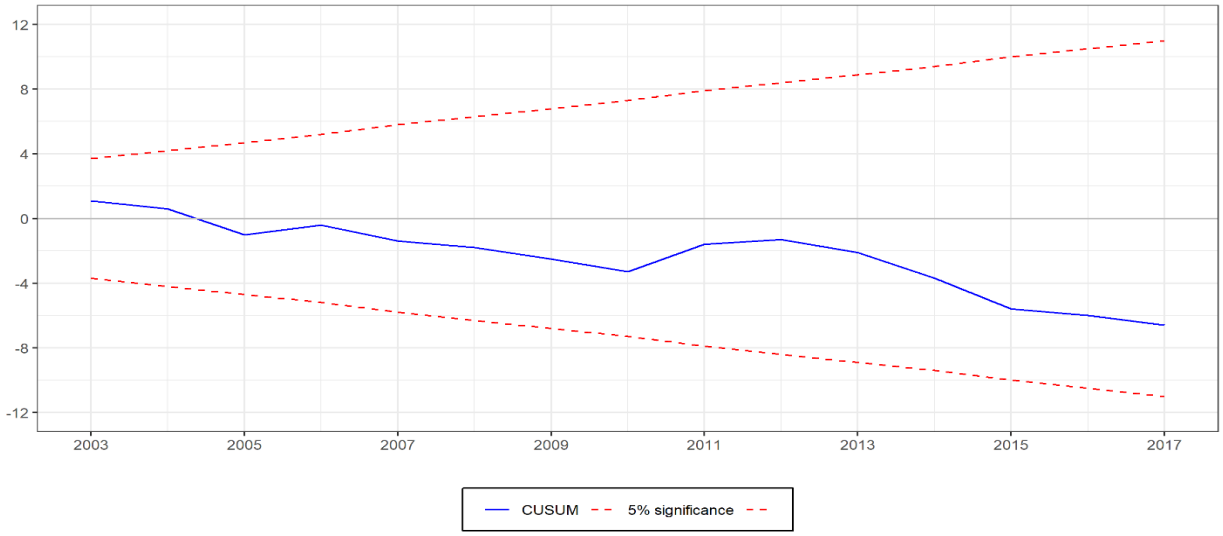

Figure 27 CUSUM stability test.
Source: Author's own construction.

Table 21
Long and short run estimates.
Source: Author's own calculation.

Panel 1: ARDL (4,4,4,2,0) long-run estimated parameters				
intercept	$lnie_t$	$lngfc_t$	$lngcf_t$	$lnse_t$
6.5938***	-0.5695***	-0.1096***	0.2602***	-0.008
(13.3908)	(-4.0499)	(-4.3878)	(19.2246)	(-0.9652)

Panel 2: ARDL (4,4,4,2,0) short-run estimated parameters				
Lags	0	1	2	3
$dlngdppc_t$		0.3991***	0.0989	0.2430**
		(3.5085)	(0.8967)	(2.6496)
$dlnie_t$	-0.3124***	0.2731***	0.3092***	0.2128**
	(-4.6298)	(3.3350)	(4.1825)	(2.8129)
$dlngfc_t$	-0.1197***	0.0774*	-0.0651	-0.1385***
	(-3.6180)	(2.1732)	(-1.7173)	(-3.4630)
$dlngcf_t$	0.1348***	-0.0631		
	(7.4684)	(-2.2938)		
$dlnse_t$				

Panel 3: Diagnostic statistics						
DW Sta	Adj-R2	F-Sta	χ^2_{LM}	χ^2_{JB}	χ^2_{ARCH}	ECM(-1)
1.8073	0.9950	371.0487	3.0141	1.83	0.32	-0.7986
		[0.00]	[0.22]	[0.4]	[0.57]	

Notes: ***, **, *means statistically significant at 1%, 5% and 10
values between (.) are calculated t-statistics
values between [.] are calculated p-values

