Causes of the parallel economy in Tunisia: The integration of a composite variable / quality of institutions

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Abstract— After the 2011 revolution, Tunisia is experiencing economic difficulties that continue to worsen and those despite significant progress in its political transition. Indeed, the growth rate is too low and unable to reduce high unemployment, Budget and current account deficits are high, inflation has increased and the population is very unhappy with the economic situation. In fact, the growth rate stood at 1% at the end of 2019 against 2.7% in 2018, the unemployment rate remains stable around 15%. The dinar is in continuous depreciation because of the decline in exports against a massive importation of consumer products and the explosion of the parallel market. All these conditions cause a budget deficit which reached 8.5% of GDP in 2019, an inflation of 6.7%.

The objective of this article consists in extracting a composite variable which reflects the quality of institutions first, to subsequently study the influence it plays in the development of the parallel economy in Tunisia.

The empirical results show that the variables representative of the quality of institutions in Tunisia can be replaced for a single component, such a component has as a coefficient in the structural equation of the MIMIC model equal to 0.39, this variable is classified as the third cause to the origin of the development of the parallel economy in Tunisia, after unemployment and tax pressure.

Index Terms— MIMIC, parallel economy, principal component analysis, quality of institutions.

1 Introduction

Estimating the size of the shadow economy is a difficult task, and some measurement methods seem inefficient. Indeed, the approach based on electricity consumption (known as Kuffman) as well as that based on demand for money (or monetary approach) only take into consideration a single indicator which must capture all the effects of the shadow economy. However, it is obvious that the effects of the shadow economy are manifested simultaneously in the markets of production, labor and monetary. Even more important criticism is that the causes which determine the size of the underground economy are only taken into account in some of the monetary approach studies which generally consider a single cause, the burden of taxation.

Likewise, estimating the size of the shadow economy by direct methods such as the survey method are potentially subject to measurement problems inherent in this type of approach. But the biggest drawback of this method is that Survey results based on questionnaires are too subjective, they depend on the wording of the questionnaires at first, and they also depend on the responses of the interviewees who may have difficulty in declaring fraudulent behavior.

The empirical method used in this article is different: it is based on the statistical theory of unobserved variables, which considers several causes and indicators of the phenomenon to be measured, i.e. it explicitly takes into account several causes leading to the existence and development of the parallel economy, as well as the multiple effects of the parallel economy over time, which is why it is called the MIMIC method or multiple indicators and multiple causes. causes and indicators is made by taking into account both the availability of data, the economic importance of these variables and by referring to the review of the theoretical and empirical literature on this subject.

The objective of this article is to determine the causes of the development of the parallel economy in Tunisia for the period from 1985 to 2017. The particularity of this work consists in estimating the weight of a qualitative variable, which reflects the quality of institutions in Tunisia. Such a variable will be extracted from a battery of qualitative variables.

So to achieve the desired objective, a first empirical part is necessary, which consists of a principal component analysis for the determination of a variable that reflects the quality of institutions. In the second part, this component will be reintegrated into the MIMIC model, as a causal variable of the parallel economy in Tunisia.

2 Principal component analysis

2.1. Description of the method

The essential objective of principal component analysis is to provide synthetic representations of a large numerical data set primarily in the form of flat graphical visualizations. The initial spaces of representations of individuals and variables being too large, it is impossible to visualize the point cloud. We are therefore looking for spaces of reduced dimensions which best fit the point cloud, that is to say which respect the initial configuration as much as possible. The method consists in projecting the cloud of points while minimizing the deformations of the distances inherent in the projection.

This amounts to choosing the projection space F which

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maximizes the criterion

$$\sum_{i=1}^{n}\sum_{j=1}^{n} p_i p_j d^2(\mathrm{i},\mathrm{j}). \ (1)$$

The required subspace is such that the average of the squares of the distances between projected points is maximum, that is to say, the inertia of the projected cloud must be maximum.

The objective of principal component analysis is to be able to explain or account for the variance observed in the mass of the initial data by limiting oneself to a reduced number of components, defined as being mathematical transformations of the initial variables.

The algorithm used to determine these components obeys two important constraints:

First, the first component extracted (C_1) must correspond to a composite score that maximizes the proportion of variance explained in the initial variables.

Thus, the principal component analysis will present us with an equation having the following form:

$$C_1 = a_1 var_1 + a_2 var_2 + a_3 var_3 + \cdots + a_k var_k \ (2)$$

The second constraint is that the algorithm underlying the PCA seeks to extract a second component C_2, independent of the first, which would in turn explain the greatest possible proportion of variance among the variance left unexplained by the component C_2.

