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## **Informal economy in Tunisia**

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**Abstract.** Informality has been a phenomenon that has existed in Tunisia for a long time; it expanded with the Tunisian revolution. The relationship between informal economy and GDP varies in only one direction, that is to say only informality has a negative effect on growth...The expansion of the informal sector comes back to the problem of economic freedom, Tunisia is among the least economically free countries also the political institutional framework such as the problem of government efficiency, the high level of corruption and political instability are among the explanatory variables of informality.

**Keywords.** Economic growth, informality, Tunisia

### **1- Introduction**

Tunisia is like most developing and poor countries, the informal sector is very large. The percentage of the latter in the real GDP per capita of Tunisia in 2017 is equal to 36%, a considerably high percentage compared to the World Bank alert threshold of 20% and also compared to other developed countries, France for example has a percentage of 11.1%, Germany 10.4%.

Over the period 2000-2017, the informal economy experienced a poor reduction in general, the percentage of which fell from 38% in 2000 to 36% in 2017. Informality was reduced in 2008 to reach a minimum of 27%.

The informal economy and its effect on economic growth varies from country to country and remains dependent on a set of variables, whether economic, social or political. Old studies, for example, have shown that the spread of the notion of informality in Tunisia is the cause of the country's economic situation. The inability of the Tunisian economy to create jobs, reduce unemployment and absorb poverty encourages the appearance of informal work. We are now faced with a bad reality which shows that the informal sector is a main component of the Tunisian economy and the situation has become more serious after the revolution with the rapid evolution of these practices. We can say that the study of this question is not simple enough as expected, the lack of clear and transparent information makes this subject very delicate and its treatment is difficult.

### **2- Theoretical considerations**

The informal economy remains dependent on several variables that can either change these practices and encourage them or create barriers and discourage them. Several studies have shown the explanatory variables of the underground economy such as the “Kaufman” variables called “governance variables”. By the case of Tunisia, we will first test the effect of the variables already used by Kaufman on the informal economy, then we will test the impact of the variables of economic freedom on this phenomenon of informality. Several researchers have worked in this context: we can cite Yilmaz Bayar (2019) who has shown that economic freedom has a negative effect on the size of the informal economy and that it can reduce the volume of this type of practice over the long term. The author's analysis sample is based on transition economies in the EU, over a period from 2000 to 2015.

Many empirical works have been developed to know the influence of certain variables on the informal economy<sup>1</sup>, we find for example all the political institutional variables (the variables of governance): such as corruption, the rules of the law, the quality of regulations, political stability and effective governance. There are also the economic institutional variables, economic freedom such as freedom of trade, as we quoted in the table below (Appendix V-1). There are not a large number of studies that have taken into account the relationship between the informal economy and economic freedom. Razmi et al. (2013) for example worked on an analysis sample of 51 states of the Organization of Islamic Cooperation, the objective was to know the relationship between the informal economy and institutional quality indicators over a period of 9 years, from 1999 to 2008. The main results obtained that economic freedom negatively influences the informal economy and reduces it over time. Manolas et al. (2013) on their part show that the liberalization and deregulation of the credit market increase the informal economy, while on the other hand the liberalization of the labor market reduces the shadow economy. The analysis sample is based on 19 OECD States over a short period of approximately 6 years (2003-2008). In the same context of analysis we find Zarra-Nezhad et al. (2014) who aligned themselves with the ideas of other researchers on the negative effect of economic freedom on the informal economy.

In the same year, 2014, these authors studied the influence of economic freedom and globalization on the informal economy but this time in Greece over a period of 8 years, among the results obtained is that there is no significant effect between these variables. We can also cite the work of Remeikiene and Gaspareniene (2015) who worked on the case of the informal economy in Lithuania, over the period from 2000 to 2011, an empirical work which aims to research the determinants of the economy underground and namely the effect of economic freedom on the latter. The results obtained also confirm the idea that freedom of enterprise reduces the size of the informal economy. Schneider (2016) is the author who has taken into account the problem of the informal economy for a long time, he has explored the main determinants of shadow activities in a large number of countries. The results obtained confirm that the components of economic freedom have a significant and negative effect on the underground economy.

Goel and Saunoris (2017), for their part, also showed that economic freedom reduces the underground economy. They emphasized the link between unemployment and the so-called parallel economy, distinguishing between the sexes. Their analysis sample covers 100 countries and a period of 16 years. Another idea comes from Ouédraogo (2017) based on empirical work

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<sup>1</sup> Appendix I: An overview of the literature on all the explanatory variables of the informal economy. (I-1: Other explanatory variables of informality).

in the form of a regression analysis conducted in 23 sub-Saharan countries. The author finds that there is no significant effect of economic freedom, on the underground economy, because the increase in business freedom, which is a component of the index of economic freedom makes the economy underground and influences it positively. Still in the same idea of the negative effect of economic freedom on the underground economy Sweidan (2017) confirms this idea according to the results obtained by the author according to empirical work carried out on 112 countries for a period of 7 years (from 2000 until 2007). Economic freedom reduces the underground economy.

Many other empirical works have been published to test the effect of economic freedom on the shadow economy. A summary of all this work can be found in the table in the Appendix<sup>2</sup>.

As every year, the 2020 edition of the "index of economic freedom", which measures economic freedom in 180 countries around the world, was recently proven by The Heritage Foundation, an American think tank based in Washington.

The "index of economic freedom" measures economic freedom in the world on the basis of 12 quantitative factors grouped into four main categories. These include: the rule of law (right to property, integrity of government, judicial efficiency); government dominance (public spending, fiscal pressure, fiscal health); regulatory efficiency (business freedom, labor freedom, monetary freedom); open markets (commercial freedom, investment freedom, financial freedom).

Tunisia's economic freedom score for 2020 is 55.8, making its economy the 128th freest according to the index out of 151 countries, down three places from last year. Its overall score increased by 0.4 points due to improved property rights and other rule of law indicators. In the MENA region, Tunisia ranks 31st.

On the African scale, Tunisia ranks 22nd out of 51 countries on the continent, far behind Morocco in 6th place. Morocco is considered a "moderately free" country for the sixth consecutive year. On the other hand, Tunisia is ahead of Egypt (30th in Africa) and Algeria (47th in Africa).

### **3- Model and estimates**

#### **3- estimates by TMC**

The modeling of the interactions between the growth rate of real GDP per capita and the percentage of the underground economy in GDP will be done using a structural model with simultaneous equations applied to unbalanced panel data. This choice of these variables is justified by the fact that the impact of the underground economy on economic growth can be positive or negative to deal with this problem it is necessary to know above all via a few exogenous variables the informal economy is evolving and then the simultaneous effect of the underground economy and its causal variables on the growth rate of real GDP per capita.

Thus, our empirical model is based on the bilateral relationship between the percentage of the underground economy in GDP and the growth rate of real GDP. It is therefore necessary to produce each equation comprising specific variables. These interrelated equations together form a system of equations. The choice of the estimation method comes down to identifying the equations

#### **3-1-1 Modeling**

##### **Identification**

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<sup>2</sup> Appendix I: An overview of the literature on all the explanatory variables of the informal economy.(I-2: the effect of economic freedom on the parallel economy. Recently published studies.).

**Notion**

To identify a structural equation is to study the possibility of finding its parameters. Indeed, an equation can be:

- o Just/exactly identified, if the solution is unique;
- o Over-identified, if the solutions are multiple;
- o Under-identified, if the equation is not solvable.

Real GDP growth rate equations in Tunisia

$$Y_{TUN,t} = \beta_0 + \beta_{it} X_{i,t} + \varepsilon_t$$

t=2000 ,... ,2015    sauf 2001  
 i= 1, 2, 3,4,10,11,12,13,14,15,16,17

$$Y_{it} = \alpha_i + \beta_1 \ln X_{1i,t} + \beta_2 \ln X_{2i,t} + \beta_3 \ln X_{3i,t} + \beta_4 \ln X_{4i,t} + \beta_{10} \ln X_{10i,t} + \beta_{11} \ln X_{11i,t} + \beta_{12} \ln X_{12i,t} + \beta_{13} \ln X_{13i,t} + \beta_{14} \ln X_{14i,t} + \beta_{15} \ln X_{15i,t} + \beta_{16} \ln X_{16i,t} + \beta_{17} \ln X_{17i,t} + \varepsilon_{i,t}$$

**Of which :**

- Where Y is the endogenous variable, represents the real GDP per capita growth rate for each country in the sample and for each year of the analysis period.
- X1, X2 and X3 are considered as control variables, all values are in percentage of real GDP per capita and they represent respectively, gross fixed capital formation, inflation and trade openness.
- X4 is the size of the informal economy as a percentage of real GDP per capita.
- X10: represents the relationship between the informal economy and corruption (X4 \* X5).
- X11: represents the relationship between the informal economy and gross fixed capital formation, i.e. (X4\*X1).
- X12: represents the relationship between the informal economy and inflation, i.e. (X4\*X2).
- X13: represents the relationship between the informal economy and trade, i.e. (X4\*X3).
- X14: represents the relationship between the informal economy and corruption (X4 \* X5).
- X15: represents the relationship between the informal economy and government effectiveness, i.e. (X4\*X6).
- X16: represents the relationship between the informal economy and political stability, i.e. (X4\*X7).
- X17: represents the relationship between the informal economy and the quality of regulation, i.e. (X4\*X8).
- X18: represents the relationship between the informal economy and the rule of law, i.e. (X4\*X9).