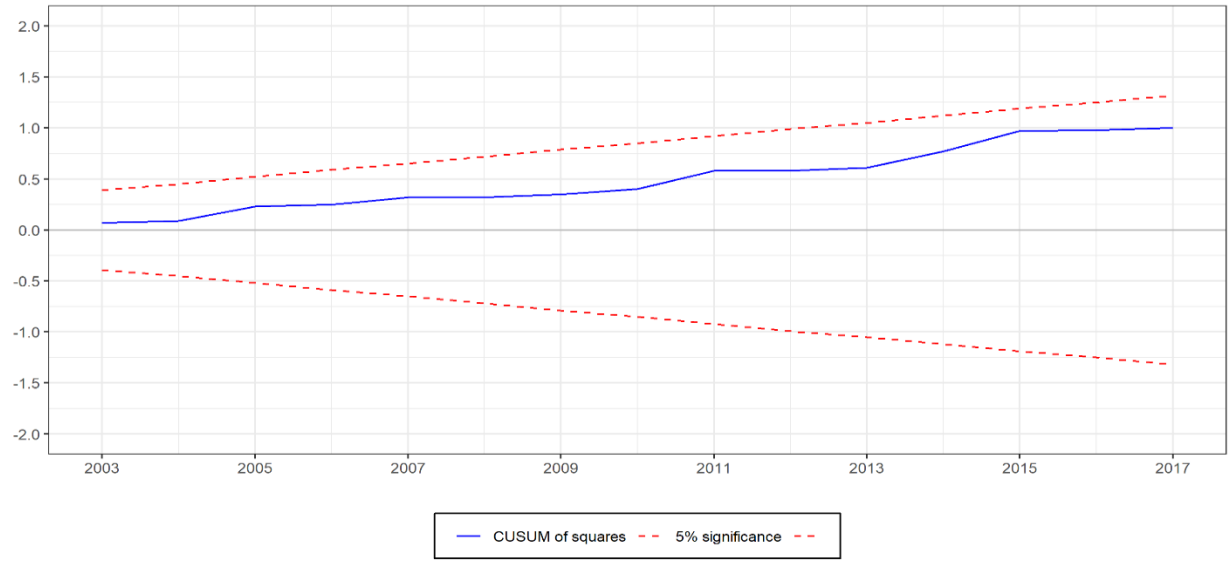

Figure 28 CUSUM stability test.
Source: Author's own construction.

The econometric findings for the most relevant variable in the current research, revealed that the informal economy has an unbalanced influence on the official economy. The latter variable has a considerably statistically significant influence on the official economy in the short term, but a statistically significantly detrimental influence on the official economy in the long-run. Given the lack of formal career opportunities, and maintaining in mind that the common job chances to work in the Algeria case are in the public sector while the privet sector has much lower working opportunities, peoples who searches for a secondary income source for some people (principally public sector employees), or a principal source of revenue in the informal activities in the case of unemployed individuals to increase their living standards and purchasing power. As a result, all revenue generated from the informal activities is consumed on goods and services in the official economy. Consequently, in the short-run generating a positive association between the two economies. However, on the long-run this impact is reversed owing to an important economic issue, which is tax evasion, reducing one of the government's primary sources of revenue.

3.4.2. Granger causality test findings

Using the approach proposed by Granger, namely the Granger causality test is employed to determine whether there is a causal link among the two economies (informal and the formal one) in the case of our selected country (Giles, 1999; Soares and Afonso, 2019). Figure 29 depicts this link using the rates of growth of the two economies. The causality test is based on the premise that if one stationary time series is Granger causative, other stationary time series the previous time series must

come before the second time series. When employing Granger causality, the two series analysed must be stationary of the time series; this is a necessary requirement (Granger, 1969). In our scenario, we look at the relationship among the scope of the IE as assessed by the second estimation approach adopted in our study the MIMIC estimation produced found previously as a proportion of formal GDP and the official economy reflected by constant GDP per capita. Extra control factors stated in the preceding part were added in the causality model. As a first step, the stationarity was tested using different unit root tests (all of the variables given are in logarithmic form) and shown in Table 7; the results indicate that IE time series and formal economy time series are stationary after applying the first difference. The FPE and AIC information criterion were utilized for the second phase to determine the optimal number of delays; they imply that the best lag number is 1.

