The impact of shadow economy on non-oil GDP growth in Algeria from 1991 to 2017.

أثر اقتصاد الظل على نمو الناتج الداخلي الخام خارج المحروقات في الجزائر من 1991 إلى 2017.

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Abstract:
This study aims to analyses the effect of the shadow economy on non-oil GDP growth during the period 1991 to 2017 in Algeria.Using Autoregressive distributed lag (ARDL) methodology, the results revealed that the shadow economy and non-oil GDP growth are co-integrated. The short-run dynamics and long-run relationship showed that the shadow economy has a negative impact on the non-oil economic growth in the short-run and a positive impact on the long-run.
keyword:Shadow economy, non-oil GDP, ARDL model.
JEL classification code :O17, O47.C29

ملخص:
تهدف هذه الدراسة إلى تحليل أثر اقتصاد الظل على نمو الناتج الداخلي الخام خارج المحروقات خلال الفترة من 1991 إلى 2017 في الجزائر. باستخدام منهجية الانحدار الخطي للفجوات الموزعة، وقد أسفرت النتائج على أن اقتصاد الظل والناتج الداخلي الخام خارج المحروقات متكاملان. العلاقة الديناميكية في الأجل القصير والأجل الطويل أظهرت أن اقتصاد الظل يؤثر سلبا على الناتج الداخلي الخام خارج المحروقات في أجل القصير وتأثير موجب في أجل الطويل.
الكلمات المفتاحية: اقتصاد الظل، ناتج الداخلي الخام خارج المحروقات، انحدار الخطي للفجوات الموزعة.
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1. Introduction :

In the last half century, the shadow economy has received ever increasing attention among the public and politicians in all over the world, it has been the main subject of many debates (Gutmann (1977); Frey & Weck-Hannemann (1984); Loayza (1996); Tedds & Giles (2000); Schneider & Enste (2003);Davidescu & Schneider (2019)), it is called Black, hidden, underground, unobserved, unrecorded, subterranean, informal, shadow, irregular, twilight, parallel. These are just a handful of the terms that have been used to describe economic activity which, for whatever reason, is not directly measured by any of the usual economic and fiscal indicators (Tedds, 1998, p. 1) According to (Aigner, Schneider, & Ghosh, 1988, p. 297) there are several important reasons why politicians and the public in general should be concerned about the growth and size of the shadow economy. Among the most important of these are:

- If an increase in the size of the shadow economy is mainly caused by a rise in the tax burden, an increased tax rate may lead to a decrease in tax receipts and thus further increase the budget deficit.
- The rise of the shadow economy can be seen as a reaction of individuals to their overburdening by state activities (such as high taxes and an increasing number of state regulations).
- If economic policy measures are based on mistaken "officially measured" indicators (such as unemployment), these measures may be at least of a wrong magnitude. In such a situation a prospering shadow economy may cause a severe problem for political decision makers because it leads to quite unreliable officially measured indicators, so that even the direction of intended policy measures may be questionable.

This implication can have an impact on the official economy, especially the economic growth. The relationship between shadow economy and

economic growth is still ambiguous to the current time, many scholars and researchers have a contradictory opinion on the relationship between growth and shadow economy. One stream of the literature associates higher shadow economy with lower growth, another stream argues the opposite (Ceyhun&Serdar , 2016, p. 273).

In the case of Algeria, the debate on whether shadow economy positively impact the economic growth KORI (2018) or the opposite case Bounoua, Sebbah & Benikhlef (2014) is still standing up till to day. Moreover, the existing literature on this relation in Algeria is small expressly in the empirical studies. We find that researchers focused on the economic growth from GDP point of view and neglegating that Algeria is an oil producing country with an importan size of shadow economy which my leads to a miss leading findings.

To address this gap in the literature, this paper focuses on the impact of shadow economy from the non-oil GDP point of view. The main research object is to answer the following question:

What is the impact of shadow economy on non-oil GDP growth in Algeria from 1991 to 2017?

In order to investigate this questions, we conducted a literature review on the nexus between this two economic phenomenon followed by empirical study.

The paper is organized as follows, in the next section we explore the interaction between shadow economy and economic growth, in section three literature review, in section four methodology and data, in section five results, finally in the last section we conclude.

2. Relation between shadow economy and economic growth:

There are various studies, who examined the interaction between shadow economy and economic growth by integrating the shadow economy into macroeconomic models, and empirically examine how

this relationship works and whether the positive effect leads over negative one or vice versa.