**- Equations of percentage of the underground economy in the GDP in Tunisia**

$$W_{TUN,t} = \beta_0 + \beta_{it} X_{i,t} + \varepsilon_t$$

t=2000 ,... ,2015    sauf  
 2001  
 i= 5,6,7,8,9,18,19,20,21,22,23,24, 25

$$W_{it} = \alpha_i + \beta_5 \ln X_{5i,t} + \beta_6 \ln X_{6i,t} + \beta_7 \ln X_{7i,t} + \beta_8 \ln X_{8i,t} + \beta_9 \ln X_{9i,t} + \beta_{20} \ln X_{20i,t} + \beta_{21} \ln X_{21i,t} + \beta_{22} \ln X_{22i,t} + \beta_{24} \ln X_{24i,t} + \beta_{25} \ln X_{25i,t} + \varepsilon_{i,t}$$

Governance variables:

- X5: corruption control
- X6: governorship efficiency
- X7: political stability
- X8: regulatory quality
- X9: Rule of law

*Economic Freedom Variables*

- X18: index of economic freedom (FEW)
- X19: government size
- X20: rule of law (legal system and property rights).
- X21: Sound money.
- X22: open markets (freedom of international trade.)
- X23: regulatory efficiency.
- X24: growth rate of real GDP per capita.

*Endogenous variable*

X4: the percentage of the underground economy in the GDP

X25(y): represents the real GDP per capita growth rate for each country in the sample and for each year of the analysis period

**Identification requirement**

The estimation method in the context of simultaneous equation models depends on the identification criterion of the model (Bourbonnais, 2009). Thus, we verify that each of the two specified equations satisfies both the order condition (the necessary condition) and the rank condition (the necessary and sufficient condition) of identification. According to Greene (2003), the equation  $j$  satisfies the identification order condition if  $K_j$  (the number of exogenous variables excluded from the equation  $j$ ) is greater than or equal to  $M_j$  (the number of endogenous variables included in the equation  $j$ ). The rank condition imposes a restriction on a submatrix of the reduced-form coefficient matrix to ensure that there is exactly one solution for the structural parameters given the reduced-form parameters. The procedure is as follows:

- Build a matrix in which each row represents a coefficient ( $\beta x$ ) and each column represents a variable in the simultaneous equation model ( $Z$  matrix)
- Construction of a row matrix for each equation. When a variable appears in an equation, it is marked with a “1” and if a variable does not appear in an equation, it is marked with a “0”. (Matrix A)
- the equation is then the product between the row matrix (A) and the column matrix (Z) this sub-matrix, if we find at least rows and columns which are not all zero, the equation is identified.

Matrix Z (column matrix of coefficients  $\beta X$  \* row matrix of exogenous variables (x))<sup>3</sup>

**The real GDP per capita growth rate equation (y):**

$Y_{TUN} = (111100000111111100000000) Z$  SO equation identified

the number of exogenous variables excluded from this function ( $k_j$ ) = 13

the number of endogenous variables included in this function ( $m_j$ ) = 2

$k_j > m_j$  over-identified equation

**The Equation of percentage of underground economy in real GDP (W)**

<sup>3</sup> Appendix II: estimates by the TMC method :(I-1: Matrix Z (column matrix of coefficients  $\beta X$  \* row matrix of exogenous variables (x)))

$W_{TUN}=(1000111110000000011111111)$  Z SO equation identified  
 the number of exogenous variables excluded from this function (kj ) = 11  
 the number of endogenous variables included in this function (mj ) = 2  
 kj > mj over-identified equation

**Estimation technique**

Our equation are all over identified so we can use the TMC technique.

**3-1-2 Estimation results and interpretations.**

- *Stationarity test of the variables*<sup>4</sup>:

The stationarity of the variables is a very important criterion in time series modeling because any linear regression that includes non-stationary variables is considered invalid. More precisely, the distribution of the regression parameters no longer follows a student law but a Brownian movement. Our variables are not stationary (dickey fuller test) in the initial state. But with the intervention of the first difference have become stationary.

- *Test of auto-correlation of errors*<sup>5</sup>:

According to the error autocorrelation test, we observe that there is a strong correlation between some variables; we will avoid involving them together in our estimation.

- *Results and interpretations:*.

Among the results obtained by our empirical work

**Table 1: Result of the estimation of the reciprocal effect Underground economy and economic growth**<sup>6</sup>.

	GDP per capita growth rate(y)	informal economy(X4)
	-0.601	-
informal economy(X4)	0.000*	
	-	-1.926
GDP per capita growth rate(y)		0.321

Source: our results

**- Interpretations**

**GDP per capita growth rate equation (y)**

The table above shows the relationship between the variation of the underground economy and the growth rate of real GDP per capita. Any variation in the underground economy has a negative effect on the GDP growth rate. Negative coefficient (0.601) and significant at the 1% level. We can say at this level that it is an inverse relationship, any increase in the informal economy leads to a deterioration of economic activity and conversely the formalization of the informal sector can stimulate economic growth. The magnitude of the informal economy in the GDP is important so the negative effect of the latter can cause a total imbalance of the economic situation of Tunisia. The method of estimating the underground economy and knowing its

<sup>4</sup> II-2: Stationarity test of variables

<sup>5</sup> II-3: Auto-correlation test of variables.

<sup>6</sup> II-4: estimation of the reciprocal effect Informal economy and economic growth.

strengths and weaknesses still remains a problematic most empirical work is inspired by surveys, for example the latest survey by the National Institute of Statistics (INS) in 2017 to assess the employment in the informal sector article published in 2019. The ITCQ also published an article in 2017 at the level of which the authors based on a survey analyzed the evolution of the unobserved economy in Tunisia the percentage of the latter in GDP is equal to 40% in 2014. Over the entire period of analysis, i.e. 1984-2014, the percentages are estimated between a minimum of 12% of GDP in 1994 and a maximum of 42% in 2011. Among the results obtained, the informal sector plays an important economic and social role as a source of work and income for a significant number of the Tunisian population regardless of the region but it does not hide the negative part that it is the very important part This type of practice can only harm investment, whether public through the lack of state revenue due to non-payment of taxes and tax evasion, or private because this sector does not make significant investments in infrastructure and major projects.

Absence of any form of banking operation such as bank credit or savings, which generates negative effects whether on the part of supply, reduction in production or on the part of demand, the fall in income generates a reduction in consumption and savings. In both cases we are only talking about the slowdown in economic activity.

The reduction of trade benefits is also an anomaly of this kind of practice because in general countries where the informal sector is very important cannot benefit from trade openness.

At the level of the underground economy, we also find a total absence of research and development, which discourages creativity in this area, such as the discovery of new, more sophisticated technologies, computer software and accounting systems, since this informal sector does not hold no normalized regular accounting.

Thus the informal economy, despite its significant weight in the formal economy, remains neglected by politicians and misunderstood by researchers. To better understand this phenomenon, it is necessary to know the factors that are at the origin of the diffusion of the notion of informal, as well as the axes on which the State must act to formalize the informal sector.

**Underground economy equation (X4):**

The change in real GDP per capita has no direct effect on the change in the underground economy. According to the results obtained, the coefficient is not significant.

**Table 2: the effect of the investment (x1) on the informal economy (x4) and the simultaneous effect (x11) on the GDP growth rate (y)<sup>7</sup>.**

	informal economy(X4)	GDP per capita growth rate(y)
	-	-0.633
informal economy(X4)		0.000*
The investment (x1)		-
	-10.101	

<sup>7</sup> II-5: the effect of the investment (x1) on the informal economy (x4) and the simultaneous effect (x11) on the GDP growth rate (y).

0.074

3.328

the simultaneous effect (x11)

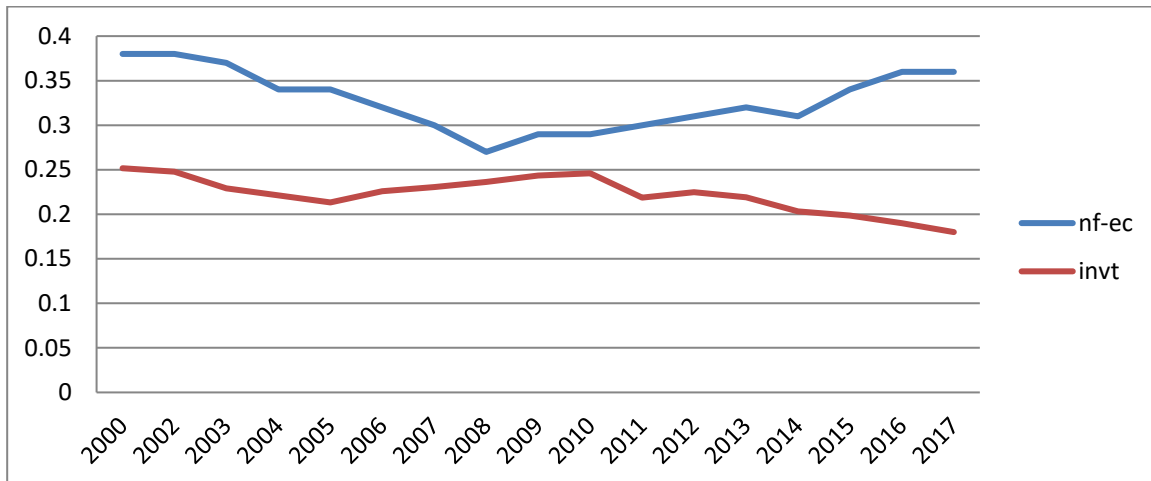
0.000

Source: our results

**Interpretations;**

**Informal economy equation (X4):**

Investment plays a very important role in the underground economy. We can say from the results obtained that to reduce the size of the informal economy in the GDP it is necessary to stimulate investment. An inverse relationship between the variation in investment and the size of the underground economy, negative coefficient (-10.101) and significant at the 10% threshold.



