Modeling Informal economy in the Republic of Macedonia

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Abstract

Informal economy is difficult to be estimated if assumption of modes weren't fulfilled. Here we describe some elements of the calculation in the particular case of the economy where complex dynamics is accompanied with some lack on the model's requirements. In our case study of the Republic of Macedonia, we used to work with very small number of data points in an acceptable stable regime obtained in [2004, 2016] making use of additional modeling and calculation tools. Next, a particular variable –remittances-shows an important effect in overall behavior and is included in an ad hoc calculation. As result we obtained that informal economy in RM in this interval has reached the highest values of around 38% of GDP at 2010 and decrease toward 30%at 2016.

Keywords: Informal and shadow economy, currency demand approach, taxation policy, MIMIC model.

Introduction

There are deferent views on what is called Informal economy. In a very strict language it is defined as part of a country's economy that is not registered and therefore it is officially unknown. In references [1], [2] the definition of hidden economy as the unobservable one is reserved only for the part of unregistered economy that is created as result of evading formal official records to simply escape the Taxes' duties. But unregistered economy could originate from criminal activities as well and in [3] it is detailed this aspect. However, this is expected to have different structure. In this case the accuracy of the estimation could be strongly affected from the size of this last. Evidences show that obtaining an appropriate model and fixing the set for variables of particular models consist in a careful analysis of concrete economy under study as seen in [5] ,[6] , [7] an many others considerations. Usually the calculation technique called the currency demand approach (CDA) is considered as an appropriate model giving evidences of relationships between informal economy expressed in in the money out of deposits and some variables. In the most simple equation it has the following form:

$$\text{h} \frac{C}{M}_t = \alpha_i \text{ h } GDP_t + \beta \log(1 + Tax_t) - \gamma R_t + \varepsilon \tag{1}$$

M is narrow/broad money, C the money in circulation, Tax is the average tax rate and R is the interest rate for Deposits. Another method is the MIMIC model that put the informal economy in the middle point between factors and indicators. It looks like the following:

$$\begin{pmatrix} GDP \\ IndicatorY. \end{pmatrix} = \Gamma GDP \_ Informal + \varepsilon$$

$$= \Gamma \begin{pmatrix} Tax.Rate \\ Unemplyment \\ GNI\_Capita \\ FactorX \end{pmatrix} + \eta$$

(2)

Where in Indicator Y could be placed any

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Vol. 5 No. 3
November, 2019

macroeconomic index areas, in Factor X could be whichever economic parameter or variable. In general, factors are parameters like Taxes, tariffs, the incomes, wages, contributions, a quantifier of the structure of the capital for the country, political performance, and many others. Mathematical procedures are analyzed in many papers as for example in [8], [9] etc. comments on real finding and relationship have been analyzed in [1] and other references related to it. Aside regression comments and preparatory tools for them, we noticed that more deep econometric analyses is needed in the implementation of (1) or (2) for a concrete economy. Stationary issues and removal of unit roots are the first thinks we observed on literature comments. But the analysis of the role of variables is very important. Different effect could be obtained from an economy to the other Moreover, part of the informal economy could exhibit irregular behavior and can affect models themselves. So, the presence of criminal or similar activities that contribute in the shadow economy is inevitable and this last cannot be modeled so the overall calculation became complicated [10]. The economy of Republic of Macedonia has known a remarkable change after 1990. We commented this feature in our recent work [11]. During [1990, 2016], methodical improvement in public database have been applied consecutively until a full modernized methodology has been adopted by the end of 2010 [12], [13]. In this view we expected that the qualities of data series are different in particular intervals so the application of models considering different intervals leads to different level of confidences. Hence we addressed them in particular