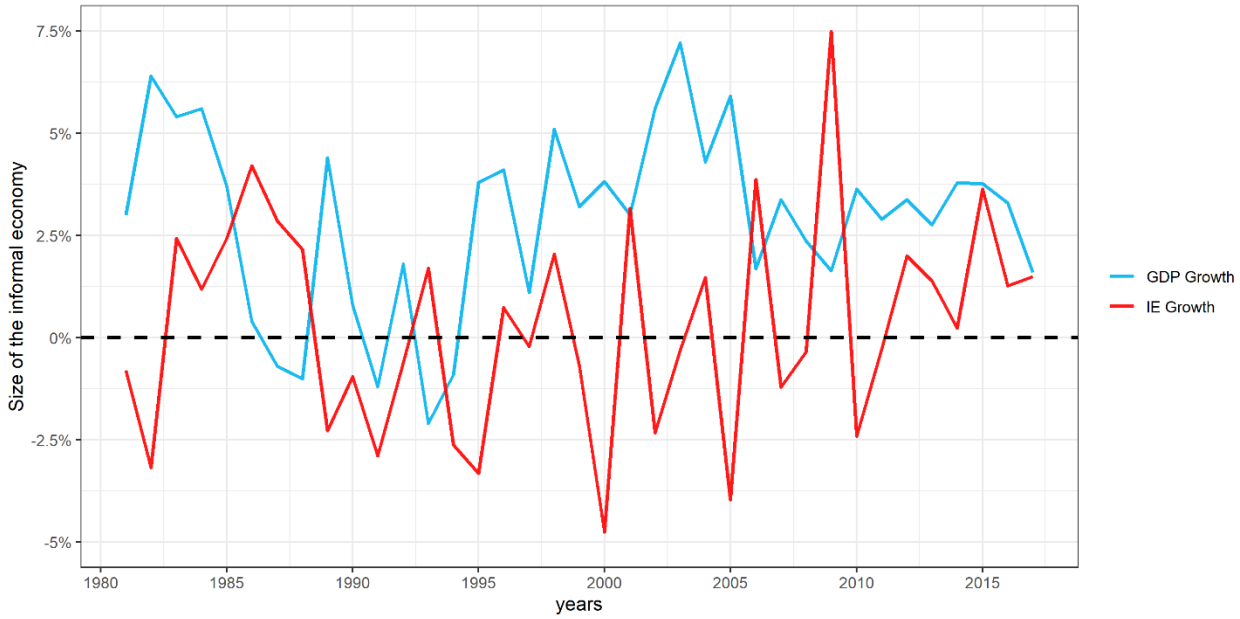

Figure 29 Growth rates of the formal and informal economy estimation using MIMIC approach. Source: Author's own construction.

The findings of Granger causality test are shown in Table 22. The directions of causation that was examined are indicated by the arrows, which means direction. It is discovered that unidirectional causality in the sense of Granger causality from GDP per cap. to the IE. Giles (1999) discovered the same finding in New Zealand. shown in Table 23, GDP per cap. has a positive effect on the scope of IE with one lag, and this effect is statistically considerable at the 5% significance level. Which means that the IE moves in lockstep with the official economy throughout the economic cycle. The predicted positive relationship indicates that the informal and informal economies are mutually beneficial in Algeria.

Table 22
Granger causality test.
Source: Author's own construction.

Variable	Direction of Granger causality	variable	results
$dlnie_t$	→	$dlngdppc_t$	0.3090[0.5583]
$dlngdppc_t$	→	$dlnie_t$	4.2812 [0.0385]

In [.] are P-values.

This result is important for policymakers since enacting expansionary policies will increase the scope and magnitude of the Algerian IE. For example, as stated by Giles (1999), indicating an expansionary fiscal policy by lowering direct and indirect taxes will reduce the scope and magnitude of the Algerian IE. As a result, authorities must assess how, if contractionary fiscal policy is implemented, individuals will be tempted to shift to the IE economy. More significantly, they must examine how impoverished individuals engaging in different informal activities will indeed be impacted, and how their purchasing power and living standards may worsen.

Table 23

VAR model estimations, from 1980 to 2017.
Source: Authors own calculation.