**Figure 1: The evolution of the percentages of the informal economy and the investment in the GDP over the period 2000-2017**

Source: our calculations

The graph above shows the variation of the percentages of investment and the underground economy in the GDP. The two curves vary in opposite directions the informal economy experienced a remarkable recession from the year 2004 until the year 2009, and on the other hand, the curve of the investment during the same period is in increase. The underground economy has evolved since 2008, the slope of the curve is increasing while the investment curve is decreasing over the period 2008-2017. We thus prove that investment according to the definition of the World Bank (data source), “GFCF includes land improvements (fences, ditches, sewers, etc.); purchases of plant, machinery and equipment; and the construction of roads, railways and the like, including schools, offices, hospitals, private residential accommodation and commercial and industrial buildings. According to the 1993 SNA, net acquisitions of valuables are also considered as capital formation” has an inverse effect on the underground economy, the increase in investment can reduce the percentage of the underground

economy in the GDP and investment breakdown encourages people to operate in the informal sector.

So, the informality of trade and employment remains dependent on the expansion of investment, the capacity of the State to provide traders with a favorable business climate to invest, whether from the infrastructure, political and social stability and above all research and development budgets and laboratories well equipped with materials and products. The INS tried with a project to change national accounts considered ambitious by the authors, the objective of which is to create a new version of national accounts for Tunisia by implementing the recommendations of the 2008 SNA. implementation of the recommendations of the new national accounting standard which takes into account the improvement of the activity of the informal economy is one of the major issues that the authors seek to study. Data inspired by “micro-enterprise” and “employment” surveys.

Among the recommendations proposed by the authors, is that it is necessary to have as a priority the improvement and the accounting of the expenses of research and development of public and private companies excluding the expenses of research and higher education because this kind of expenses are accounted for generally in the form of intermediate consumption. The extension of GFCF to R&D expenditure leads to the identification of a specific asset, namely an R&D intellectual property asset, and a corresponding consumption of fixed capital (CCF). This is particularly the case for the public administration sector. In the latter case, the CCF on R&D intellectual property assets increases, all other things being equal, the value of overall non-market output.

The need for investment in reducing the size of the informal economy has been justified also by the work of the ITCEQ where the results show that the unmeasured sector has experienced two trends, the first is downward, from the end of the year 1985 until the year 1994, the second, it is on the rise, and it is from the year 2009 that the unmeasured activity has grown with a share exceeding 30% of GDP. It should be noted that the unmeasured economy experienced an increase of more than 7 percentage points due to the environment of uncertainty and insecurity which strongly affected investment.

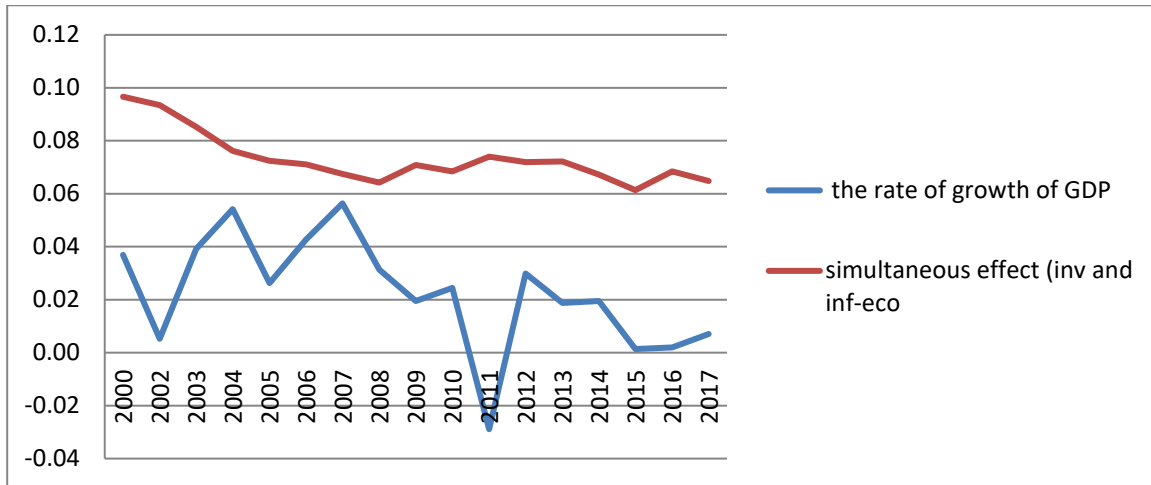
Thus "the State" must set itself objectives with clear percentages to achieve an annual extension of unstructured companies to become structured (extension pillars or tranches), and by this, improving the incentive and improvement system of the investment climate and by a genuine reform of the tax system.

**Equation of GDP per capita growth rate (y):**

We note from the results obtained the robustness of the negative relationship between the variation of the underground economy and the GDP growth rate, always a negative and significant coefficient at the 1% level.

With the intervention of the investment variable, we prove the positive effect of investment variation on economic growth. A coefficient of (0.923) significant at the threshold of 5% p value is equal to 0.022 (appendix).

After identifying the inverse effect between the variation in investment and the underground economy, our results show that the simultaneous variation of these two variables generates a positive effect on the rate of growth of GDP, a positive coefficient of 3.328 and significant at the threshold of 1%.



**Figure 2: The simultaneous effect of the underground economy and investment on the GDP growth rate over the period 200-2017**

Source: our results

The two curves vary almost in the same direction, negative slope decreasing curves, we notice at this level that over the period 2000-2017 the economic recession is caused by the increase in the informal economy which itself has found its improvement with the slowdown investments. So, we can identify that the informal economy is a brake on development and economic growth, to manage this problem, which makes most developing countries suffer where the percentage of informal activities is too high in the GDP and in Tunisia specifically, investment must be stimulated at the micro and macro level.

**Table 3: the effect of openness (x3) on the informal economy (x4) and the simultaneous effect (x13) on the GDP growth rate (y)<sup>8</sup>.**

	informal economy(X4)	GDP per capita growth rate(y)
	-	-0.573 (0.000)
informal economy(X4)	-0.378 (0.668)	
		0.072 (0.000)
the simultaneous effect (x11)		

**Interpretations;**

**Informal economy equation (X4):**

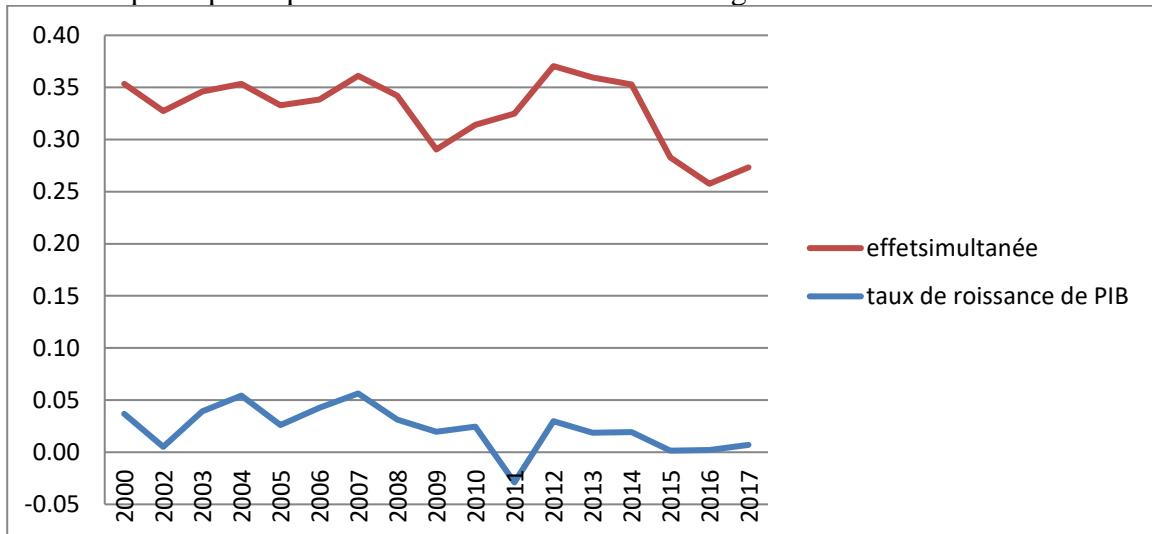
The change in the sum of exports and imports of goods and services measured as a percentage of gross domestic product does not have a direct effect on the underground economy. We can say at this level that trade openness and more precisely the exchange of goods and services between Tunisia and the rest of the world according to the definition of the World Bank of our

<sup>8</sup> II-6: the effect of trade (x 3) on the informal economy (x4) and the simultaneous effect (x13)

variable, (Trade) does not have a significant effect on the growth or reduction of informal activities.

**GDP per capita growth rate equation (y):**

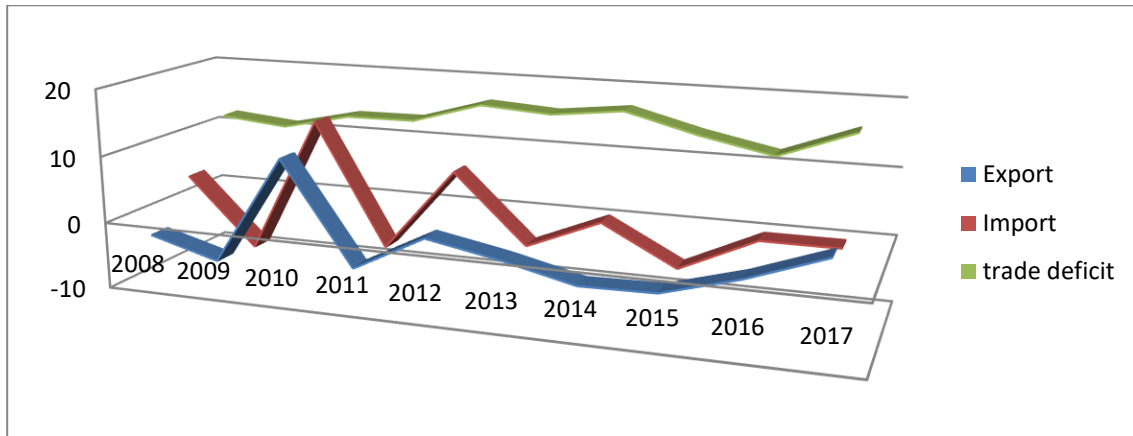
Our results in the table above, show on one hand the robustness of the negative relationship between the variation of the underground economy and the GDP growth rate, always a negative and significant coefficient at the 1% threshold. And on the other hand the simultaneous positive effect of the variation of the underground economy and trade openness on the growth rate of real GDP per capita positive coefficient of 0.072 and significant at the 1% threshold.