To better understand how these two economic phenomena interact with each other we provide the table1 below which summaries the interaction between shadow economy and economic growth in to three main topics namely taxation, general locations and biased effects of economic policies(Schneider & hametner, 2014, p. 298)

Table1 : Interactions between the shadow and official economy

The shadoweconomy influences	**Through**	**Effects on official economy and overalleconomic performance**
Tax system →	Taxevasion →	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 shadow economy activity is complementary to the official economy, extra income is generated via the shadow economy which is then (at least partly) spent in the official economy for goods and services
Allocations →	Stronger → competitionand stimulationofmarkets	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 ruinouscompetition Problems in information flows forproducers and consumers due to reductionin transparency and lack of structure inunofficial sector
→	→	→
Policy decisions	Bias in officially published data	Stabilizing, re-distributional and fiscalpolicies may fail desired effects

Source: Schneider &Hametner, 2014, p. 298

According to Schneider, Buehn & Montenegro (2010) the official economy could never work efficiently if it were totally separated from the shadow economy. therefore, there is a important interaction between this two complexed economic phenomenon. Some researchers argue that this two are complementary to each other likeBajada & Schneider (2005)**,** Bovi & Dell'Anno (2010)and that's because firms apperating in the shadows tend to employ lower-skilled workers meaning lowering the purser of unemployment on the official economy, operating with less capital. This adverse selection in itself could raise productivity in the formal sectorAmaral & Erwan (2006)**.** However**,** other researchers argue that shadow economy is substitutional for the official economy Loayza, Oviedo & Luis (2004), Johnson, Daniel & Andrei (1997) thus lowering the 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 shadow economy could severely limit government resources to finance several public goods such as education, health, or infrastructure investment. Hassan & Schneider (2016) 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 case.

3. Literaturereview :

There is a considered number of studies witch analyzed the determinants of shadow economy and it size around the world using many approaches and variables. on the other hand, this research can be seen as addressing the effects of the shadow economy on the economic growth the literature on this topic is relatively small spatially in the Algerian caseKori (2018).

Schneider& hametner (2014) analyzed the interaction between shadow and official economy in Colombia during the period 1980 to 2012. They specified their study model of economic growth as follow: GDP per capita to reflect the economic growth as dependent variable in addition to inflation, exchange rate, domestic and foreign direct investment, population, human capita, labor, public spendingand shadow economy as independent variables.

Results demonstrated a clear negative relation between the size of the shadow economy and the growth rates of real GDP per capita: The average growth rate of real GDP per capita between 1980 and 2012 was 1.86 %, without illicit activity the real economy would have grown between 1.96 % and 2.01 % on a yearly average during the period of the study.

Gheorghe &Zizi (2015) aimed to test the relationship between shadow economy and economic growth in Romania over the period

from 1999 to 2012. They regressed GDP as dependent variable against shadow economy using OLS methodology and three econometric models; the results showed a negative relation between shadow economy and economic growth in Romania during the study period, in addition to a co-integrating relationship, suggesting that shadow economy is consistently related to the official economy and they display similar trends on the long-run.

Ceyhun&Serdar (2016) Studied the relation among shadow economy and economic growth using classical growth model for using panel data of 161 countries from 1950 to 2010. The researchers reflected the economy growth in their model with GDP per capita and shadow economy as explanatory variable in addition to control variables. The study concluded with nonlinear relation between the two variables (Inverted-U relationship) and small and large sizes of the informal economy are associated with little growth and medium levels of the size of the informal economy are associated with higher levels of growth.

Rajeev et all (2017) investigated empirically the estimated the short-run dynamics and long-run relationship between shadow economy on USA economic growth reflected by GDP per capita growth from 1870 to 2014 using a neo-classical growth model and controlled for investment and labor quality. Empirical results indicated economy had a negative effect on economic growth; however, post-WWII the shadow economy was beneficial for growth.

Olga et all (2018) considered whether the shadow activity has a positive or negative impact on the economy and social sphere of the state. They tried to find out if the shadow economy could be a source of economic growth. The authors concluded that the relationship among shadow economy and economic growth is ambiguous and differs among countries in example in the Russian case the shadow economy negatively influence the economic growth.