Variable	$dlnie_t$	$dlngdppc_t$
$dlngdppc_{t-1}$	0.3854**	0.3455**
	(0.1862)	(0.1415)
	[2.0691]	[2.4424]
$dlnie_{t-1}$	0.0834	-0.0757
	(0.1794)	(0.1363)
	[0.4650]	[-0.5558]
c	-0.0031	0.0027
	(0.0061)	(0.0046)
	[-0.5057]	[0.5988]
Control variables		
$dlngfc_t$	-0.0019	-0.0534
	(0.1034)	(0.0785)
	[-0.0192]	[-0.68025]
$dlngcf_t$	-0.0300	0.1351
	(0.0455)	(0.0346)***
	[-0.0192]	[3.9050]
$dlnse_t$	-0.1098**	-0.0317
	(0.0532)	(0.0404)
	[2.0622]	[-0.7847]
$d\pi_t$	0.015303**	-0.0044
	(0.0056)	(0.0044)
	[2.6877]	[-1.0350]
LM test	0.72	0.72
Adjusted R^2	0.04	0.53

*, **, *** are the 10%, 5%, and 1% significance levels, respectively. In (.) are Z-scores. R^2 is R-square. In [.] are P-values.

GENERAL

CONCLUSION

As aforementioned, this study investigates the causes and evolution of the Algeria's IE from 1980 to 2017. The study started by conducting an extensive literature review on the IE, especially in Algeria, to answer some important questions to help conduct this study, such as the different angles explored to analyse the IE in the last several decades. The methods adopted to analyse this phenomenon and find which approach is more appropriate for the Algerian case. What are the different causal variables and indicators found in empiric literature to significantly affect the scope of this phenomenon? And What are the usual problems researchers face, and how do they overcome them? Finally, and most importantly, to analyse the previous studies investigating the size and development of the IE in Algeria.

As a result, and for the first time our study carries an empirical investigation with special consideration to the Algerian data features (e.g., stationarity, multinormality, structural changes, etc.), the purpose of the current study is to examine the sources of informality that are responsible for the development of the IE size and calculating its scope employing the Currency Demand Approach (CDA) and structural equation modelling, specifically the multiple indicators multiple causes (MIMIC) from 1980 to 2017. In doing so, the research employs Hassan and Schneider (2016a, p. 2) "The IE reflects mostly the legal economic and productive activities that, if recorded, should contribute to the national GDP." Accordingly, any unlawful activities are thus prohibited, such as smuggling, criminal acts, and human trafficking.

The CDA and MIMIC approaches are selected for several reasons most important one is using two different approaches to compare and validate the obtained results, in addition to other reasons such as: (a) Despite their detractors, these methods are thought to be better compared to previous indirect methods; (b) the MIMIC approach employs the idea of unobservable variable, which is appropriate with the nature of IE; and (c) it considers multiple determinants and multiple indicators to reflect the scope of the IE at the same time, allows researchers to choose a diverse range of determinants and indicators depending on the characteristics of the economic system under research and the availability of information.

Furthermore, as the logical next step, the study analysed the interaction between the informal and formal economy over the same period employing the ARDL approach to investigate this relation in the short and long run, and the Granger causality tests to know the causality direction.

The empirical part of the study showed that the size of the informal economy in Algeria using CDA and MIMIC approaches is 21% and almost 33.5% of the recorded GDP, respectively, and it has been growing in scope in the last 15 years.

The tax burden is the most important source of informality in Algeria, although they were measured differently. The CDA model estimated a one per cent rise in taxes would lead to a rise of 35% in the currency demand, where the MIMIC results revealed a 1% rise in taxes (direct and indirect) rises the scope of the Algerian IE by almost 0.52%. thus, the tax burden is the most important source of informality in Algeria. The results found are supported by the economic literature and support the findings of Boudlal (2012) regarding the influence of the tax burden on the growth of Algeria's IE, while they contradict with the findings of Bounoua et al. (2014), Kori (2018) and Ziad and Dahmani (2019) who found the Tax variable does not affect the size of the IE in Algeria.

The second most significant determinant is the agricultural sector. It should be mentioned that, to the author’s knowledge, this factor has not been taken into consideration in previous investigations. This discovery is especially significant in the Algerian example since agriculture is supported by the Algerian government. Various strategies have been implemented by the Algerian government throughout the years in order to expand this industry. As stated by the Minister of Algerian Agriculture, over 20,000 new investment loans that worth over 200 billion DA were accomplished in the agricultural sector from 2010 to 2016, and 60,000 investments were subsequently funded by the NASYE, in addition to a massive 7% tax cut on agricultural supplies, as well as loan removal by presidential order in 2008 and 2014. The data, however, reveal that the IE is decreasing the efficacy of these regulations; over half of their influence is transferred to the IE.