2. Some preliminary findings

The estimation of the informal economy for the Republic of Macedonia up to 2008 has been reported consecutively as seen in [13] , [14] or in a more general view as in [16]. Some specifics of the calculation for this period were reported in [11]. In the calculation of the informal economy using discrepancies models we observed that the level of informal economy has been around 25-30% in the period [2004, 2016] and if we considers the interval [1998, 2016] the level of it is found as low as 0.05. Clearly that calculation evidenced that the processes contributing in this part of the economy are likely to be complex or even of an unknown nature. The estimation of hidden economy using GDP discrepancies is shown in the Figure 1.a. nevertheless, the estimation seems to be worth in some qualitative analyses. It has the same trend as the corruption index as seen in the Figure 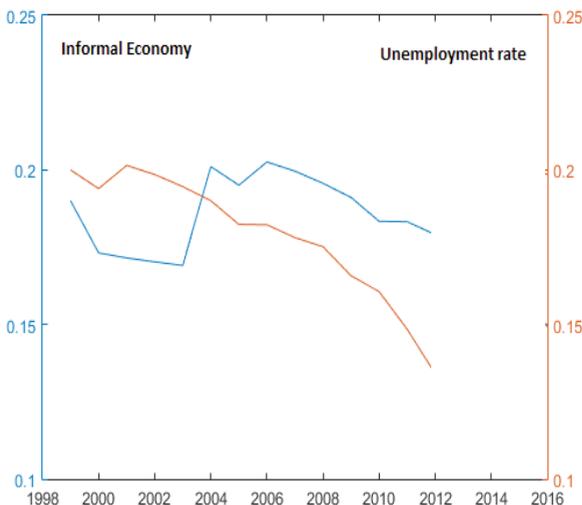1.b. Therefore in mechanical view, this variable is expected to influence our latent variable. In practice, there is a common belief that correlation is indicator of causative.

a. *Percent of Informal GDP. Orange line, according to GDP discrepancies, blue line, according to Unemployment model*
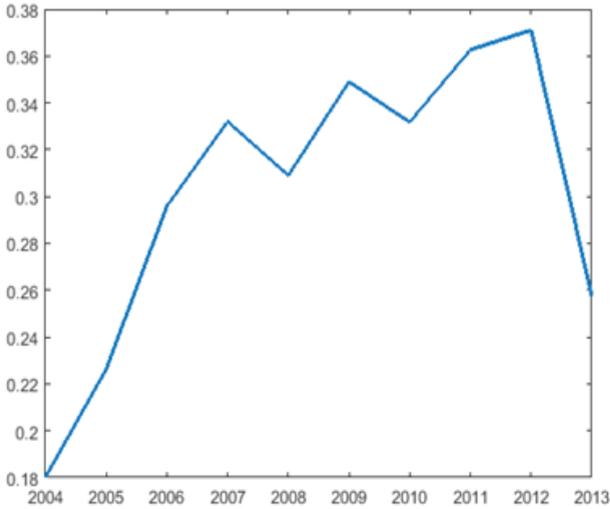
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b. *Relativized Corruption index (orange line) and Informal Economy (black line)*
Figure 1: Informal economy and the corruption index

The same result is obtained in the case of the variable measuring administrative performance of the government as the ratio Budget Deficit/GDP. In our analysis we commented those findings as indicators for possible relationship. The use of linear modeling of the type (1) as discussed in [18] and other models of type (2) shows many specifics. So, we obtained that the regression and the statistics for the variable "*index of corruption*" didn't confirm the direct relationship with informal economy. This is however not a novel finding for other cases as seen in [17]. In the revision of the set of variables involved in the model, we analyzed the set proposed in [1] in the framework of CDA or MIMIC model. Using Cagan CDA model as given in [1] etc., a variable that is expected to be co-linear- the rate of unemployment-shows a very strange behavior near the year 2002, Figure 2.a. up here we consolidated the idea that the models could not be applied in all interval and avoiding some points around the year 2000-2002 could help in improvement of the calculation. Using the reviewed CDA model proposed by Tanzi, we obtained the same behavior which supports the evidence change in-betweens the years 2002-2004. Moreover,

a. Informal Economy by Unemployment method

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Vol. 5 No. 3
November, 2019

the estimation with CDA in the full interval [1998, 2014] showed an undervaluation of informal economy, because the level of 20% is characteristic for the developed country as reported in [7] which is not our case. So, we excluded the points that cause disturbances on the regressions and calculation.