The component C_2 will therefore be represented in turn by a new equation:

$$C_2 = b_1 var_1 + b_2 var_2 + b_3 var_3 + \cdots + b_k var_k \ (3)$$

C_1 explains more variance than C_2, C_2 more than C_3 more than C_4, etc. To be able to extract a component corresponding to a linear function of the initial variables, these variables must be inter-correlated. When we are in the presence of a variable which does not correlate with any other in the correlation matrix, it is necessary to subtract this variable before proceeding to a PCA.

Examining the individual variables is facilitated by the calculation of the Kaiser-Meyer-Olkin sampling adequacy measures. These indices are calculated for each of the variables as well as for the global matrix and can also take values between 0.0 and 1.0. To be kept in a PCA, a variable must obtain a K-M-O measurement exceeding 0.5.

2.2. Extraction of the principal components

The maximum number of principal components is equal to the number of variables in the matrix. However, the percentage of variance explained by each component decreases systematically as one progresses in the extraction process and can become negligible once the most important components have been extracted. Several extraction criteria will be used.

2.2.1. The Kaiser criterion

The total variance in the correlation matrix is the sum of the variances of each variable. The question is to know the distribution of this variance between the principal components. The answer is obtained by calculating what is called the eigen value or "Eigen value" of each component. As we mentioned previously, the algorithm used in PCA ensures to maximize the variance explained by the first component thereafter the second component extracted makes it possible to explain an additional proportion of variance lower than the previous one and so to after. According to Kaiser (1960), the extraction of components must therefore stop as soon as an eigen value becomes less than 1.0.

2.2.2. Bartlett test

This test can be used to test the hypothesis H_0: the variables are not correlated Bartlett's test of sphericity offers an overall measure based on a statistical approach. It aims to detect to what extent the observed correlation matrix R diverges significantly from the unit matrix (theoretical matrix under null hypothesis H0). Trying to summarize is illusory when the null hypothesis is not contradicted by the data. On the other hand, it is possible to compress the information, to what extent it is not known, into a smaller number of factors when the null hypothesis is rejected. This does not mean, however, that we are going to find "interesting" information in our PCA.

To measure the link between the variables, we compute the determinant | R | of the correlation matrix. Under H0, | R | = 1; if there are perfect collinearities, we would have | R | = 0. Usually, when | R | is less than 0.00001, it is considered that there are very strong redundancies in the data i.e. they contain only one type of information. The result will be extremely trivial.

Conversely, when | R | gets close to 1, the PCA won't do much because the variables are almost two-by-two orthogonal.

The Bartlett test is designed to verify whether there is a significant deviation from this reference situation | R | = 1. The test statistic is written:

$$\chi^2 = -\left(n - 1\frac{22p+5}{6}\right) X \log|R| \ (4)$$

under H0, it follows a law of

$\chi^2\left[\frac{px(p-1)}{2}\right]$ degrees of freedom.

2.2.3. Cattell's scree test of accumulation of variance

In 1966, Cattell proposed a graphical method for deciding the number of components to extract. The variance accumulation test commonly known as the "Scree test" consists of drawing a graph illustrating the size of the eigenvalues "Eigen values" of the various components in according to their extraction order. The criterion proposed by Cattell leads us to stop the extraction of the components at the point where the change in slope occurs in the graph.

2.3. Application OF THE PCA TO TUNISIA

In this subsection we seek to rule on the quality of institutions in Tunisia. The set of variables necessary for such a study are of the order of 12 and taken from an extract from the guide on the international risk of countries for the period 1985 to 2014.

2.3.1.Variables and data

- Government stability:
- Socioeconomic conditions,
- The possibility of investment,
- Internal conflicts,
- External conflicts,
- Corruption,
- Political or religious tensions
- Involvement of military power in politics
- Respect for laws and order
- Ethical tensions,
- Democratic accountability
- Bureaucracy.

Data are taken from an extract from the Country International Risk Guide for the period 1985 to 2014.

2.3.2. Results of the PCA

Using the SPSS software the outputs allow us to conclude:

According to the correlation matrix, the bureaucracy variable is not correlated with any variable, so it must 689> 0.5 encourages us to continue with PCA.

Similarly and according to Bartlett's sphericity test we will test:

H_0: the variables are not correlated c a d the correlation matrix is the identity matrix.

H_1: the variables are correlated.

be eliminated from the PCA.