The variable chosen to reflect institutions quality (quality of bureaucratic institutions) has been proven to have a favourable influence on the IE's success. The levels of corruption in the Algerian public and privet administration justify the existing of negative effect. It was stated that the Algerian case's insignificant relationship between unemployment and the IE is attributable to the varied jobless labour force. As a result, partaking in informal activities is dependent on the IE's position. Another relevant result is that during recessions, people try to compensate for decreased money in stated activities by indulging in IE. The negative relationship among GDP per capita and the IE reflects this.

The empirical investigation revealed the existence of a unidirectional causal relationship between the formal economy and the IE in the Granger causality sense. This finding means that when the government adopts programs to promote and develop the official economy, some of the stimulus money is diverted to increase the scope of informal activities, limiting policy efficacy. It should be mentioned that certain key reasons were missed from the study owing to a lack of data and its frequency; also, the empirical section suffers from a limited sample size.

To decrease the scope and development of the IE, the authorities must implement combined economic policies that target the different causes of informality by lowering taxes, augmenting tax morality, reducing undeclared labour in agriculture, decreasing the intensity of bureaucratic precoders, reducing corruption levels and combating corrupted officials in the public and private sectors, and lastly, improving the social and economic wellbeing of the people.

Taxation, for example, must be based on the general economic and social circumstances; in instance, during a downturn, the tax burden must be decreased. The government should limit individual's incentive to involve in unofficial businesses.in this way. Boosting citizen's trust in authorities responsible on tax collection and distribution by guaranteeing additional openness in the management of taxes revenues, educating individuals about tax aims, and, most significantly, combatting the high levels of corruption at the level of tax authorities is significantly beneficial. Because our findings indicate that the level of corruption is a significant inherent source of increasing the IE, addressing these issues is an important and critical aspect in lowering the magnitude of Algeria's IE.

The adoption of electronic money is another major aspect in reducing the scope and development of the IE. As a solution, our policymakers can implement Law No. 08/96 of December 1996, which regulates and money exchange offices by establishes the right environment and methods, in order to attract the greatest number of unofficial foreign money changers possible by constructing public and private official money exchange agencies. With this law being implemented the government will create an additional source of taxes and social security income, and by doing so, it creates new and effective employment chances for the working force. If the government achieves in generalizing e-payments (electronic payments) while withdrawing cash from the economy, the number of transactions

in the IE will be reduced, lowering its size. Unfortunately, until recently, this law is still not all economic transactions were done in cash.

The Algerian government has not made major changes to public salaries in years, resulting in a degradation in purchasing power, especially with the augmented rates of inflation. Hence, the government needs to revise the formal wages and salaries and rise them. Bearing in mind that the study discovered a negative effect of personal income on the development of the IE, boosting official salaries and pay will diminish an individual's inclination to work in the IE, hence reducing its size. For example, as it was shown in a study on teachers' wages conducted by the University of Chicago's higher education research center, the average Kuwaiti teacher's salary is almost 2900 USD, while the average Algerian salary is 345 USD, which is less than the Kuwaiti salary by 8.5 times, and it is considered to be among the lowest salaries in comparison to other MENA countries. While a research study conducted by the CASI concluded that the average monthly base salary that assures all the basic life requirements in Algeria is more than 600 USD, which is almost double the teacher's salary. Accordingly, individuals are motivated to engage in informal activities to ensure another source of income.

In the end, the Algerian government faces a tough dilemma when formulating economic policies, especially after the established positive relationship between the IE scope and the size of the agricultural sector. Policymakers need to take this relationship into consideration when trying to stimulate this sector because almost half their effect will be lost to the IE. Thus, reducing the impact of these expansionary policies while at the same time increasing the IE's scope and magnitude.