Nedra&Younes (2018) Founed by using a dynamic simultaneous equation model for 17 developing and 33 developed countries over the period 2005-2015, that the relationship between economic growth (classical economic growth) and the shadow economy is unidirectional in the MENA countries, but it is bidirectional in the OECD countries. The empirical study also revealed higher GDP per capita is related with a smaller shadow economy in countries with a good institutional quality. However, in countries where institutional quality is low, the rise of GDP per capita does not affect the size of the shadow economy.
Kori (2018) Targeted the relationship between shadow economy and economic growth in Algeria over the period 1995-2016 using autoregressive distributed lag ARDL and proposing two models to investigate this relationship. The empirical findings suggested that the shadow economy has a positive effect on GDP. 1% rise in shadow economy escalation the GDP by about 0.4 % in the short-run and about 0.8 % in the long-run.

4. Studymethodology:

4.1 Model specification:

Based on the previews literature stated above, economic theory and in order to determine the dynamic relationship between shadow economy and non-oil GDP growth in Algeria we use the Cobb-Douglas production function following the footsteps of Nedra&younes (2018) andCeyhun&sedar (2016). The general form takes the following form:

$$Y = AK^{\alpha}L^{\beta} \quad (1)$$

Where Y represents the non-oil GDP growth, K is capital stock, L is labor, A is technological progress, α and β refer to the output elasticity, of capital and labor, respectively.

We first introduce the shadow economy to equation (1) and we rerate it in a linear form as :

$$non - oil\ GDP\ = \alpha_0 + \alpha_1 SE + \alpha_2 K + \alpha_3 L \quad (2)$$

In econometric term Equation (2) can be wrirren as:

$$non - oil\ GDP_t = \alpha_0 + \alpha_1 SE_t + \alpha_2 k_t + \alpha_3 L_t + \varepsilon_t \qquad (3)$$

The dependent variable is the per capita non-oil GDP growth. The main independent variable of this study is shadow economy (SE). As we stated earlier the impact of this variable on economic growth is ambiguous it could be negative or positive. In line with most literature we control for capital stock (k) and labor (L) in driving economic growth.

4.2 DATA:

Our dataset is a yearly macroeconomic time series from 1991to 2017 (due to the avibility of shadow economy estimations) consisting of non-oil GDP per capita growth taken from official national statistics , Shadow economy estimation was taken fromMedina & Schneider (2018) which is based on estimating a general MIMIC model applied to worldwide context providing the estimation for the Algerian context as percentage of the official GDP in addition to capital in stock and labor in Algeria the dataset source is provided in the table2 below:

Table 2 : data description and source

variable	label	source	definition
non-oil GDP per capita growth	non-oil econGR	Official national ststistics	Percentage of GDP outside oil rent divided by population in the mid-year
Shadow economy	SE	Medina & Schneider (2018)	Shadow economy as percentage of official GDP
Capital in stock	K	Official national ststistics	As percentage of GDP
labor	L	Official national ststistics	Employees divided by population in working age (15 -64 years)

Source : authors construction

In our sample the average of the shadow economy is 30.41% of GDP with highest percentage was in the year 1994 38.88% of GDP due to the economic and political state in this period, a more detailed statistic description of the dataset is shown in the table 3 in appendix.

5. Results and findings:

5.1 unit root testing:

In the following table 4 the p-value of the ADF tests is reported, while the null hypothesis is the presence of the unit root, and therefore a value greater than 0.05 indicates non-stationary time series. The results showed that all the series are not stationary in level. However, they are stationary in the first difference I (1). and since the variables found to be integrated in the same order then there is possibility for the series to be co-integrated.

Table 4: Unit root test Augmented Dickey-Fuller test

Variable	Included in equation	level	First difference	Integration order
		ADF	ADF	
Non-oil econGR	Intercept	0.650	0.000*	I(1)
	Trend and Intercept	0.921	0.001*	
	None	0.762	0.000*	
SE	Intercept	0.859	0.036*	I(1)
	Trend and Intercept	0.831	0.409	
	None	0.143	0.004*	
K	Intercept	0.881	0.005*	I(1)
	Trend and Intercept	0.743	0.007*	
	None	0.911	0.000*	
L	Intercept	0.803	0.002*	I(1)

Trend and Intercept	0.448	0.011*
None	0.809	0.000*

Source: authors construction based on Eviews V.10 outputs.