The KMO Index = 0.

According to the outputs of SPSS the probability of the null hypothesis H_0 is equal to 0.000 and the determinant of the correlation matrix | R | is equal to 9.770.E-8≪1 and therefore can perform PCA.

TABLE 1
SPSS TEST OUTPUT FROM KMO AND BARTLETT

Indice KMO et test de Bartlett

Indice de Kaiser-Meyer-Olkin pour la mesure de la qualité d'échantillonnage.		,689
Test de sphéricité de Bartlett	Khi-deux approx.	411,605
	ddl	55
	Signification	,000

When extraction of components

Total explained variances

Component	eigenvalues			Sums extracted from the load square		
	Total	% of variance	% cumulative	Total	% of variance	% cumulative
1	6,513	59,210	59,210	6,513	59,210	59,210
2	1,987	18,062	77,272	1,987	18,062	77,272
3	,954	8,670	85,943			
4	,689	6,259	92,202			
5	,290	2,634	94,836			
6	,190	1,723	96,559			
7	,173	1,572	98,130			
8	,135	1,224	99,355			
9	,031	,284	99,639			
10	,030	,275	99,913			
11	,010	,087	100,000			

Source: Author's work

According to Kiser's criterion, the first component C_1 has an eigen value of 6.513 or 59.210% of the total variance explained by all the variables, while the second component C_2 has an eigen value equal to 1.987 or 18.062 of the total variance explained. Consequently, the first two components extracted make it possible to accumulate a variance of 77.272% of the total variance.

While the third component C_3 has an eigen value 0.954 <1, and consequently, and according to Kiser's criterion, we can reject this component and limit ourselves to the first two components C_1 and C_2.

These results are also verified using the Cattell Scree Test Accumulation of Variance.

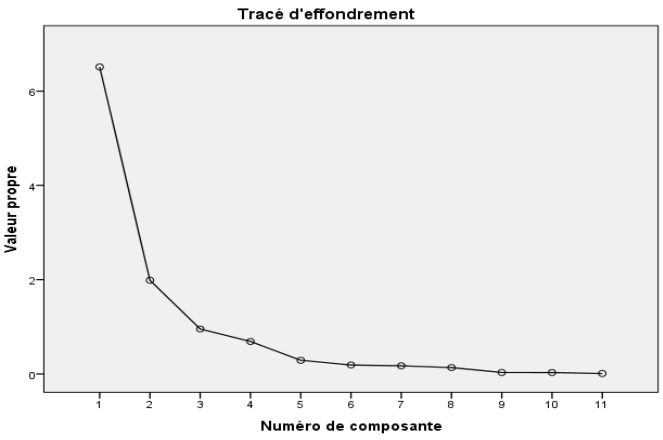

Fig. 1. SPSS output: Variance accumulation test or Cattell's "Scree test"

Source: author's work

- We note that the slope changes radically with the component C_3. The graphical representation of the variances helps us to see that the point C_3 belongs much more to the segment $C_3$to C_7than to the segment C_1toC_3. according to Cattel's criterion one should limit oneself to the extraction of the first two components ($C_1$and C_2).

Matrice of components		
	Component	
	1	2
Government stability	,889	,303
Socio economic conditions	,658	-,624
Investment profile	,903	,135
Democtratic accountability	-,723	,079
Ethnic tensions	-,394	,813
Law and order	,955	-,071
Religious tensions	,911	,344
Military in politics	,566	-,689
Internal conflict	,862	,097
External conflict	,840	,368
Corruption	-,535	-,278

Method of extraction : Principal component analysis
source: author's work

According to the matrix of components, the component $C_1$is strongly correlated with the possibility of investment (0.903), respect for laws and order (0.955), political or religious tensions (0.911) and the stability of the government therefore this component indicates the quality of institutions in Tunisia. While the component $C_2$is strongly correlated with the ethical tension variable (0.813), while its correlation with the variables socioeconomic conditions and the involvement of military power in politics is negative (respectively -0.624 and -0.689).

So the component C_1extracted will be integrated into the MIMIC model, as a causal variable of the parallel economy in Tunisia.

3 PARALLEL ECONOMY AND QUALITY OF INSTITUTIONS IN TUNISIA: MIMIC MODEL

3.1. Review of the literature on the MIMIC method

Regarding estimation techniques, Joreskog and Goldberger (1975) present a significant contribution to the development of the MIMIC model by proposing the maximum likelihood procedure for estimating a model with a single latent variable.