**Figure 3: The simultaneous effect of the underground economy and trade on the GDP growth rate over the period 200-2017**

Source: our calculations (World Bank data).

We notice from the graph that the two curves vary almost in the same direction with a decreasing slope so the simultaneous variation of trade and the informal economy can cause economic depression. Our second asset in this empirical work shows that the informal economy can harm economic growth through its effect on trade. Among the main practices of the underground economy, smuggling and illegal exchanges of Tunisia with especially Libya and Algeria. Recent studies have shown that Tunisia's trade with these two partners exceeds 5% of Tunisian foreign trade, this rate is higher than that of formal trade with its neighbors. What despairs the national GDP since the latter takes into account in the calculation the balance of trade. With regard to formal and declared trade, Tunisia experienced a trade deficit over the period 2008-2017 around 14.03%, this deficit is justified by the increase in imports with a higher rate than that of exports in almost all sectors have a trade balance deficit as Tunisia is a country that buys more abroad than it sells. Our country is a major importer of energy products, food products and intermediate consumer products.



**Figure 4: Exports, imports and trade deficit over the period 2008-2017**

Source: our calculations (INS data)

The graph above shows the evolution of export compared to import over the period 2008-2017. We notice that imports always exceed exports, which generates a growing trade deficit curve. The excess of imports can be a primary cause of the diffusion of the notion of the informal following the deterioration of the profitability of citizen companies, Aleman-Castilla (2006) shows, according to a study on the effect of NAFTA (North American Free Trade Agreement) on the shadow economy in Mexico, that reductions in import duties reduced informality by increasing profitability for businesses. So, we can identify at this level the increase in purchases from abroad is painfully affecting Tunisian production. In 2017 all product groups recorded a deficit. Sharp deterioration in the energy balance which generated a deficit of 4 billion Dinars in line with the increase in imports by 39.9% (against -19.2% in 2016). Maintenance of the food balance deficit at a high level (-1,355 MTD). Continued deterioration in the balance of consumer goods (-986 MTD in 2017) in relation to the high level of imports which have been on an upward slope in recent years, reaching 12.8 billion Dinars in 2017, This slope is also observed at the level of the underground economy curve, which also experienced an evolution of 5 percentage points in 2017, i.e. 36% of GDP compared to 31% of GDP in 2015. Finally, the encouragement of Tunisian production and consumption can be a solution to minimize informal activities through the improvement of the profitability of our companies which then causes economic growth.

**Table 4: the effect of inflation (x2) on the informal economy (x4) and the simultaneous effect (x12) on the GDP growth rate (y)<sup>9</sup>.**

	informal economy(X4)	GDP per capita growth rate(y)
	-	-0.573
informal economy(X4)		(0.000)
inflation (x 3)	3.566 (0.454)	

<sup>9</sup> II-7: the effect of inflation (x 2) on the informal economy (x4) and the simultaneous effect (x12) on the GDP growth rate (y).

the simultaneous effect (x13) 1.283  
(0.004)

Source: our calculations (INS data)

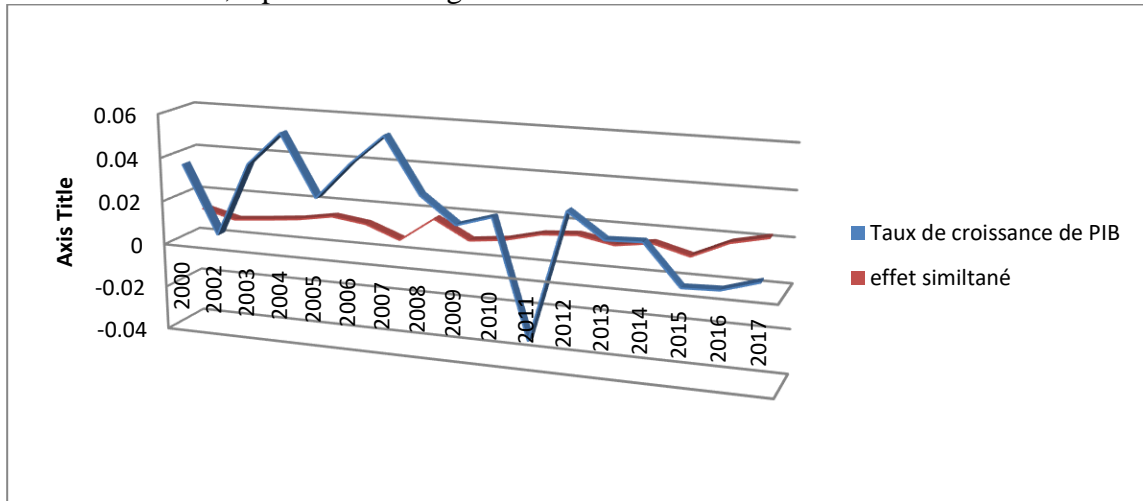
**Interpretations;**

**Informal economy equation (X4):**

Inflation, as defined by the World Bank, describes the implicit GDP deflator is the ratio of GDP in current local currency. We note here that price inflation does not have a direct effect on the Tunisian informal economy with a non-significant coefficient.

**GDP per capita growth rate equation (y):**

The robustness of the negative effect of the variation of the underground economy on the real GDP growth rate is a significant and negative coefficient at the 1% threshold. We can also identify the simultaneous positive effect of the variation in the underground economy and inflation on GDP, a positive and significant coefficient at the 1% level.



**Figure 5: The effect of the simultaneous variation of inflation and the underground economy on the GDP growth rate**

Source: our calculations (INS data)

The increase in the underground economy accentuates price inflation, which leads to an economic recession. The increase in the share of the informal economy in GDP over the period 2008-2017 (of which the year 2008 represents the lower limit) the rate increased from 27% to 36% accompanied by an increase in inflation as a percentage of GDP, the rate of which increased from 3% to 6% and a decrease in the GDP growth rate. We can see at this level that the informal economy increases inflation, which leads to an economic recession. Our result is justified by a recent study in which the authors tested the causal relationship between the informal economy and inflation in Morocco empirically using a time series econometric model over the period 1991 -2015, using VAR and Granger causality modeling techniques. According to the prediction of the model, a positive and significant effect of the underground economy on the rate of inflation. In other words, inflation increases with the increase in the size of the informal economy.

### **Governance variables:**

Our second hypothesis tests according to the simultaneous regression of the TMC method, namely the effect of the variation of governance variables (kauffman) on the underground economy and the simultaneous effects on the GDP growth rate. The results show the robustness of the negative effect of the variation of the underground economy on the growth rate of real GDP per capita.

### **Corruption<sup>10</sup> :**

We thus note according to the estimates that at the 1% threshold, there is a negative effect of the simultaneous variation of corruption and the underground economy on the growth rate of the negative coefficient of GDP of (0.374) P-value 0.024. There is no direct effect of the change in corruption on the informal economy, the coefficient is not significant, but the simultaneous effect varies in the opposite direction to the GDP growth rate. This shows that corruption increases parallel activities, which amplifies the extent of the underground economy in the GDP. The results obtained thus support the thesis of a set of works which would show that corruption stimulates the informal economy directly or indirectly citing the example of the study by Borlea, al (2017) the authors tested the simultaneous effect of the influence of corruption and the parallel economy on economic growth, the results show that there is a relationship that is both high and negative. This means that the increase in the level of corruption and the underground economy negatively influences economic growth.

### **Government effectiveness<sup>11</sup>:**

The variation in the governorship efficiency variable has a negative effect on the informal economy According to the World Bank, this variable "reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence. vis-à-vis political pressure, the quality of policy formulation and implementation, and the credibility of the government's commitment to these policies". We subsequently prove the direct effect of the variation in government efficiency on the size of the informal economy negative coefficient of (-1.019) and significant at the 10% threshold a negative relationship shows that any deterioration in the quality of public service and the structure of the state increases the percentage of the informal economy in the GDP. This generates an economic recession because the effect of the simultaneous variation of these two variables influences the GDP growth rate negatively, a negative coefficient of (-0.397) and significant at the 5% threshold P-value equal to 0.030.

We can interpret at this level that the efficiency of the government among the primary causes of the diffusion of the informal economy in Tunisia and the increase of its percentage in the GDP from one year to another, which subsequently generates the economic recession justified by the growth of the informal economy which we have already proven to have a negative effect on the GDP, including this increase caused by the deterioration of the efficiency of the government. .

### **Political stability<sup>12</sup>:**

Political stability is one of the causes that deepen the problem of the informal economy. A negative effect of the change in political stability on the underground economy negative coefficient of (0.035) and significant at the 5% threshold P-value equals 0.035.