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Appendix

Table A1

Reducing time series observations at the start of the original time period.
Source: author's own calculation.

	from 1981 to 2017	from 1985 to 2017	from 1990 to 2017	from 1995 to 2017
	Model number four	Model number four	Model number four	Model number four
Causes				
Taxes to GDP	0.499*** (4.354)	0.533*** (5.069)	0.485*** (4.097)	0.432*** (2.995)
Qua. Inst.	0.344*** (4.562)	0.343*** (5.705)	0.342*** (4.821)	0.128* (1.824)
Uemp. Rate				
growth rate of GDP Per capita	-0.269** (-2.648)	-0.272*** (-2.858)	-0.198* (-1.828)	-0.255 (-1.548)
Agr. to GDP	0.494*** (5.544)	0.451*** (5.358)	0.444*** (4.114)	0.486*** (4.122)
Indicators				
LCurr. to GDP	-1	-1	-1	-1
Emp. as % work. Pop.				
LCurr. to M1	0.34** (2.296)	0.377** (2.265)	0.369** (2.159)	0.501*** (3.626)
Fit indicators				
χ^2	4.73 [0.32]	4.26 [0.81]	5.53 [0.766]	6.863 [0.816]
CFI	0.98	0.995	0.969	0.916
TLI	0.95	0.989	0.93	0.811
RMSEA	0.07 [0.27]	0.04 [0.24]	0.117 [0.275]	17.6 [0.177]
SRMR	0.051	0.058	0.77	0.074
Df	14	14	14	14
R^2	0.76	0.80	0.811	0.73

*, **, *** are the 10%, 5%, and 1% significance levels, respectively. χ^2 is Chi-square. In (.) are Z-scores. R^2 is R-square. In [.] are P-values.

Table A2

Reducing time series observations at the end of the original time period.

Source: author's own calculation.

	From 1981 to 2017	From 1981 to 2013	From 1981 to 2008	From 1995 to 2017
	Model number four	Model number four	Model number four	Model number four
Causes				
Taxes to GDP	0.499*** (4.354)	0.469*** (4.051)	0.466*** (3.297)	0.498*** (3.482)
Qua. Inst.	0.344*** (4.562)	0.363*** (4.654)	0.438*** (4.475)	0.128*** (4.715)
Uemp. Rate				
growth rate of GDP Per cap.	-0.269** (-2.648)	-0.272** (-2.355)	-0.198* (-2.002)	-0.323 (-2.174)
Agr. to GDP	0.494*** (5.544)	0.45*** (4.691)	0.41*** (3.518)	0.433*** (3.192)
Indicators				
LCurr. to GDP	-1	-1	-1	-1
Emp. as % work. Pop.				
LCurr. to M1	0.34** (2.296)	0.2 (1.245)	-0.051 (-0.314)	-0.008 (-0.046)
Fit indicators				
χ^2	4.73 [0.32]	6.073 [0.97]	4.517 [0.34]	5.224 [0.27]
CFI	0.98	0.941	0.977	0.93
TLI	0.95	0.868	0.949	0.841
RMSEA	0.07 [0.27]	0.124 [0.31]	0.06 [0.292]	0.13 [0.382]
SRMR	0.051	0.06	0.06	0.074
Df	14	14	14	14
R^2	0.76	0.67	0.603	0.65

*, **, *** are the 10%, 5%, and 1% significance levels, respectively. χ^2 is Chi-square. In (.) are Z-scores. R^2 is R-square. In [.] are P-values.

Table A3

Results of Model four after omitting growth rate of GDP per cap. using the original time series. Source: author's own calculation.

	Model 4 omitting GDP per cap.	Original Model 4 estimations
Causes		
Taxes to GDP	0.543***	0.499***
	(4.286)	(4.354)
Qua. Inst.	0.334***	0.344***
	(3.302)	(4.562)
Uemp. Rate	0.035	
	(0.266)	
growth rate of GDP Per cap.		-0.269**
		(-2.648)
Agr. to GDP	0.444***	0.494***
	(3.948)	(5.544)
Indicators		
LCurr. to GDP	-1	-1
Emp. as % work. Pop.		
LCurr. to M1	0.35**	0.34**
	(2.108)	(2.296)
Fit indicators		
χ^2	5.95	4.73
	[0.8]	[0.32]
CFI	0.956	0.98
TLI	0.901	0.95
RMSEA	0.102	0.07
	[0.26]	[0.27]
SRMR	0.065	0.051
Df	14	14
R^2	0.743	0.76

*, **, *** are the 10%, 5%, and 1% significance levels, respectively. χ^2 is Chi-square. In (.) are Z-scores. R^2 is R-square. In [.] are P-values.