As for the economic application, Frey and Weck-Hannemann (1984) are considered to be the pioneers in the application of the MIMIC model to estimate the shadow economy. They use this model to estimate the size and development period of the shadow economy of OECD countries. They find that regulation, tax burden and tax morality were the main determinants of the underground economy in these countries.

Giles (1999) developed the MIMIC model by taking into account the unit root test and cointegration analysis of the data to generate a historical time series index of the shadow economy and the New Zealand tax gap for the period 1968-1994 The causal variables of this study include average and marginal tax rates, inflation, real income and the degree of regulation of the economy.

The indicators include changes in the rate of participation in the labor force and the ratio of cash to money supply. Giles (1999) finds that the introduction of the goods and services tax in New Zealand in 1986 resulted in an immediate drop in the relative size of the underground economy, and this economy follows the direction of the business cycle. He estimates that parallel economic activity will rise from around 6.8% of official real GDP in 1986 to a peak of 11.3% in 1987, then fall to 8.7% of GDP in 1992 before rising to around 11.3% in 1994. As parallel economic activities are not taxed, Giles estimated the gap between actual and potential tax revenues.

Dell'Anno (2007) applies the MIMIC model to estimate the Portuguese shadow economy from 1977 to 2004. He suggests that the shadow economy is caused by the employment of labor by the government and by taxes. Burden measured by total taxes and social contributions expressed as a percentage of gross domestic product of subsidies paid by government to businesses, social benefits paid by government to households, self-employed workers, and the unemployment rate. Dell'Anno defines the shadow economy indicators as the index of real gross domestic product and labor force participation rate. He begins his model with the MIMIC Specification 6-1-2 (six causes, one latent variable and two flags). After removing the non-significant variables, he considers the MIMIC 4-1-2 model to be the best. This specification reveals that social benefits / GDP, lack of economic freedom, unemployment rate, and self-employment / labor force are the main causes of the dynamics of the informal economy.

Alañón and Gómez-Antonio (2005) apply the MIMIC approach to estimate the size of the informal economy in Spain over the period 1976-2002. They find that the tax burden, the degree of regulation and the unit labor costs are the main causes of the underground economy in Spain during this period. They also find a positive correlation between GDP, money demand and the level of the shadow economy. Their estimates show that the shadow economy in Spain represented between 8 and 18.8% of GDP between 1976 and 2002.

Buehn and Schneider (2008) develop a MIMIC model with an error correction model (ECM) as an alternative method to transform the time series into the first difference in order to overcome the stationary problem. They test the cointegration relationship between the cause and indicator variables and use their long-term equilibrium relationships to estimate the size and evolution of the black economy in France using quarterly data from 1981 to 2006. They use the MIMIC 4-1-2 where the causal variables included are the ratio between tax and social charges, the unemployment rate, the burden of regulating the economy (public sector employment / labor) and the number of hours worked per employee in the total economy. They use the M1 monetary aggregate and a GDP volume index as indicators for the informal economy. Their results show that the black economy in France increased from 12.9% in the first quarter of 1982 to 15.9% in the fourth quarter of 2006.

Dobre and. Al. (2010) examine the causal link between the underground economy and the unemployment rate in the United States for the period 1980-2007 by performing Granger causality tests. They apply the MIMIC to four causal variables (corporate income tax, social security contributions, unemployment rate and self-employment) and two indicators (index of real GDP and participation in the civilian labor force). They find clear evidence of the causality of the unemployment rate to the shadow economy, and no reverse causation of the shadow economy to the unemployment rate.

3.2. Strategy of the MIMIC method

This approach is based on the idea that the shadow economy can be viewed as a latent or unobserved variable which is influenced by several causes and which affects several macroeconomic variables. These macroeconomic variables can be interpreted as indicators of the underground economy. It is for this reason that this method is known as MIMIC for multiple indicators and multiple causes.

The equation that expresses the relationship between the latent variable and these causes is called the structural equation, while the one that defines the relationship between the unobservable variable and its indicators is called the measurement equation.

The structural equation looks like this:

$$\boldsymbol{\gamma_t = \alpha X'_t + \varepsilon_t} \quad (5)$$

Where $X'_t=(x_{1t}, x_{2t}, \dots\dots\dots x_{qt})$ is a vector (1xq) of variables which are each time series.

Each time series x_it, i ranging from 1 to q is a potential causal variable of the latent variable $\boldsymbol{\gamma_t}$ and the error term ε_ is the unexplained component. . $\alpha = (\alpha_1, \alpha_2, \dots\dots\dots\dots \alpha_q)$, vector (qx1) defining the cause relations between the latent variable and its causal variables.