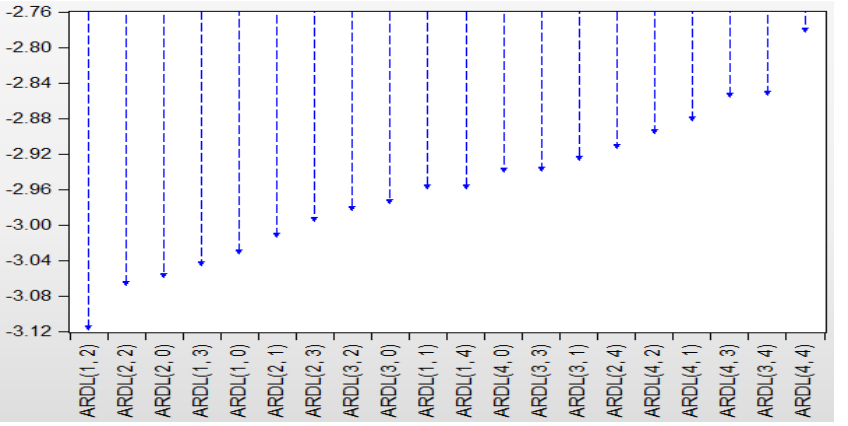
* sig at 5% level

Based on the results of unit root test above and trying to investigate the possible long-run equilibrium relationship and the short run relationships between non-oil economic growth and shadow economy in our case we will rely on autoregressive distribution lag (ARDL).

5.2 ARDL model estimation

Figure 1 bellow shows the best 20 models according to the Akaike Information Criteria (AIC). The ARDL model (1,2) correspond respectively to the smallest AIC value.

Figure 1 : Akaike information creteria (AIK)



Source: Eviews V.10 outputs.

Based on the Akaike Information Criterion (AIC) The selected model is ARDL (1,2). Therefore, the optimum lag lengths of the variables non-oil econGR and shadow economy are: $p_1 = 1$ and $p_2 = 2$ respectively.

5.3 Diagnostic tests of the model

The estimation results table 5 showed that the study model is of good fit and it passes all the diagnostic tests. The R-squared is 0.9092(Adj-R2: 0.8790) implying that almost 91% variations in the dependent

variable are explained by the model and the rest by the error term. The D-W statistics is 2.0490, which confirms that the model is not spurious. Moreover, the computed F-statistic = 30.0631 (Prob. 0.000) clearly rejects the null hypothesis that the regressors have zero coefficients the results are provided by detail in table 6 in the appendix.

Table 5 : model diagnostic test results

Test	χ^2	p-value
Breusch-GodfreySerial Correlation LM test	0.3390	0.8441
Breusch-Pagan-Godfrey	5.5882	0.4709
Jarque-Bera test	0.054322	0.9732

Source: authors construction based on Eviews V.10 outputs.

As proved in the table above, the model passes the test regarding serial correlation (Breusch-Godfrey Serial Correlation LM tests), Normality (Jarque-Bera) and heteroscedasticity (Breusch-Pagan-Godfrey test).

5.4 ARDL bounds test

Since the model passed all the diagnostics tests, now we can move to the next part of ARDL methodology which is the bound test for co-integration. Based on the empirical findings showed in the table 7 below the F-test result of ARDL bound testing is 9.329120 and it is above the critical level of 5%. Which indicate the existence of long-term co-integration relations among the variables.

Table 7 : ARDL bound test

Test Statistic	Value	K
F-statistic	9.329120	1
	Critical value bounds	
significance	I(0) bound	I(1) bound
10%	3.02	3.51
5%	3.62	4.16
1%	4.94	5.58

Source: authors construction based on Eviews V.10 outputs.

5.5 short-run and Long-run relationship:

5.5.1 short-run dynamics:

The table8provides the estimation of error correction model ARDL(1.2), the results showed that the non-oil GDP growth responds negatively to the shadow economy lagged one year -0.5776 and this effect is statistically significant at 5% level. In terms of elasticity, a 1% increase in the shadow economy decreases economic growth by 57.76% in the short term.

we can see also that the error correction term ($CointEq_{(-1)}$) is negative and equals to -0.6782 with p-value of 0.000 This represents that there exists a long-term relationship between the non-oil GDP growth and the shadow economy. adjustment to long-run equilibrium takes approximately one year and 5 months.

Table 8 : error correction model estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LSE)	0.309465	0.221597	1.396519	0.1795
D(LSE(-1))	-0.577604	0.222654	-2.594179	0.0183
LEMP	-0.127174	0.052912	-2.403497	0.0272
LK	0.548357	0.089661	6.115917	0.0000
CointEq(-1)*	-0.678258	0.121629	-5.576475	0.0000

Source: authors construction based on Eviews V.10 outputs.