Table A4

Re-estimation of the theoretical MIMIC model by employing data in standard form.
Source: author's own calculation.

	Model one (5-1-3)	Model two (4-1-3)	Model three (5-1-2)	Model four (4-1-2)	Model five (3-1-2)
Causes					
Taxes to GDP	0.469***	0.465***	0.510***	0.509***	0.57***
	(4.448)	(4.344)	(4.478)	(4.355)	(4.282)
Qua. Inst.	0.335***	0.323***	0.364***	0.35***	0.349***
	(4.395)	(4.45)	(4.599)	(4.589)	(3.378)
Uemp. Rate	0.067		0.088		0.047
	(0.631)		(0.771)		(0.349)
growth rate of GDP Per cap.	-0.257**	-0.246**	-0.288**	-0.227***	
	(-2.528)	(-2.473)	(-2.788)	(-2714)	
Agr. to GDP	0.426***	0.442***	0.485***	0.514***	0.483***
	(4.547)	(5.264)	(4.831)	(5.650)	(4.065)
Indicators					
LCurr. to GDP	-1	-1	-1	-1	-1
Emp. as % work. Pop.	0.093	0.097			
	(0.83)	(0.848)			
LCurr. to M1	0.263*	0.266**	0.358**	0.36**	0.378**
	(1.875)	(1.927)	(2.327)	(2.387)	(2.256)
Fit indicators					
χ^2	21.21	22.47	5.98	4.16	4.78
	[0.01]	[0.91]	[0.308]	[0.38]	[0.31]
CFI	0.74	0.756	0.975	1	0.98
TLI	0.575	0.594	0.946	0.99	0.959
RMSEA	0.182	0.192 [0.017]	0.075	0.033	0.066
	[0.02]		[0.25]	[0.26]	[0.353]
SRMR	0.09	0.087	0.058	0.049	0.061
Df	26	19	20	14	9
R^2	0.636	0.64	0.781	0.80	0.84

*, **, *** are the 10%, 5%, and 1% significance levels, respectively. $\chi 2$ is Chi-square. In (.) are Z-scores. R2 is R-square. Df degrees of freedom = 0.5 (q+p) (q+p+1)-j, where q is the indicators number, p is the determinants number, and j is the free parameters number.

Table A5

Re-estimation of Model four using growth data over the original period.
Source: author's own calculation.

	Data in growth form		Data in growth form	Model four estimations
	Model four	Model four with emp.	Model four omitting GDP per cap.	Model four
Causes				
Taxes to GDP	0.582***	0.539***	0.585***	0.499***
	(4.234)	(4.261)	(3.815)	(4.354)
Qua. Inst.	0.308***	0.29***	0.283**	0.344***
	(2.898)	(2.981)	(2.463)	(4.562)
Uemp. Rate	0.129	0.114	0.08	
	(0.975)	(0.903)	(0.713)	
growth rate of GDP Per cap.	0.138	0.146		-0.269**
	(1.144)	1.262)		(-2.648)
Agr. to GDP	0.425***	0.374***	0.441***	0.494***
	(3.889)	(3.757)	(4.184)	(5.544)
Indicators				
Log current GDP	-1	-1	-1	-1
Employment to the working population		0.144		
		(0.993)		
Log currency to M1	0.40**	0.337**	0.42**	0.34**
	(2.814)	(2.462)	(2.417)	(2.296)
Model fit indicators				
χ^2	8.22	20.472	5.77	4.73
	[0.14]	[0.92]	[0.21]	[0.32]
CFI	0.93	0.79	0.96	0.98
TLI	0.85	0.65	0.91	0.95
RMSEA	0.11	0.153	0.11	0.07
	[0.26]	[0.07]	[0.26]	[0.27]
SRMR	0.07	0.09	0.06	0.051
Df	21	19	14	14
R^2	0.81	0.676	0.80	0.76

*, **, *** are the 10%, 5%, and 1% significance levels, respectively. $\chi 2$ is Chi-square. In (.) are Z-scores. R2 is R-square. Df is degrees of freedom = 0.5 (q+p) (q+p+1)-j, where q is the indicators number, p is the determinants number, and j is the free parameters number.