In other words the equation (1) can be written:

$$\boldsymbol{\gamma_t = \alpha_1 x_{1t} + \alpha_2 x_{2t} + \alpha_3 x_{3t} + \dots\dots + \alpha_q x_{qt} + \varepsilon_t} (6)$$

The measurement equation highlights the link between the latent variable and its indicators, in other words it expresses the unobservable latent variable as a function of a group of observable variables. It is written as follows:

$$\boldsymbol{Y_t = \beta \gamma_t + \mu_t} \quad (7)$$

Where $Y'_t = (y_{1t}, y_{2t} \dots\dots\dots\dots y_{pt})$ is a vector (1xp) of variables (indicators.

β_j : j= 1……p is a vector (1xp) of regression coefficients which represents the magnitude of the expected variation of the corresponding indicator for a unit change of the latent variable.

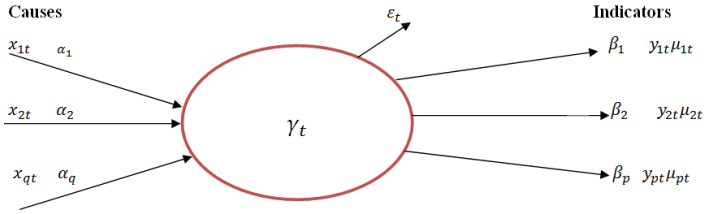

Fig. 1. General structure of the MIMIC model

3.3. Application of the MIMIC model to Tunisia

3.3.1. Variables used

3.3.1.1. Causal variables

* The weight of taxation ($\boldsymbol{X_1}$): is a major cause of the increase in the shadow economy according to the majority of the literature. The higher the tax rate, the more expensive the production costs in the formal economy and therefore lower will be the after-tax profits. This difference in costs and therefore in profits between the parallel and formal economy can be very large, for example in Germany and Austria the difference between the profits before tax and after tax can be assimilated to personnel costs.

This cost differential is likely to push people to integrate into the informal sector to avoid paying these taxes. Likewise, taxes increase the production costs of goods and services, which increases prices in the legal market, which pushes consumers to buy from the parallel market.

In Tunisia, several empirical studies have confirmed the significant effect of tax pressure on the development of the informal sector.

* The unemployment rate ($\boldsymbol{X_2}$): Economic theory cannot give an index on the sign of this variable, is it positive or negative, the solution is to decide through empirical analyzes for each country or group of countries.

Even if the sign of the coefficient of the unemployment rate in the measurement equation turns out to be unpredictable, the majority of studies have concluded that the informal economy plays an important role in reducing unemployment in the official economy. the rate of job loss in the formal sector the higher the unemployment rate, and as a consequence the relative share of the informal economy in the workforce increases, because unemployed people seek in the informal sector.

In Tunisia, the development of the parallel economy is more important in the regions with the highest unemployment rate (generally the interior regions and border regions).

* Self-employment ($\boldsymbol{X_3}$): the self-employment rate as a percentage of the labor force is considered to be a determinant of the black economy.

According to Bordignon Zanardi (1997) the significant diffusion of small businesses and a large proportion of professionals and self-employed in relation to the total labor force is an important indicator of the growth of the informal economy. It should be noted that the sign of the coefficient of this variable is positive, as examples of studies that justify this hypothesis we can cite those of Dell'Anno (2007) and Tedds (2005).

* Household final consumption expenditure ($\boldsymbol{X_4}$): Household final consumption expenditure includes the expenditure actually made by resident households to acquire goods and services intended to meet their needs. Household final consumption expenditure includes the share of expenditure on health, education and housing, remaining at their expense, after possible reimbursements. They also include imputed rents which are housing services produced by landlords who occupy their own homes and which they fictitiously pay to themselves.

* The rate of inflation ($\boldsymbol{X_5}$): Inflation is the loss of the purchasing power of money which results in a general and lasting increase in prices. It must be distinguished from the increase

in the cost of living. The loss of value of units of currency is a phenomenon which strikes the national economy as a whole, without discrimination between the categories of agents.

To assess the rate of inflation, the consumer price index (CPI) is used. This measure is not complete, the inflationary phenomenon covering a wider field than that of household consumption.

In our study, high inflation, measured by the consumer price index, indicates a development of moonlighting.

* The quality of institutions ($\boldsymbol{X_6}$): This variable is extracted from 12 qualitative variables listed above through a principal component analysis.