5.5.2 long-run relationship

According to the estimation of long-run estimation in table 9 there is a conjunction with the short-run relationship between non-oil economic growth and shadow economy as it shown the impact of the later is positive on the non-oil GDP growth and its statisticly significant at 5% level. In terms of elasticity a 1% increase in shadow economy will rise the non-oil economic growth by roughly 70%.

Table 9 : long-runtelationship

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSE	0.755576	0.224322	3.368266	0.0034
C	-0.500192	2.418852	-0.206789	0.8385

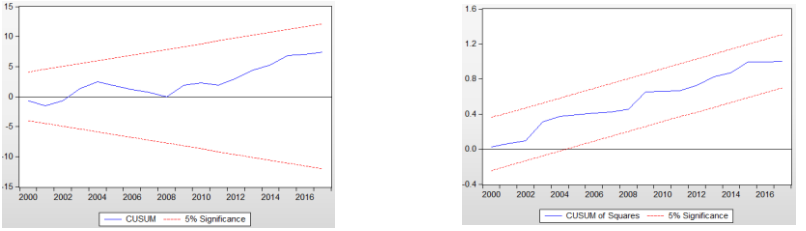
Source: authors construction based on Eviews V.10 outputs.

5.6 stability of the model:

To ensure the robustness of our results we employ structural stability tests on the parameters of the long-run results based on the cumulative sum of recursive residuals (CUSUM) and cumulative sum of recursive residuals of squares (CUSUMSQ) tests as suggested by (Pesaran & Pesaran , 1997) . A graphical representation of CUSUM and CUSUMSQ statistics are provided in figure 2 below.

Figure2:cusum test andcusum of squares

cusum CusumQ



Source: Eviews V.10 outputs.

As it shown from the two graphs the plots of both the CUSUM and CUSUMSQ are within the boundaries where plot of the CUSUM has hovered around the zero line and CUSUMSQ confirms the stability of the parameters.

6. Conclusion

The aims of this study is to fill the gap in the literature review concerning the relationship between shadow economy and economic growth from an alternative point of view. While the researchers focused on economic growth measured by the GDP our study focused on non-oil GDP to reflect the economic growth outside the oil rent growth. arguing that in an oil producing country like Algeria this indicator may be miss leading when it comes to the impact of shadow economy on the growth of non-oil economy. using Autoregressive distributed lag (ARDL) methodology and a data set from 1991to 2017. the results revealed that the shadow economy and non-oil GDP growth are co-integrated meaning that the two variables have a long-run relation, the short-run dynamics and long-run relationship showed that the shadow economy has a negative impact on the non-oil economic growth. In terms of elasticity, a 1% increase in the shadow economy decreases economic growth by 57.76% in the short-run and a positive impact on the long-run. In terms of elasticity a 1% increase in shadow economy will rise the non-oil economic growth by roughly 70%.

This finding enforces the importance of the effect of shadow economy on economic growth especially in countries with significant size of informal economy like Algeria, which my impact also the economic policies made by politicians and economists.

7. References

Aigner, D. J., Schneider, f., & Ghosh, D. (1988). Me and My Shadow: Estimating the Size of the U.S. Hidden Economy From Time-Series Data. Dynamic Econometric Modelling: Proceedings of the Third International Symposium in Economic Theory and Econometrics, Cambridge University Press. 297-334.

Amaral, P., &Erwan, Q. (2006). A competitive model of the informal sector. Journal of Monetary Economics 53, 1541-1553.

Bajada, C., & Schneider, F. (2005). THE SHADOW ECONOMIES OF THE ASIA-PACIFIC. Pacific Economic Review 10 (3), 379–401.

Bounoua, c., Sebbah, F., &Benikhlef, Z. (2014). l'économie informelle en algerie: analyse de l' evolution du phenomene et evalutionmacroeconomique (1990-2009). Les cahiers du cread, 110(1), 35-52.

Bovi, M., &Dell'Anno, R. (2010). The changing nature of the OECD shadow economy. J Evol Econ 20(1):19-48.

Ceyhun , e., & Serdar , B. (2016). GROWTH AND INFORMALITY: A COMPREHENSIVE PANEL DATA ANALYSIS. Journal of Applied Economics 19 (2), 271-292.

Davidescu, A., & Schneider, F. (2019). Shedding Light on the Driving Forces of the Romanian Shadow Economy: An Empirical Investigation Based on. Sustainable Entrepreneurship: The Role of Collaboration in the Global Economy, 1-86.

Frey, B., & Weck-Hannemann, H. (1984). The hidden economy as an "unobserved" variable. European Economic Review 26 (1), 33-53.