Figure 2: Informal economy by different models

b. Informal economy by CDA in Tanzi version

3. Specifics on the series and the behavior of the variables

By application of special technique proposed in [22], [23] for other dynamical series, we obtain that trimestral data of C/D variable in [2002, 2016], looks like having had entered a self-organized regime starting from 2002. It is possible that the annual behavior would be correlated with this dynamics and therefore the "problematic" edge of 2000-2002 would better be excluded form series in case of linear regions. Our new interval is however shorter, say [2004, 2016]. After 2006 we rechecked the tiniest series –monthly data- in the sense of log-periodic analyses explained in [22]. We next used a retuned calculation as commented in [24] so the regimes and critical times were analyzed in depth. By this approach only the year 2016 is found questionable but due to the very short number of data series, we kept it in. So, we obtained that this case values of informality obtained using different models lies in the range of 28%-43% and do not differ remarkably.
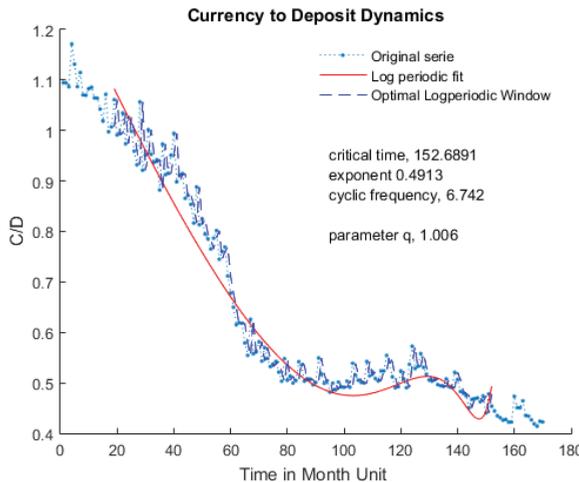

Figure 2: The log periodic approach for C/D variable

ISSN 2410-3918
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Academic Journal of Business, Administration, Law and Social Sciences
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Vol. 5 No. 3
November, 2019

Considering rapport C/M2 as another candidate for response variable in CDA model, we observe that a shorter regime has been found in its underlying behavior. It probably started at coordinate 112 that is April 2012 and finished at coordinate 170 that is January 2017. Results are presented in the Table 1. Under such condition all the period discussed [2004, 2016] contains a regime change point for variable the C/M2 and moreover, it correspond to a bubble-like behavior around end of 2017, Figure 3. The data points around 2017 impose high deviations when used in our linear models as CDA or MIMIC. Next, taking into account the important weight of remittances in the country, we proposed to analyses the ratio of C to the broad money M22. In this case we obtained that more than one critical–like process might underline the dynamics of variable C/M22, as seen in Figure 4. We expect that the presence of more than one critical point would minimize the deviation effect of each other. With acceptable statistical significance we identified a relatively medium term regime that start at coordinate 82 and die at 159.
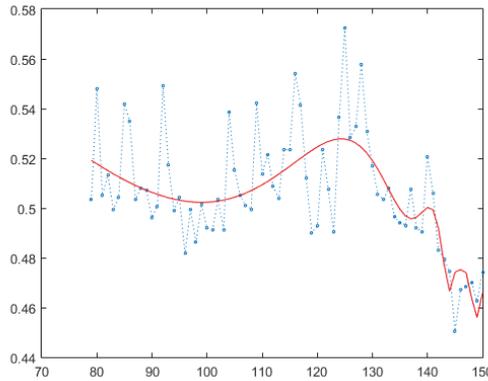