Analysis a makes it possible to conclude that the 12 variables can be replaced by the first two extracted components (C_1 and C_1) which make it possible to accumulate a variance of 77.272% of the total explained variance. According to the correlation matrix, this component is strongly correlated with variables that reflect the quality of institutions in Tunisia.

3.3.1.2. The indicators

* Gross domestic product ($\boldsymbol{Y_1}$): Regarding the relationship between the informal economy and official GDP, growth in the informal sector may reflect a recession in the official economy. This may be because during periods of recession also both labor and capital are diverted to the informal sector.

* The labor force participation rate ($\boldsymbol{Y_1}$): the labor force participation rate is calculated as the ratio between the active population and the working age population (working age).

3.3.2. Formulation of the general model

In our study reserved for Tunisia, the structural equation is as follows:

$$\boldsymbol{\eta_t = \alpha_1 X_{1t} + \alpha_2 X_{2t} + \alpha_3 X_{3t} + \alpha_4 X_{4t} + \alpha_5 X_{5t} + \alpha_6 C_{1t} + \varepsilon_t} \quad (8)$$

Where

$\boldsymbol{X_{1t}}$: is the rate of the fiscal pressure.

$\boldsymbol{X_{2t}}$t: is the unemployment rate.

$\boldsymbol{X_{3t}}$: is self-employment.

$\boldsymbol{X_{4t}}$: represents household consumption expenditure.

$\boldsymbol{X_{5t}}$: is the rate of inflation.

$\boldsymbol{C_{1t}}$: is a composite variable which expresses the quality of institutions in Tunisia. The measurement equation highlights the link between the latent variable and its indicators,

It is written as follows:

$$\boldsymbol{Y_t = \beta\ \eta_t + \mu_t} \quad (9)$$

In our study devoted to Tunisia, the measurement equations will be as follows:

$$Y_{1t} = \beta_1 \eta_t + \mu_{1t} \quad (10)$$

$$Y_{2t} = \beta_2 \eta_t \mu_{2t} \quad (11)$$

With Y_{1t}: represents the GDP growth rate in Tunisia.

Y_{2t}: represents the rate of participation in the active population in Tunisia.

We cannot estimate all the parameters α_i and β_j individually, therefore we will include a condition for standardizing the coefficients of the indicators (β_1 = 1 / -1). According to Tedds (2005), the choice of the sign of β_1 is arbitrary. The relative impacts of η on the other indicator variables are then measured with respect to this pre-assigned value. Real GDP is generally chosen as a scale variable that is normalized in the model, by setting its coefficient $\beta_1$to (1) or (-1).

According to Dell'Anno (2006) in the MIMIC model the vector of structural coefficients is proportional to the coefficient of the scale variable, when the sign of β_1 changes, the parameters of the causal variables α_i change sign from positive to negative and vice versa. Therefore if we fix β_1= + 1 and if the estimation of the model shows that the signs of the Xs (causal variables) are incompatible with economic theory we change the sign of β_1 to (-1) Therefore we will fix β_1= -1 and therefore the measurement equation which rereads the GDP to the size of the parallel economy is written: $Y_{1t} = -1\eta_t + \mu_{1t}$

The MIMIC model will be estimated using the maximum likelihood estimator using a special software for structural equations called LISREL. The model identification procedure begins with the most general model (MIMIC 6-1-2) shown in the figure below, and continues by eliminating the causal variables whose parameters are statistically insignificant.

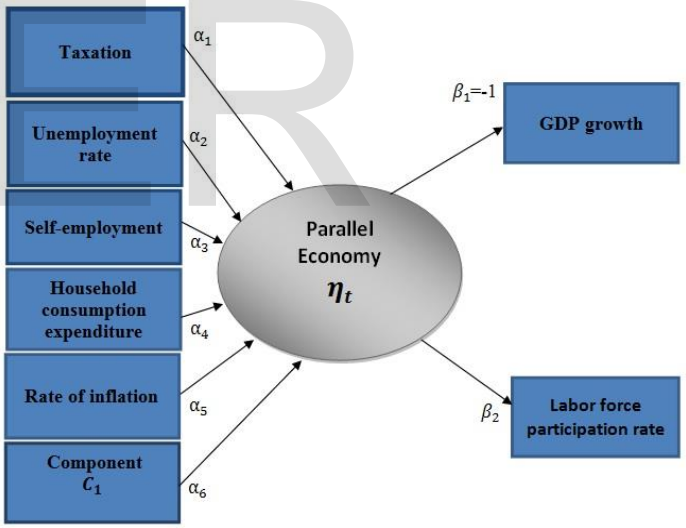

Fig. 3. Path diagram MIMIC 6-1-2

Circles represent latent variables, rectangles represent measured variables.