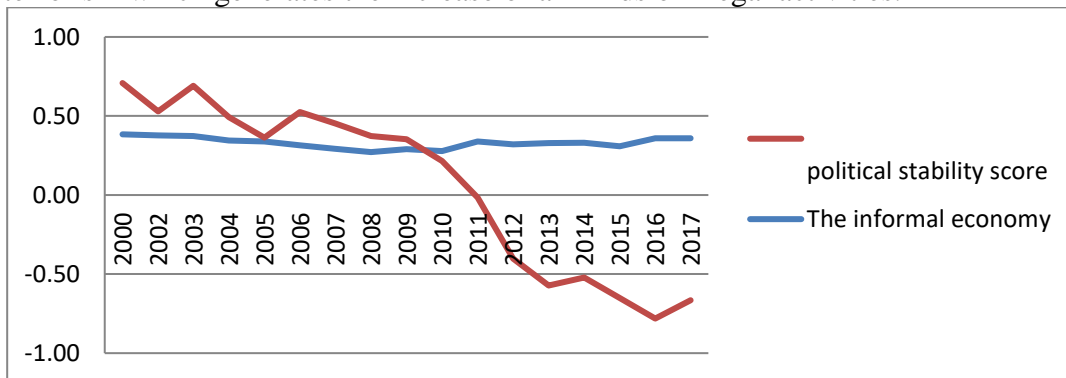
<sup>10</sup> II-8: the effect of corruption (x 5) on the informal economy (x4) and the simultaneous effect (x10) on the GDP growth rate (y).

<sup>11</sup> II-9: the effect of government effectiveness (x6) on the informal economy (x4) and the simultaneous effect (x14) on the GDP growth rate (y)

<sup>12</sup> II-10: the effect of political stability (x7) on the informal economy (x4) and the simultaneous effect (x15) on the GDP growth rate (y).

Political instability measured by the presence of politically motivated violence and terrorism can aggravate the situation of the informal sector. Our result obtained is confirmed by that of the ITCEQ published in 2017 in the article “The Unobserved Economy in Tunisia”. The authors showed that the unobserved economy had its maximum as a percentage of GDP and it kept almost the same percentage or it had a poor decrease from 2011 to 2014.

Over the period 2000-2009 the scores of political stability are all positive and above zero (Kaufman) at the same time the underground economy has experienced a poor decrease. But from 2010 where Tunisians have experienced moments of political instability with the Jasmine Revolution, Tunisia has experienced a total political imbalance, the spread of violence and terrorism which generates the increase of all kinds of illegal activities.



**Figure 6: The effect of variation in political stability on the informal economy**

Source: our calculations

The graph above shows the inverse relationship between the underground economy and political stability especially from the year 2011 where the score of political stability is negative and followed by a remarkable drop until the year 2017, the informal economy has experienced a poor increase, more or less increasing curve.

Regarding the simultaneous effect of political stability and the informal economy on the GDP growth rate, our results show that there is no justified effect with an insignificant coefficient.

**Regulatory quality and rule of law<sup>13</sup>.**

We emerge from the results that the two variables of the quality of regulation and rule of law do not have a direct effect on the underground economy nor a simultaneous effect on the GDP growth rate, the coefficients are not significant. Most of the scores for both variables are below zero. Regulatory quality, which reflects the perception of the government's ability to formulate and implement strong policies and regulations that enable and promote private sector development, has an average score of -0.15. Also, the rule of law variable that manifests the rule of law captures perceptions of the extent to which agents trust and respect the rules of society, and in particular the quality of contract enforcement, rights of property, police and courts, as well as the likelihood of crime and violence. This variable has an average score over the period 2000-2017 of -0.03. Despite the unfavorable situation of these two variables, our results show that there are no direct effects on the informal economy.

<sup>13</sup> II-11: the effect of the quality of regulation and rule of law respectively (x8), (x9) on the informal economy (x4) and the simultaneous effect (x16), (x17) on the growth rate of GDP (y)

### **The variables of economic freedom<sup>14</sup>:**

In terms of the index of economic freedom, our results show a negative effect of the variation in the variable of economic freedom on the underground economy, a negative and significant coefficient at the 5% threshold, i.e. (0.576) and equal p-value (0.046). A simultaneous negative effect also on the growth rate of real GDP per capita negative coefficient of (0.085) significant at the threshold of 1% p-value equal (0.000).

Economic freedom, as the authors of this ranking reminded us, is the fundamental right of every human being to control their own work and property. In an economically free society, individuals are free to work, produce, consume and invest as they see fit. In economically free societies, governments allow labor, capital, and goods to flow freely and refrain from constraining freedom beyond the extent necessary to protect and maintain freedom itself. Tunisia like most developing countries has the lowest index of economic freedom. According to the ranking published by the Heritage Foundation recently for the 2020 edition of its Index of Economic Freedom, which ranks more than 180 countries. Tunisia is present there and has been ranked among the least economically free countries. It is far surpassed by countries like Rwanda (33rd), Jordan (66th) and Morocco (78th). Tunisia's economic freedom score is 55.8 out of 100, making its economy the 128th freest in the 2020 index. Its overall score rose 0.4 points due to improved rights ownership and other indicators of the rule of law.

This situation pushes individuals and companies to move towards the informal sector to practice their activity. Our empirical results align with several studies that have tested the effect of sure economic freedom, such as Berdiev et al. (2018) the authors worked on the influence of the components of economic freedom on the underground economy. Analysis sample of 100 countries, observed over 15 years from 2000 to 2015. The results obtained by this work Economic freedom and its components reduce the volume of the underground economy. Also Yılmaz Bayar, Ömer Faruk Öztürk, on their part, showed according to a research on the effect of economic freedom, globalization and parallel economy in the transition economies of the European Union that economic globalization had a decreasing influence on the parallel economy.

We will therefore conclude that most of the empirical work is confirmed, that the more the less economically free countries the greater the percentage of the underground economy. This leads to economic recession.

To quantify the level of economic freedom enjoyed by the citizens of each country according to The Fraser Institute focused on 5 key variables:

- Government preponderance (size of government): public spending, tax burden, fiscal health
- Legal system and property rights: integrity of government, judicial efficiency;
- Sound Money: Money Growth, Standard Deviation of Inflation, Most Recent Year Inflation, Freedom to Own Foreign Currency Bank Accounts.
- Trade freedom: trade freedom, investment freedom, financial freedom
- Regulatory efficiency: business freedom, labor freedom, monetary freedom

We also empirically tested the effect of variations in the key variables of economic freedom to know very precisely which of these sub-variables have a direct effect on the percentage of the underground economy in GDP and also the simultaneous effect on the rate of GDP growth.

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<sup>14</sup> II-12: the effect of the global variable of economic freedom (x18) on the informal economy (x4) and the simultaneous effect (x181) on the GDP growth rate (y).

### **Government preponderance<sup>15</sup>:**

Negative relationship between the size of the governorate which reflects (level of public expenditure, tax burden and fiscal health) and the underground economy. Negative coefficient of (0.233) and significant at the 10% level.

According to the report of the Tunisian central bank, the illegal informal economy causes the Tunisian State a lack of tax revenue and social security contributions of 11.7 billion Dinars, which represents almost 28.8% of the 40.6 billion of the 2019 state budget. Also the budget deficit the same year amounts to 4 billion a deficit which will be filled by borrowing under very restrictive conditions. This loss in public spending can only create a fragile economic situation and an unfavorable business climate that discourages investment, deteriorates infrastructure and amplifies the inequality between formal and informal businesses. Tunisia's participation in the Open Budget Initiative launched by the World Bank, in which Tunisia was the only country in the MENA region to take part, this Public Expenditure Review (PER) aims to provide evidence allowing to probe the root causes of the failure of Tunisian fiscal policy through the analysis of the efficiency and equity of public expenditure by the central administration and public enterprises. Such a solution shows that priority must be given to the fight against fraud and tax evasion, to improving the efficiency of the tax administration and the incentives it offers, to integrating the informal sector and the establishment of a fairer taxation system for all. It is unlikely that a solution based exclusively on the mobilization of tax revenues through higher taxation and stronger growth that would make structural failures in public spending can solve Tunisia's budgetary difficulties. Such an approach could even exacerbate certain economic difficulties, such as the weak growth of the private sector and job creation or the expansion of the informal sector. Our results are aligned with several empirical works that take into account the effect of institutional development on informality. Most of which confirm that the institutional framework within minimizes informality. We cite as examples the works of Hießen (2010), Alm and Embaye (2013), Petreski (2014), Bayar and Ozturk (2016), Bayar (2016).

### **Legal system and property rights<sup>16</sup>:**

Regarding the integrity of government, judicial efficiency, there is no real a direct relationship between this variable and the informal economy. Our results show a non-significant coefficient for the effect of the variation of the legal system and property right and also the simultaneous effect of these two variables on the GDP growth rate for the case of Tunisia, but we can say that this is a unique condition because a lot of empirical work has shown that there is a negative effect of legal development on the size of the underground economy let us cite for example Torgler and Schneider (2009), thießen (2010), Bayar (2016), Bayar et al. (2018).

### **Sound money<sup>17</sup>:**

This variable reflects the situation of financial development in general such as monetary growth, Standard deviation of inflation, Inflation of the most recent year, Freedom to own foreign currency bank accounts. We have shown that there is a negative effect of the variation in sound money on the underground economy, a negative coefficient of (0.615) and significant at the 10% level. This situation increases the share of the informal economy in GDP, which generates

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<sup>15</sup> II-13: the effect of the government dominance variable (x19) on the informal economy (x4) and the simultaneous effect (x191) on the GDP growth rate (y).

<sup>16</sup> II-12: the effect of the legal system and property rights variable (x20) on the informal economy (x4) and the simultaneous effect (x201) on the GDP growth rate (y).

<sup>17</sup> II-13: the effect of the sound Money variable (x21) on the informal economy (x4) and the simultaneous effect (x211) on the GDP growth rate (y).

a simultaneous negative variation of these two variables (the informal economy and sound money) on the growth rate of real GDP per capita. Our result aligns with other empirical work which has shown that financial development reduces the size of the underground economy, we find Blackburn et al. (2012), Bayar and Ozturk (2016) the results of this empirical work show that there is a negative effect of financial development on the size of the underground economy.

#### **Freedom of trade<sup>18</sup>:**

Freedom of trade in Tunisia does not have a direct effect on the underground economy, of which our work shows that there is no direct and clear relationship between the informal economy and freedom of trade (insignificant coefficient) whereas that the simultaneous effect of these variables negatively influences the GDP growth rate, negative coefficient of (0.082) and significant at the 1% level.