Figure 3: Extreme behavior near 2017 for C/M_2 variable

There are some short range processes lasting around 2 years or so as shown in figure 4. Hence the variable C/M22 spanning all target intervals [2002, 2016] is found admissible to be used in models.
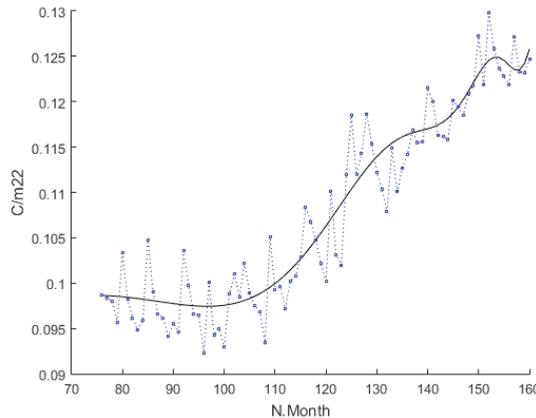

Figure 4: Log-periodic behavior of C/M_{22} variable

In this case we observe that CDA and MIMIC approach gives similar result for all the period considered, say [2004, 2016]. Up here we underline to important facts. First, findings herein give some information for precaution in the linear analysis, but they are not considered sufficient for a trustworthy modeling. The dynamics observed in monthly data is not expected to be transferred in yearly data, but the presence of special points strongly suggested that linear relationship could be destroyed nearby them. However, the verification of the log-periodic presence needs for more data and more sophisticated analysis so false alarms are possible. Being aware of this, we use those result as precaution measure in linear regressions as mentioned above.
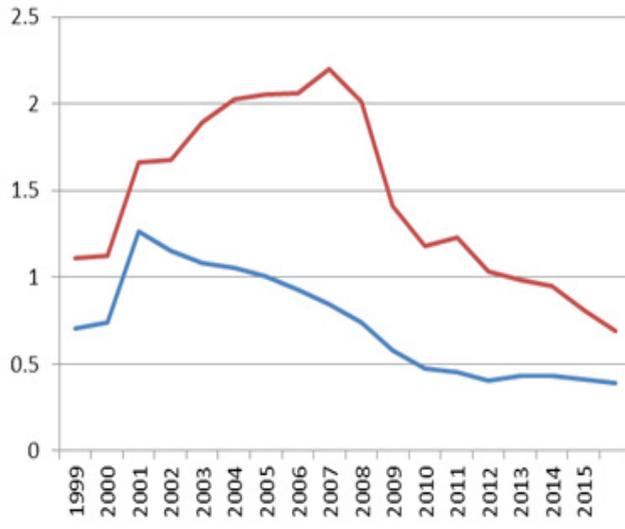
Table 1: Some data from log periodic fit

	T.Start	T.End	Critical Time	Exponent	Cyclic Frequency	q_Parameter
C/M1	33.00	158.00	171.01	0.54	6.74	1.0006
C/M22	79.00	168.00	111.95	0.34	9.70	1.0016
C/M2	38.00	165.00	129.71	0.68	7.49	1.0008
C/D	13.00	159.00	165.68	0.76	7.80	1.0017