One-way arrows indicate the direction of causation. Likewise in the LISREL approach the variables are denoted by index letters.

η: denomination of the latent variables to be explained

X: denomination of the measured variables which are the causes of the latent variables.

Y: name of the measured variables which are indicators of the latent variables.

3.3.3. Results of the MIMIC model

The coefficients estimated by maximum likelihood are presented in the table below (Table 2), these coefficients are directly compared to assess the relative weight of the variables in the explanation of the evolution of the parallel economy in Tunisia. Starting from the

MIMIC 6-1-2 model, the variables whose coefficients are not statistically significant are eliminated.

Table 2: Estimated coefficients of the MIMIC model

Variables / Models	X1	X2	X3	X4	FAC 1	X5	Y2
	Taxes	unemployment rate	self-employment	consumption expenditure	C1 quality of institutions	Inflation	rate of participati in the active population
MIMIC 6-1-2	0.39	0.49	0.05	0.13	0.55	0.11	0.36
MIMIC 5-1-2	0.48	0.51	-----	0.15	0.56	0.12	0.34
MIMIC 4-1-2	0.43	0.51	-----	0.23	0.39	-----	0.30
MIMIC 3-1-2	0.56	0.50	---	---	0.19	----	0.38
The fit indices	Chi-square (p-value)		RMSEA (p-value)		Degree of freedom		
MIMIC 6-1-2	9.34 0.096		0.162 0.12		5		
MIMIC 5-1-2	8.66 0.070		0.188 0.091		4		
MIMIC 4-1-2	3.58 0.31		0.076 0.35		3		
MIMIC 3-1-2	0.52 0.77		0.000 0.79		2		

source: author's work

Among the criteria for choosing the model, the RMSEA or the approximation mean squared error. According to this criterion, only the last two models (MIMIC 4-1-2 and MIMIC 3-1-2) are accepted, indeed they have RMSEA <0.08. By combining this criterion with the goodness-of-fit index (GFI) as well as the corrected goodness-of-fit index (IFGI), the MIMIC 4-1-2 model is retained.

The estimate shows that the main causes of the parallel economy in Tunisia, among those included in the model are (in descending order): the unemployment rate, the tax burden, the quality of institutions (noted C1) and expenditure household consumption.

This model is written:

Measurement equations:

GDP = - 1.00*$\boldsymbol{\eta_t}$ +$\boldsymbol{\mu_t}$ (12)

PAR AC POP = 0.30*$\boldsymbol{\eta_t}$+$\boldsymbol{\mu_t}$ (13)

Structural equation:

$\boldsymbol{\eta_t}$ = 0.43*TAXES + 0.51*UNEMPLOYMENT + 0.23* CONS EXP +$\boldsymbol{0.39C_{1_t} + \varepsilon_t}$(14)

with $\boldsymbol{C_1}$ represents the quality of institutions in Tunisia.

4 CONCLUSION

The results of our study show that apart from the economic causes which are at the origin of the development of the parallel economy, namely the unemployment rate, the tax burden and household consumption expenditure, bureaucratic obstacles (inflation of procedures, very long waiting times, exorbitant costs) are likely to push most workers to work in the informal sector. Indeed the coefficient of the variable quality of institutions in the structural equation is equal to 0.39, this variable is classified as the third cause at the origin of the development of the parallel economy in Tunisia, after unem-

ployment (major cause) and the tax burden.

These results are likely to push political decision-makers to modify their strategies to fight against the black economy, indeed repression approaches are ineffective and expensive. Governments need to change the institutions and regulations that cause this phenomenon.

REFERENCES

[1] Adam, C., and Ginsburgh, V., 1985. "The effects of irregular markets on macroeconomic policy: Some estimates for belgium" European Economic Review Volume 29, Issue 1, 1985, Pages 15-33.

[2] Adriana, A., Davidescu, M., Dobre, I., 2012. "The causal relationship between unemployment rate and US shadow economy .A Toda- Yamamoto approach" .journal of social and economic statistics no 1, vol1.

[3] Bajada, C., and Schneider, F., 2009. " Unemployment and the shadow economy in the oecd" Presses de Sciences Po | « Revue économique » 2009/5 Vol. 60 | pages 1033 à 1067.