#### **Regulatory efficiency<sup>19</sup>:**

A negative effect occurs on the underground economy caused by the variation of the regulatory efficiency coefficient significant at the threshold of 5% and negative of (0.442). This then generates a negative effect on the GDP growth rate. Also a significant and negative coefficient at the 1% threshold (0.086).

Regulations in Tunisia only increase the size of the informal economy, which reinforces the negative effect of the latter on the GDP growth rate. In most of the reports published by Heritage Foundation, the improvement of the degree of freedom in Tunisia accept that it remains dependent on the shortcomings in terms of taxation, financial freedom and governmental integrity, but also, to the progress of public policies based on the principles of free enterprise and individual freedom. Recent business reforms have focused on combining different registrations to start a business and improving the protection of minority investors. Youth unemployment levels are high and strikes in the phosphate sector indicate some level of labor unrest. The government is facing pressure from foreign lenders to cut public spending, including food and fuel subsidies, but the cuts will be politically sensitive.

We can say at this level that the degree of economic freedom is considered as a main cause in the improvement of the size of the informal economy because the score of this indicator is low compared to other developing countries and with middle income. Our work also shows that the sources of this weakness come mainly from government effectiveness (government dominance) and regulatory effectiveness. With regard to property rights and other indicators of the rule of law, our results show that there is no significant effect of the latter on the size of the informal economy. These results are justified by the fact that the increase in the economic freedom score in recent years is due to the improvement in property rights, state law and judicial efficiency, especially after the revolution.

#### **Unemployment<sup>20</sup> :**

Unemployment in Tunisia is one of the major problems that suffers from which the unemployment rate until 2020 reaches 17.4%. Also most works and research have shown that

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<sup>18</sup> II-14: the effect of the free trade variable (x22) on the informal economy (x4) and the simultaneous effect (x221) on the GDP growth rate (y).

<sup>19</sup> II-15: the effect of the regulatory efficiency variable (x23) on the informal economy (x4) and the simultaneous effect (x231) on the GDP growth rate (y).

<sup>20</sup> II-16: the effect of the unemployment variable (x24) on the informal economy (x4) and the simultaneous effect (x241) on the GDP growth rate (y).

the outbreak of the political crisis (caused by the revolution) was caused by the increase in unemployment, especially among young people.

Our result, with respect to unemployment, shows that the latter does not have a direct effect on the size of the underground economy. In other words, this remarkable increase in unemployment does not cause the variation of the informal economy coefficient to be insignificant. Also, the simultaneous variation of these two variables does not have an effect on the GDP growth rate. We can therefore conclude unemployment in general and young graduates in particular cannot be considered it as causes of the spread of informal activities in Tunisia. Relationship between unemployment and informal economy still remains a point of discussion for several researchers, there are studies that have shown that unemployment exerts a positive impact on the informal economy, citing for example Boeri and Garibaldi (2002), Dell 'Anno and Solomon (2008), Buček (2017). However, other authors like Sahnoun and Abden-nadher (2019) show that unemployment has a negative effect on the informal economy.

### **Conclusion**

The informal economy is a phenomenon that has existed in Tunisia for a long time, but it experienced its expansion with the Tunisian revolution of 2011. Our work in this article shows that the relationship between informality and growth is inverse, because the informal economy negatively influences the formal economy.

The explanatory variables for the expansion of this phenomenon are mainly due to the delay in the resumption of public and private investments, to political instability especially after the revolution. Tunisia has so far failed to find a favorable democratic climate to ensure political balance. Tunisia also suffers from the problem of government efficiency and the high level of corruption which, according to our results, have contributed to the growth of the informality rate. On the economic level, the variables of economic freedom stand in the way of the formal sector, which pushes people to involve in the informal sector, especially since Tunisia is ranked among the least economically free countries.

En savoir plus sur ce texte source Vous devez indiquer le texte source pour obtenir des informations supplémentaires

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Appendix I: An overview of the literature on all the explanatory variables of the informal economy.

I-1) : Other explanatory variables of informality.

Les déterminants de l'économie informelle	auteurs	Les effets des déterminants sur l'économie souterraine
Charge fiscale, sociale et réglementation du travail.	Kanniainen et al. (2004), Manolas et al. (2013), Schneider et Williams (2013), Stankevičius et Vasiliauskaitė (2014), Gasparėnienė et al. (2016), Buček (2017)	Ces auteures trouve qu'il existe un effet positive des Charge fiscale, sociale et réglementation du travail. Sur l'économie souterraine
Chômage	Boeri et Garibaldi (20 02), Dell 'Anno et Solomon (2008), Buček (2017)	Impacte positive de chômage sur l'économie souterraine.
Sahnoun et Abdenadher (2019)		Effet négative de chômage sur l'économie souterraine.
Développement financière	Blackburn et coll. (2012), Bayar et Ozturk (2016)	Un effet négatif de développement financière sur la taille de l'économie souterraine
Libéralisation du commerce	Ghosh et Paul (2008), Fugazza et Fiess (2010)	Effet positif de la liberté de commerce sur la taille de l'économie souterraine.
Développement institutionnel	thießen (2010), Alm et Embaye (2013), Petreski (2014), Bayar et Ozturk (2016), Bayar (2016)	Impacte négatif de développement institutionnel sur la taille de l'économie souterraine
Développement juridique	Torgler et Schneider (2009), thießen (2010), Bayar (2016), Bayar et al. (2018)	Les auteurs trouvent qu'il existe un effet négatif de développement juridique sur la taille de l'économie souterraine.
La corruption	Manolas et coll. (2013), Albulescu et coll. (2016), Borlea et coll. (2017), Bayar et coll. (2018)	Un effet positif de la corruption sur l'économie souterraine.
Dreher et Schneider (2010)		Il n'y a pas réellement un effet significatif de la corruption sur l'économie souterraine.

I-2) the effect of economic freedom on the parallel economy. Recently published studies.

## Des études récemment publiées. Les auteurs

	<b>Travaux empirique</b>	<b>Résultats obtenus</b>
Tekin et al. (2018)	L'effet de la liberté économique sur l'évasion fiscale. échantillon d'analyse de 63 pays.	La liberté économique influence négativement l'évasion fiscale.
Berdiev et al. (2018)	l'influence des composants de la liberté économique sur l'économie souterraine. Echantillon d'analyse de 100 pays observé sur 15 ans de 2000 à 2015.	La liberté économique et ses composants réduisent le volume de l'économie souterraine.
Aleman-Castilla (2006)	l'effet de l'ALENA (Accord de libre-échange nord-américain) sur l'économie parallèle au Mexique	les réductions des droits d'importation réduisaient l'informalité en augmentant la rentabilité pour les entreprises.
Farzanegan et Hassan (2017)	étudié l'influence de la mondialisation économique sur l'économie parallèle en Égypte au cours de la période 1976–2013 avec une analyse VAR.	montre que la réponse de l'économie souterraine en Égypte aux chocs positifs de la mondialisation économique est négative et statistiquement significative pendant les trois premières années suivant le choc. Cette constatation est obtenue en contrôlant plusieurs canaux intermédiaires dans le lien mondialisation-économie souterraine tels que l'éducation, les dépenses publiques, la production industrielle et la participation à la main-d'oeuvre. Nos résultats montrent combien il est important de promouvoir la mondialisation économique en réduisant les coûts des affaires et du commerce face à l'importante économie parallèle en Égypte
Yılmaz Bayar, Ömer Faruk Öztürk	Liberté économique, mondialisation et économie parallèle dans les économies de transition de l'Union européenne	ont révélé que la mondialisation économique avait une influence décroissante sur l'économie parallèle

Blanton et al. (2018)

étudié l'influence de l'ouverture économique sur la taille de l'économie souterraine dans 145 pays pour la période 1971-2012

l'ouverture économique réduisait la taille de l'économie souterraine.

Berdiev et Saunoris (2018)

étudié l'influence des principaux types de mondialisation sur l'économie souterraine dans 119 pays entre 2000 et 2007 par analyse de régression

découvert que la mondialisation, la mondialisation économique et politique réduisait l'économie souterraine

Appendix II: estimates by the TMC method

I-1: Matrix Z (column matrix of coefficients  $\beta X$  \* row matrix of exogenous variables (x))

Source : Nos calculs

	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
$\beta_0$	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_1$	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_2$	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_3$	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_4$	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_5$	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_6$	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_7$	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_8$	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_9$	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_{10}$	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_{11}$	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_{12}$	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_{13}$	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
$\beta_{14}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
$\beta_{15}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
$\beta_{16}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
$\beta_{17}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
$\beta_{18}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
$\beta_{19}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
$\beta_{20}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
$\beta_{21}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
$\beta_{22}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
$\beta_{23}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
$\beta_{24}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
$\beta_{25}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

## II-2: Stationarity test of variables

. dfuller d(x4), lags(0)

Dickey-Fuller test for unit root		Number of obs = 14		
Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Interpolated Dickey-Fuller
Z (t)	-4.385	-3.750	-3.000	-2.630

MacKinnon approximate p-value for Z(t) = 0.0003

. dfuller d(y1), lags(0)

Dickey-Fuller test for unit root		Number of obs = 14		
Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Interpolated Dickey-Fuller
Z (t)	-5.619	-3.750	-3.000	-2.630

MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller d(x19), lags(0)

Dickey-Fuller test for unit root		Number of obs = 14		
Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Interpolated Dickey-Fuller
Z (t)	-3.543	-3.750	-3.000	-2.630

MacKinnon approximate p-value for Z(t) = 0.0070

*Rq : Il est bien de noter que d'après nous essais nous pouvons confirmer que tous les variables sont stationnaires à la différence première. Ce trouve ci-dessus quelques exemples d'essais seulement.*