In the case where the presence of a DSI regime is likely to be present we identify a critical point that behaves differently from the others. This point is exploded by shortened the old series. It makes regressions more difficult and less confident, but keeping those points would likely rend linearization less meaningful, even affecting the fitting as well. We preferred to save the logic of mathematics however. Another issue has been initiated from unexpected findings for the effects of some factors. So, in calculation of the type (3) coefficient of linear regressions for some categories of Taxes were found negative that seems to be a meaningless result. In principle this is possible as discussed in the reference [2], [3] and others because economical systems are complicated in the best approach, and sometimes behave as complex in the full sense. A corollary of this property is that there is no rigid model for all cases, as is proven to be true in many applications. In such a case we operated according tactics mentioned above to exclude "exterior troubles". Next we extended the idea of an adaptive application of the models recommended in the literature as [6] or [5] by considering a set of variables for each category involved in equations of the type (3) or (4). Thus, we searched empirically to find which concrete variable could be exactly in the role described by the appropriate category in the equation. So, in CDA model the variable "Taxes" appears in relation as ln (1+Tax.Rate) [1]; variables "Interests Rates" appears directly in equation of the type (3), other parameters appear in logarithm Figures etc. Hereto we realized a generalized regression procedure of a linear approach for ln (C/M) including all categories of variables and all variables under examination. The series that "survive" statistical test for regressions including a satisfactory ratio of error to the average value evaluated as seen in Table 1, have been qualified as the appropriate term for final calculation within the model of the type (3) or (4).
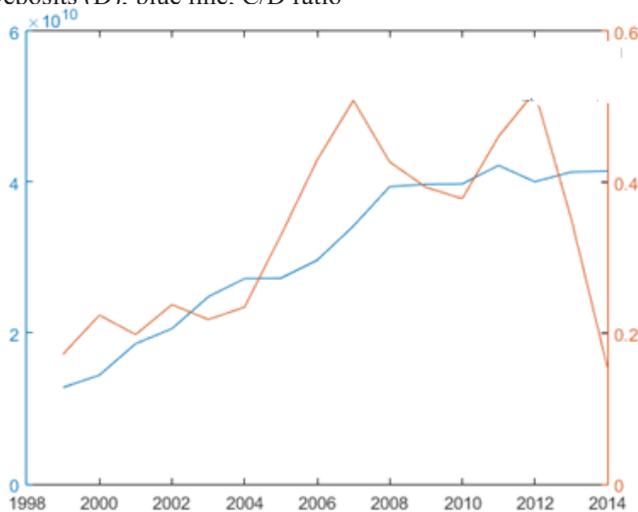
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Vol. 5 No. 3
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Table 1: Typical factors

		Value	Error	T stat	pValue
Average Taxes rate	Intercept	-1.9738	0.15995	12.34	2.25E-07
	Elasticity	5.9286	3.0365	1.9524	0.079429
VAT	Intercept	-4.999	1.1046	4.5256	0.001099
	Elasticity	20.602	6.8664	3.0004	0.013335
Total Taxes	Intercept	-5.6745	1.1329	5.009	0.00053
	Elasticity	26.723	7.5881	3.5217	0.005522

In the Table 1 we observed that all variables in the regressions have good pvalues, but VAT has a good error to value ratio and good statistical fitting parameters. The variable "Average Taxes" that appears in standard models of the type (3) and its Tanzi equivalents seems to be not the best choices. In the other side, the VAT has good statistics (pvalue is obtained lower than standard thresholds) and good error to vale ratio. Moreover, we obtained that in some regressions of type (3) the coefficient of the term $ln(1+AverageTaxRate)$ has negative value that is theoretically wrong. The two other terms including VAT or Total Taxes have had positive sign in the regression so each one could play the role of "Taxes" in theoretical model. Taxes are expected to simulate the informal economy so the sign should be positive. In the same way we have to decide which element of the category "Interest Rate" plays the role of the Interest rate for Deposit as an expected inhibitor effect in informality in original model and so on. The last element we addressed herein was the Indicator variable. In theory the indicator of informal economy is money aggregate. The question herein is to identify which one of them represents at the best the informality for the economy. Again, the direct use of series has given acceptable values but not consistent with some expectation. The most important indicator for informal economy is the currency out of deposits [1] so we discussed it more thoroughly. We considered the fact that the amount of money entering in cash the country in the form of remittances is considerable [19], [20]. In general, those inputs are found usually in Euro currency which has been used as payment tool as well, behaving temporally as national currency itself (Denar) and therefore we proposed to use it as part of total money in circulation by replacing C/C+R in the CDA model. Notice that by direct use of models we obtained a lower than expected level of informal economy whereas if including remittances in C in has shifted up by a few percent. But the most intriguing part of these discussions comes from finding represented in the Figure 3.a where it is seen that C/D has a decreasing trend in all the period [2001, 2015] whereas it is supposed to be proportional to the informal economy.

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Vol. 5 No. 3
November, 2019

a. By red line, the ratio of Currency (C)+Remittance to
Deposits (D): blue line. C/D ratio

b. In orange, informal economy by simple Cagan model. Blue
line, Currency +Remittances

Figure 3: Role of remittances in the simply monetary models.