[4] Daniel Kaufmann and Aleksander Kaliberda " Integrating the Unofficial Economy into the Dynamics of Post-Socialist Economies: A Framework of Analysis and Evidence" World Bank policy Research.Working paper No 1691.

[5] Dell Anno, R. and Schneider, F., 2003. "The shadow economy of Italy and other OECD countries: what do we know?" Journal of public finance and public choice economicadellesceltepubbliche.

[6] Dell Anno, R., 2007. "The shadow economy in Portugal: an analysis with the MIMIC approach" journal of applied economics vol X No 2.

[7] Dell'Anno, R, and Schneider. F., 2006. "Estimating the underground economy: A response to T. Breusch's critique". Working Paper 06/07, Department of Economics, Johannes Kepler University of Linz.

[8] Dell'Anno,R · Miguel Gómez-Antonio · Angel Alañon-Pardo " The shadow economy in three Mediterranean countries: France, Spain and Greece. A MIMIC approach" Empirical Economics (2007) 33:197

[9] Dell'Anno,R and Offiong Helen Solomon" Shadow Economy And Unemployment Rate In U.S.A. Is There A Structural Relationship? An Empirical Analysis". https://hal.archives-ouvertes.fr/hal-00582021 Submitted on 1 Apr 2011.

[10] Dobre, I., Adriana, A., and Alexandru, M., 2009. "The impact of unemployment rate on the dimension of shadow economy in Spain. A structural equation approach". European research studies volume XII issue (4).

[11] Feige .Edgar "How Big Is the Irregular Economy?" Challenge Vol. 22, No. 5 1(1979 .

[12] Frey, B. and Weck-Hanneman, H., 1984. «The Hidden Economy as an "Unobservable" variable», European Economic Review, 26, No. 1, pp. 33-53.

[13] Giles, D. E. A. – Tedds, L. M., 2002. «Taxes and the Canadian Underground Economy», Canadian Tax paper n.106, Canadian Tax Foundation. Toronto.Gutmann P. M. (1977), « Subterranean Economy ». Financial Analysis Journal, November, 34, pp. 26-27.

[14] Giles, D. E. A., 1999a. « Measuring the hidden Economy: Implications for Econometric Modeling ». The Economic Journal, Vol. 109, No 46, pp.370-380.

[15] Johnson S., Kaufmann D., Zoido-Lobatón P., 1998. « Regulatory Discretion and the Unofficial Economy ». American Economic Review, 88:2, pp. 387-92.

[16] Johnson, S. Kaufmann, D. and Shleifer, A., 1997. «The unofficial economy in transition », Brookings Papers on Economic Activity, Fall, Washington D.C.

[17] Joreskog, K. – Goldberger, A. S., 1975. «Estimation of a model with multiple indicators and multiple causes of a single latent variable», Journal of the American Statistical Association, 70, pp. 631-639.

[18] Lacko, M., 2000. "Hidden Economy - an Unknown Quantity? Comparative Analysis of Hidden Economies in Transition Countries, 1989-95". Economics of Transitio

[19] Massimo Bordignon and Alberto Zanardi " Tax evasion in italy" Giornale degli Economisti e Annali di Economia Nuova Serie, Vol. 56 (Anno 110), No. 3/4 (Dicembre 1997), pp. 169-210.

[20] Schneider, F and Enste, D., 2000. « Shadow Economies: Size, Causes and Consequences », Journal of Economic Literature 38/1, pp. 77-114.

[21] Schneider, F., 1997."The shadow economies of western Europe". Economic affairs, 17/3, pp42-48.

[22] Schneider, F ,2007." Shadow Economies and Corruption All Over the World: New Estimates for 145 Countries" Economics.E-journal. Vol. 1, 2007-9 | July 24, 2007.

[23] Schneider, F,2010" Shadow Economies All over the World New Estimates for 162 Countries from 1999 to 2007" The World Bank Development Research Group Poverty and Inequality Team & Europe and Central Asia Region Human Development Economics Unit July 2010.

[24] Tanzi, V., 1999. « Uses and Abuses of Estimates of the Underground Economy ». The Economic Journal, 109 (June), pp. 338-347-

[25] Tanzi " The Underground Economy in the United States: Annual Estimates, 1930- 80" 1983, IMF Economic Review Volume 30, Number 2, Page 283

[26] Thomas, J., 1999. « Quantifying the black economy: 'measurement without theory' yet again? ». The Economic journal, 109 (June), pp. 381-389.