## II-3: Auto-correlation test of variables.

. corr d(x4) d(x1) d(y1) d(x2) d(x3) d(x5) d(x6) d(x7) d(x8) d(x9) d(x10) d(x14) d(x15) d(x16) d(x17)  
(obs=15)

	D. x4	D. x1	D. y1	D. x2	D. x3	D. x5	D. x6	D. x7	D. x8	D. x9	D. x10	D. x14	D. x15	D. x16	D. x17
x4	1.0000														
D1. x1	-0.5685	1.0000													
D1. y1	-0.4857	0.1676	1.0000												
x2				1.0000											
D1. x3	-0.0071	-0.0355	0.0000	1.0000											
D1. x5	-0.5415	0.2230	0.1085	0.3490	1.0000										
D1. x6	0.3301	0.0203	-0.2022	-0.2570	-0.1374	1.0000									
D1. x7	-0.2798	0.3612	0.2316	-0.2464	-0.2149	0.1682	1.0000								
D1. x8	-0.3298	0.1527	0.1128	0.0133	0.0558	-0.1177	0.5710	1.0000							
D1. x9	-0.4663	0.3544	0.3804	0.3145	0.1584	-0.2811	0.5769	0.7140	1.0000						
D1. x10	-0.4465	0.2535	0.3925	-0.0702	-0.2157	-0.0366	0.5646	0.3769	0.2566	1.0000					

**II-4: estimation of the reciprocal effect Informal economy and economic growth.**

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
y1	x4						
	D1.	-.600514	.1494786	-4.02	0.000	-.8934866	-.3075414
x4	y1						
	D1.	-1.926474	1.939895	-0.99	0.321	-5.728598	1.87565

Endogenous variables: y1 x4  
 Exogenous variables: D.x4 D.y1

**II-5: the effect of the investment (x1) on the informal economy (x4) and the simultaneous effect (x11) on the GDP growth rate (y).**

. reg3( y1=(x11),noconstant) (x4= d(y1)d(x1),noconstant)

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	1	.0207189	0.5590	16.51	0.0000
x4	15	2	.2955305	0.1681	3.62	0.1633

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
y1	x11	.30642	.0754033	4.06	0.000	.1586323	.4542077
x4	y1	.4501174	3.033142	0.15	0.882	-5.494731	6.394966
	D1.						
	x1	-10.86084	5.723318	-1.90	0.058	-22.07834	.3566579
	D1.						

Endogenous variables: y1 x4  
 Exogenous variables: x11 D.y1 D.x1

. reg3( y1=d(x4)(x11),noconstant) (x4= d(y1)d(x1),noconstant)

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	2	.0125568	0.8380	81.07	0.0000
x4	15	2	.2949422	0.1714	3.11	0.2110

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
y1	x4						
	D1.	-.6334085	.1242734	-5.10	0.000	-.8769799	-.3898371
	x11	.3282127	.0460275	7.13	0.000	.2380004	.4184249
x4	y1						
	D1.	1.220031	3.044252	0.40	0.689	-4.746595	7.186656
	x1	-10.10199	5.741866	-1.76	0.079	-21.35584	1.15186
	D1.						

Endogenous variables: y1 x4  
 Exogenous variables: D.x4 x11 D.y1 D.x1

*Rq : La robustesse de l'effet négatif de la variation de l'économie informelle(X4) sur Le PIB*

## II-6: the effect of trade (x 3) on the informal economy (x4) and the simultaneous effect (x13)

```
. reg3( y1=(x12),noconstant) (x4= d(y1)d(x2),noconstant)
```

Three-stage least-squares regression

Equation	Obs	Farms	RMSE	"R-sq"	chi2	F
y1	15	1	.0238365	0.4163	8.13	0.0044
x4	15	2	.3202374	0.0232	0.61	0.7382

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x12	1.283931	.4502847	2.85	0.004	.4013894 2.166473
x4	y1 D1.	-.7006283	3.223364	-0.22	0.828	-7.018305 5.617049
	x2 D1.	3.566333	4.767307	0.75	0.454	-5.777417 12.91008

Endogenous variables: y1 x4  
 Exogenous variables: x12 D.y1 D.x2

```
. reg3( y1=(x12),noconstant) (x4=d(x2),noconstant)
```

Three-stage least-squares regression

Equation	Obs	Farms	RMSE	"R-sq"	chi2	F
y1	15	1	.023855	0.4153	8.02	0.0046
x4	15	1	.3194735	0.0278	0.56	0.4524

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x12	1.273707	.449801	2.83	0.005	.3921135 2.155301
x4	x2 D1.	3.579379	4.763096	0.75	0.452	-5.756118 12.91488

Endogenous variables: y1 x4  
 Exogenous variables: x12 D.x2

```
. reg3( y1=(x13),noconstant) (x4= d(y1)d(x3),noconstant)
```

Three-stage least-squares regression

Equation	Obs	Farms	RMSE	"R-sq"	chi2	F
y1	15	1	.0216121	0.5201	15.82	0.0001
x4	15	2	.3221749	0.0113	0.19	0.9116

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x13	.0727284	.0182827	3.98	0.000	.036895 .1085618
x4	y1 D1.	.2438302	3.307084	0.07	0.941	-6.237935 6.725596
	x3 D1.	-.3780632	.8802606	-0.43	0.668	-2.103342 1.347216

Endogenous variables: y1 x4  
 Exogenous variables: x13 D.y1 D.x3

```
. reg3( y1=d(x4) (x13),noconstant) (x4= d(y1)d(x3),noconstant)
```

Three-stage least-squares regression

Equation	Obs	Farms	RMSE	"R-sq"	chi2	F
y1	15	2	.0138761	0.8022	60.56	0.0000
x4	15	2	.3221607	0.0114	0.17	0.9181

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x4 D1.	-.6359981	.1375536	-4.62	0.000	-.9055982 -.366398
	x13	.0708487	.0117544	6.03	0.000	.0478104 .093887
x4	y1 D1.	.3208397	3.307385	0.10	0.923	-6.161515 6.803195
	x3 D1.	-.360921	.8803412	-0.41	0.682	-2.086358 1.364516

Endogenous variables: y1 x4  
 Exogenous variables: D.x4 x13 D.y1 D.x3

**II-7: the effect of inflation (x 2) on the informal economy (x4) and the simultaneous effect (x12) on the GDP growth rate (y).**

. reg3( y1=(x12),noconstant) (x4= d(y1)d(x2),noconstant)

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	1	.0238365	0.4163	8.13	0.0044
x4	15	2	.3202374	0.0232	0.61	0.7382

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x12	1.283931	.4502847	2.85	0.004	.4013894 2.166473
x4	y1 D1.	-.7006283	3.223364	-0.22	0.828	-7.018305 5.617049
	x2 D1.	3.566333	4.767307	0.75	0.454	-5.777417 12.91008

Endogenous variables: y1 x4  
 Exogenous variables: x12 D.y1 D.x2

. reg3( y1=(x12),noconstant) (x4=d(x2),noconstant)

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	1	.023855	0.4153	8.02	0.0046
x4	15	1	.3194735	0.0278	0.56	0.4524

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x12	1.273707	.449801	2.83	0.005	.3921135 2.155301
x4	x2 D1.	3.579379	4.763096	0.75	0.452	-5.756118 12.91488

Endogenous variables: y1 x4  
 Exogenous variables: x12 D.x2

. reg3( y1=(x13),noconstant) (x4= d(y1)d(x3),noconstant)

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	1	.0216121	0.5201	15.82	0.0001
x4	15	2	.3221749	0.0113	0.19	0.9116

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x13	.0727284	.0182827	3.98	0.000	.036895 .1085618
x4	y1 D1.	.2438302	3.307084	0.07	0.941	-6.237935 6.725596
	x3 D1.	-.3780632	.8802606	-0.43	0.668	-2.103342 1.347216

Endogenous variables: y1 x4  
 Exogenous variables: x13 D.y1 D.x3

. reg3( y1=d(x4) (x13),noconstant) (x4= d(y1)d(x3),noconstant)

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	2	.0138761	0.8022	60.56	0.0000
x4	15	2	.3221607	0.0114	0.17	0.9181

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x4 D1.	-.6359981	.1375536	-4.62	0.000	-.9055982 -.366398
	x13	.0708487	.0117544	6.03	0.000	.0478104 .093887
x4	y1 D1.	.3208397	3.307385	0.10	0.923	-6.161515 6.803195
	x3 D1.	-.360921	.8803412	-0.41	0.682	-2.086358 1.364516

Endogenous variables: y1 x4  
 Exogenous variables: D.x4 x13 D.y1 D.x3

**II-8: the effect of corruption (x 5) on the informal economy (x4) and the simultaneous effect (x10) on the GDP growth rate (y).**

```
. reg3( y1=d(x1)d(x10),noconstant) (x4=d(y1)d(x5),noconstant)
```

Three-stage least-squares regression

Equation	Obs	Farms	RMSE	"R-sq"	chi2	P
y1	15	2	.0283969	0.1715	7.13	0.0283
x4	15	2	.3192421	0.0293	2.90	0.2345

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x1					
	D1.	.8192212	.3834748	2.14	0.033	.0676244 1.570818
x4	x10					
	D1.	-.3558677	.1705963	-2.09	0.037	-.6902302 -.0215051
y1	x4					
	D1.	-3.308987	2.262017	-1.46	0.144	-7.742459 1.124484
x4	x5					
	D1.	-.7117914	.6508769	-1.09	0.274	-1.987487 .5639039

Endogenous variables: y1 x4

Exogenous variables: D.x1 D.x10 D.y1 D.x5

**II-9: the effect of government effectiveness (x6) on the informal economy (x4) and the simultaneous effect (x14) on the GDP growth rate (y).**

```
. reg3( y1=d(x1)d(x14)d(x10),noconstant) (x4=d(x6)d(x5),noconstant)
```