Abstract :

This study aims first to investigate the main determinants and sources of informality in Algeria, second to estimate the size and evolution of the informal economy (IE) from 1980 to 2017, third to analyse the interaction between the informal and formal economy over the same period. For the first two purposes, the study employs two macroeconomic approaches the Currency Demand Approach (CDA) and Multiple Causes Multiple Indicators (MIMIC) approach, and for the fourth purpose, a growth model and the Granger causality test are employed to explore the direction of causality between these two economies.

The study revealed several significant results. First, according to the MIMIC results, the tax burden is the most crucial determinant, followed by the size of the agriculture sector, quality of institutions, and GDP per capita. Second, the scope of Algeria's informal economy using CDA and MIMIC approaches is 21% and 33.5% of the official GDP, respectively, and it has been growing in scope over the former 15 years. Furthermore, interaction analyses between the two economies revealed that the IE positively influences the official economy in the short run, while in the long run, this influence is reversed. Moreover, unidirectional Granger causality from GDP to IE is observed.

As for policy implications, the Algerian government must review its tax policies, generalize electronic transactions in economic activities, reduce corruption in the public administrations, and re-examine policies performed to stimulate the agricultural sector, which half of their influence is consumed by the IE.

Key words: informal economy; multiple indicators multiple causes approach; currency demand approach; ARDL; Granger causality.

JEL classification: C51; C39; O17; E26

الملخص:

تهدف هذه الدراسة أولاً إلى الدراسة المحددات الرئيسية ومصادر الاقتصاد غير الرسمي في الجزائر، ثانيًا لتقدير حجم وتطور الاقتصاد غير الرسمي (IE) من 1980 إلى 2017، ثالثًا لتحليل التفاعل بين الاقتصاد غير الرسمي والاقتصاد الرسمي خلال نفس الفترة. بالنسبة للهدفين الأولين، تستخدم الدراسة من مقاربتين في الاقتصاد الكلي، وهما مقاربة الطلب على العملة (CDA) ومقاربة المؤشرات المتعددة والأسباب متعددة(MIMIC) ، وللهدف الرابع، تم استعمال نموذج النمو الاقتصادي ونموذج Granger لاختبار ولاستكشاف اتجاه السببية بين هذين القطاعين.

كشفت الدراسة عن عدة نتائج مهمة. أولا، وفقًا لنتائجMIMIC ، فإن العبء الضريبي هو المحدد الأكثر أهمية، يليه حجم قطاع الزراعة، ونوعية المؤسسات، ونصيب الفرد من الناتج المحلي الإجمالي. ثانيا، إن متوسط حجم الاقتصاد غير الرسمي في الجزائر باستخدام مقاربة CDA وMIMIC هو 21٪ و33.48٪ من الناتج المحلي الإجمالي الرسمي، على التوالي، وقد زاد حجمه على مدار الخمسة عشر عامًا الماضية. رابعًا، كشفت تحليلات التفاعل بين القطاعين أن الاقتصاد غير الرسمي يؤثر إيجابًا على الاقتصاد الرسمي على المدى القصير، بينما على المدى الطويل، هذا التأثير ينعكس. بالإضافة إلى ذلك، تم العثور على سببية Granger أحادية الاتجاه من الناتج المحلي الإجمالي إلى الاقتصاد غير الرسمي.

أما بالنسبة للسياسات الاقتصادية المقترحة، تحتاج الحكومة الجزائرية إلى إعادة النظر في سياساتها الضريبية، لتعميم استخدام المعاملات الإلكترونية في الأنشطة الاقتصادية، الحد من الفساد في الإدارات العامة، وإعادة النظر في السياسات المنفذة لتحفيز القطاع الزراعي الذي يتم تسريب نصف أثرها للاقتصاد غير الرسمي.

الكلمات المفتاحية: اقتصاد غير الرسمي؛ مقاربة الطلب على النقود؛ مقاربة المؤشرات المتعددة والأسباب المتعددة؛ سببية Granger؛ ARDL.

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