This last was not reported to show constant decreasing trend in this period and
therefore the initially assumed indicator variable C/D would better be (C+R)/D.
Hereby we noticed the improvement of the calculation but again the change from
year to year is high, in some case around 5% that is not theoretically supported. This
last remark suggests again the use of tiniest series which we reported in [11].

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Vol. 5 No. 3
November, 2019

4. Informal economy for the Republic of Macedonia

In the period [1996, 2016] our estimation has been inadequate for further commenting more than above. For the narrower interval [2004, 2014] we reached the conclusive step with CDA and MIMIC models. The latent variable under analysis shows the behavior as in Figure 4.a
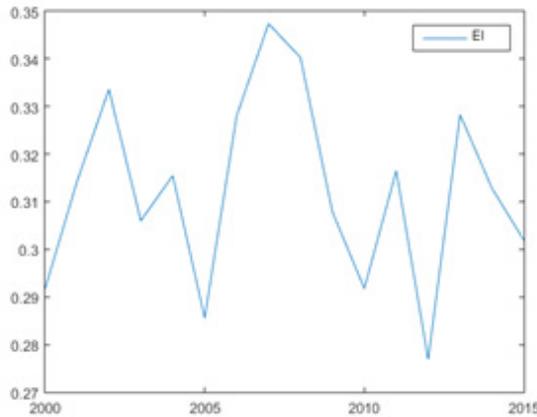
a. Informal Economy by MIMIC 8-1-3 model :
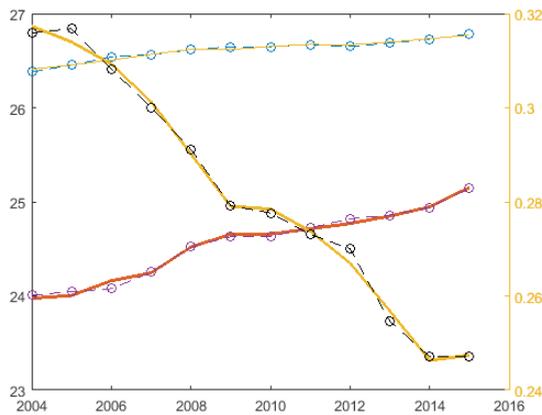
b. Reproduction of the indicators: yellow line, unemployment rate, blue line, ln(GDP); red line logarithm of narrow money,

Figure 4: Informal Economy estimated by MIMIC model

It has slight changes at around 1%-3% from year to year. The reproduction of the indicators based in MIMIC model's parameters is obtained qualitatively good (quite correct in logarithmic scale) as seen in the Figure 4.b. Next, the full analysis of the system has been performed straightforwardly. Thus, variables as Remittances, GDP per capita, VAT, GDP deflator, Taxes over Personal Incomes, and Interest Rates of

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IIPCCL Publishing, Graz-Austria

Vol. 5 No. 3
November, 2019

Deposits have been identified as key factor in the size of the informal economy for the country. Indicators of the informal economy were identified to be the GDP per Capita, the Narrow money M1 and the Rate of Unemployment. The unregistered economy has reached 35% of the GDP near the year 2010 and now is around 31-33% of the GDP. Oscillations continue to be present on the trend of the annuals value estimated, so the analysis needs more improvement which remains to be addressed in our future works.

Conclusions

Informal economy during [2004, 2016] has been estimated with reliable confidence. It has a peak at 34%-38% around the year 2010 and varies from year to year by an amount of 1-3% of the GDP. After 2016 it is probably decreasing toward a stationary state of the around 33% of the gross national production. Some of important variables have been identified as factors or related to informal economy. So we obtained that the corruption and economic performance of the government have a complicated effect, whereas Remittances, Value Added Taxes, Taxes in the Incomes, Interest of Deposits and GDP acts as a set of factors that are responsible for the size of informal economy for the period [2004, 2014]. Variables as GDP per Capita, the Narrow Money and the Un-employment play the role of its key indicators for the period exanimated. Next, the economic and political measures undertaken recently in the framework of reduction of informality might have functioned in the designed direction.

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