Gheorghe, Z., & Zizi , G. (2015). Shadow economy and economic growth in Romania. Cons and pros. procedia economics and finance 22, 80-87.

Gutmann, P. (1977). The subterranean economy. Financial Analysts Journal 34 (1), 24-27.

Hassan, M., & Schneider, F. (2016). Size and Development of the Shadow Economies of 157 Countries Worldwide: Updated and New Measures from 1999 to 2013, CESifo working paper no 5727, 1-50.

Johnson, S., Daniel, K., & Andrei, S. (1997). The unofficial economy in transition. Brookings Papers on Economic Activity 2, 159-221.

KORI, y. (2018). The Relationship Between Unemployment And Output In Algeria (1989-2016). Revue des sciences Économiques de gestion et de commerce 21 (2), 37-53.

kori, y. (2018). The Impact of the Shadow Economy on GDP for Algeria, 1995-2016. el-bahith review 18 (01), 189-200.

Loayza , N. (1996). The economics of the informal sector: a simple model and some empirical evidence from Latin America. Carnegie-Rochester Conference Series on Public Policy 45. 129–162.

Loayza, N., Oviedo, A., &Luis, S. (2004). Regulation and macroeconomic performance. Policy Research Working Paper 3469,Washington, D.C., World Bank.1-36.

Medina, L., & Schneider, F. (2018, January). Shadow Economies Around the World: What Did We Learn Over the Last 20 Years?,International Monetary Fund. 1-76

Nedra , B., & Younes , B. (2018). A simultaneous equation model of economic growth and shadow economy: Is there a difference between the developed and developing countries? Economic Change and Restructuring, 1-20.

Olga , M., Yulee , M., & Tatyana , T. (2018). INFLUENCE OF THE SHADOW ECONOMY ON ECONOMIC GROWTH. 16(1),87-94.

Rajeev , K. G., James , W. S., & Friedrich, S. (APRIL 2017). Growth in the Shadows: Effect of the Shadow Economy on U.S. Economic Growth over More Than a Century. IZA DP No. 10705, 1-20.

Schneider, F., & Enste, D. (2003). The Shadow Economy An International Survey. cambridge university press.

Schneider, f., Buehn, A., & Montenegro, C. (2010). New Estimates for the Shadow Economies all over the World. International Economic Journal 24(4), 443–461.

Schneider , F, & hametner, b. (2014). The Shadow Economy in Colombia: Size and Effects on Economic Growth. de gruyter 20 (2), 293-325.

Tedds, L., & Giles, D. (2000, april). Modelling the Underground Economies in Canada and New Zealand: A Comparative Analysis.Econometrics Working Paper.1-16.

Tedds. (1998). Measuring the size of the hidden economy in Canada. University of Victoria, Department of Economics, 1-15.

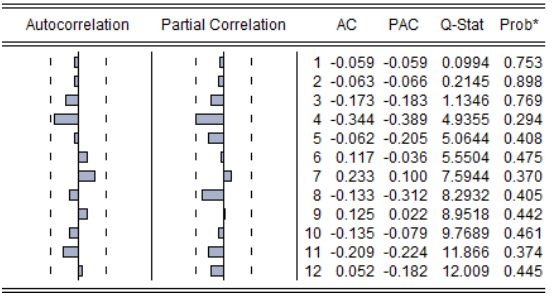
8. Appendices :

Table 3 : descriptive statistics of the variables

	Non-oil GDP	Shadow economy	Labor	Capital in stock
Mean	5610988.	30.41148	34.91267	1200214.
Median	3829293.	27.76000	35.15800	728754.1
Maximum	14934100	38.88000	39.39400	4617703.
Minimum	625887.5	23.98000	30.60100	4992.400
Std. Dev.	4598520.	5.609780	2.745166	1365047.
Observations	27	27	27	27

Source: Eviews V.10 outputs.

Figure 3:autocorrelation of residues



Source: Eviews V.10 outputs.

Table 6: estimation outputs

R-squared	0.909264	Meandependent var	4.117199
Adjusted R-squared	0.879019	S.D. dependent var	0.128139
S.E. of regression	0.044570	Akaike info criterion	-3.152024
Sumsquaredresid	0.035756	Schwarz criterion	-2.810739
Log likelihood	46.40030	Hannan-Quinn criter.	-3.057366
F-statistic	30.06311	Durbin-Watson stat	2.049012
Prob(F-statistic)	0.000000		

Source: authors construction based on Eviews V.10 outputs.