Three-stage least-squares regression

Equation	Obs	Farms	RMSE	"R-sq"	chi2	P
y1	15	3	.0262356	0.2928	11.47	0.0094
x4	15	2	.3012025	0.1359	4.09	0.1295

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x1					
	D1.	1.006514	.3744097	2.69	0.007	.2726843 1.740343
x4	x14					
	D1.	-.3315174	.1702458	-1.95	0.052	-.6651931 .0021583
y1	x10					
	D1.	-.2832594	.1625156	-1.74	0.081	-.601784 .0352653
x4	x6					
	D1.	-.9938481	.5525891	-1.80	0.072	-2.076903 .0892065
x4	x5					
	D1.	-.3621789	.6277822	-0.58	0.564	-1.592609 .8682517

Endogenous variables: y1 x4

Exogenous variables: D.x1 D.x14 D.x10 D.x6 D.x5

**II-10: the effect of political stability (x7) on the informal economy (x4) and the simultaneous effect (x15) on the GDP growth rate (y).**

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x1					
	D1.	.7348551	.4017936	1.83	0.067	-.0526459 1.522356
x4	x15					
	D1.	-.1391648	.138357	-1.01	0.314	-.4103396 .13201
x4	x7					
	D1.	-.8500984	.4024929	-2.11	0.035	-1.63897 -.0612268

Endogenous variables: y1 x4

Exogenous variables: D.x1 D.x15 D.x7

**II-11: the effect of the quality of regulation and rule of law respectively (x8), (x9) on the informal economy (x4) and the simultaneous effect (x16), (x17) on the growth rate of GDP (y)**

. reg3 (y1= d(x4) d(x17)d(x16),noconstant) (x4= d(y1)d(x8) d(x9),noconstant)

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	3	.0253715	0.3386	14.38	0.0024
x4	15	3	.3187008	0.0325	1.51	0.6808

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x4					
	D1.	-.5596453	.1971878	-2.84	0.005	-.9461263 -.1731643
	x17					
	D1.	.1838402	.2440774	0.75	0.451	-.2945427 .662223
x16						
	D1.	-.0958107	.1922585	-0.50	0.618	-.4726305 .2810091
x4	y1					
	D1.	-2.230491	2.17339	-1.03	0.305	-6.490256 2.029274
	x8					
	D1.	-.3506348	.797766	-0.44	0.660	-1.914227 1.212958
	x9					
	D1.	.6932725	.896148	0.77	0.439	-1.063145 2.44969

Endogenous variables: y1 x4

Exogenous variables: D.x4 D.x17 D.x16 D.y1 D.x8 D.x9

### II-12: the effect of the global variable of economic freedom (x18) on the informal economy (x4) and the simultaneous effect (x181) on the GDP growth rate (y).

. reg3 ( y1= d( x181),noconstant) (x4=d(y1)d(x18),noconstant)

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	1	.0266433	0.2707	14.20	0.0002
x4	15	2	.3358872	-0.0746	4.57	0.1017

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x181					
	D1.	-.0857804	.022762	-3.77	0.000	-.1303931 -.0411677
x4	y1					
	D1.	-3.803019	2.369582	-1.60	0.109	-8.447313 .8412756
	x18					
	D1.	-.5767862	.2888491	-2.00	0.046	-1.14292 -.0106523

Endogenous variables: y1 x4

Exogenous variables: D.x181 D.y1 D.x18

### II-13: the effect of the government dominance variable (x19) on the informal economy (x4) and the simultaneous effect (x191) on the GDP growth rate (y).

```
. reg3( y1=d( x191),noconstant) (x4=d(x19),noconstant)
```

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	1	.029578	0.1012	7.88	0.0050
x4	15	1	.3432732	-0.1224	3.47	0.0623

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x191 D1.	-.079231	.0282195	-2.81	0.005	-.1345402    -.0239218
x4	x19 D1.	-.2339563	.1255171	-1.86	0.062	-.4799652    .0120526

Endogenous variables: y1 x4  
 Exogenous variables: D.x191 D.x19

### II-14: the effect of the legal system and property rights variable (x20) on the informal economy (x4) and the simultaneous effect (x201) on the GDP growth rate (y).

```
. reg3( y1=d( x201),noconstant) (x4=d(y1) d(x20),noconstant)
```

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	1	.0277072	0.2113	9.27	0.0023
x4	15	2	.3384997	-0.0914	2.61	0.2714

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x201 D1.	-.0604617	.0198616	-3.04	0.002	-.0993898    -.0215337
x4	y1 D1.	-3.943137	3.199506	-1.23	0.218	-10.21405    2.32778
	x20 D1.	-.2357152	.1483701	-1.59	0.112	-.5265153    .0550849

Endogenous variables: y1 x4  
 Exogenous variables: D.x201 D.y1 D.x20

### II-15: the effect of the Healthy Money variable (x21) on the informal economy (x4) and the simultaneous effect (x211) on the GDP growth rate (y).

```
. reg3( y1=d( x211),noconstant) (x4=d(x21)d(x18),noconstant)
```

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	1	.0257583	0.3183	21.50	0.0000
x4	15	2	.3156488	0.0510	2.78	0.2496

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
y1	x211 D1.	-.0984454	.0212333	-4.64	0.000	-.1400618    -.0568289
x4	x21 D1.	-.6156738	.3696402	-1.67	0.096	-1.340155    .1088077
	x18 D1.	-.1039035	.2198131	-0.47	0.636	-.5347293    .3269224

Endogenous variables: y1 x4  
 Exogenous variables: D.x211 D.x21 D.x18

### II-16: the effect of the free trade variable (x22) on the informal economy (x4) and the simultaneous effect (x221) on the GDP growth rate (y).

```
. reg3( y1= d( x221),noconstant) (x4=d(x22),noconstant)
```

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	1	.0278496	0.2031	12.90	0.0003
x4	15	1	.3336568	-0.0604	1.67	0.1966

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
y1	x221						
	D1.	-.082883	.0230791	-3.59	0.000	-.1281172	-.0376488
x4	x22						
	D1.	-.2440246	.1889573	-1.29	0.197	-.6143741	.1263249

Endogenous variables: y1 x4

Exogenous variables: D.x221 D.x22

### II-15: the effect of the regulatory efficiency variable (x23) on the informal economy (x4) and the simultaneous effect (x231) on the GDP growth rate (y).

```
. reg3( y1= d( x231),noconstant) (x4=d(x23),noconstant)
```

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	1	.0277113	0.2110	16.27	0.0001
x4	15	1	.3388707	-0.0938	3.89	0.0485

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
y1	x231						
	D1.	-.0868029	.0215194	-4.03	0.000	-.1289801	-.0446256
x4	x23						
	D1.	-.4427425	.2244234	-1.97	0.049	-.8826042	-.0028807

Endogenous variables: y1 x4

Exogenous variables: D.x231 D.x23

### II-16: the effect of the unemployment variable (x24) on the informal economy (x4) and the simultaneous effect (x241) on the GDP growth rate (y).

```
. reg3( y1=d( x241),noconstant) (x4=d(x24),noconstant)
```

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	15	1	.0294723	0.1076	2.07	0.1498
x4	15	1	.3299648	-0.0371	0.87	0.3509

		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
y1	x241						
	D1.	-1.153015	.8006566	-1.44	0.150	-2.722273	.4162432
x4	x24						
	D1.	4.110207	4.406094	0.93	0.351	-4.525579	12.74599

Endogenous variables: y1 x4

Exogenous variables: D.x241 D.x24

### Annexe VII : les estimations par la méthode de VAR.

- VII-1 : Nombre optimum de retard, le critère d'information d'Akaike.

*Modèle : économie informelle, taux de croissance du PIB, investissement.*

. estat ic

Akaike's information criterion and Bayesian information criterion

Model	Obs	ll (null)	ll (model)	df	AIC	BIC
.	13	.	20.7274	21	.5452023	12.40914

Note: N=Obs used in calculating BIC; see [\[R\] BIC note](#)

*Modèle : économie informelle, taux de croissance du PIB, inflation*

. estat ic

Akaike's information criterion and Bayesian information criterion

Model	Obs	ll (null)	ll (model)	df	AIC	BIC
.	13	.	20.45316	21	1.093689	12.95763

Note: N=Obs used in calculating BIC; see [\[R\] BIC note](#)

*Modèle : économie informelle, taux de croissance du PIB, Echange commercial*

~~Akaike's information criterion and Bayesian information criterion~~

<del>Model</del>	<del>Obs</del>	<del>ll (null)</del>	<del>ll (model)</del>	<del>df</del>	<del>AIC</del>	<del>BIC</del>
<del>.</del>	<del>13</del>	<del>.</del>	<del>20.45316</del>	<del>21</del>	<del>1.093689</del>	<del>12.95763</del>

~~Note: N=Obs used in calculating BIC; see [\[R\] BIC note](#)~~

*Modèle : économie informelle, taux de croissance du PIB, efficacité du gouvernement :*

Akaike's information criterion and Bayesian information criterion

Model	Obs	ll (null)	ll (model)	df	AIC	BIC
.	13	.	81.82707	21	-121.6541	-109.7902

Note: N=Obs used in calculating BIC; see [\[R\] BIC note](#)

*Modèle : économie informelle, taux de croissance du PIB, stabilité politique :*

Akaike's information criterion and Bayesian information criterion

Model	Obs	ll (null)	ll (model)	df	AIC	BIC
.	13	.	-13.68699	21	69.37397	81.23791

Note: N=Obs used in calculating BIC; see [\[R\] BIC note](#)

*Modèle : économie informelle, taux de croissance du PIB, liberté économique :*

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Akaike's information criterion and Bayesian information criterion

Model	Obs	ll (null)	ll (model)	df	AIC	BIC
.	13	.	-14.19744	21	70.39488	82.25882