Reply to Referee Report 1of the paper with the title: "The nexus between unemployment rate and shadow economy: A comparative analysis of developed and developing countries using a simultaneous-equation model"

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We thank the reviewer for revising our manuscript carefully. We are especially grateful for the constructive comments and suggestions, which helped improving our research. We address the comments point-by-point as follows:

Major Comments

The authors' paper studies the effects and causal links between the shadow economy and the unemployment rate using a dynamic simultaneous-equation panel data model for 38 developing and 40 developed countries over the 2000-2015 period. Their analysis suggests that there is a unidirectional and negative causality running from the unemployment rate to the shadow economy in the developing countries. However, in the developed countries, there is a bidirectional and negative causal relationship between the shadow economy and unemployment rate. The sensitivity of the results makes us realize that institutional quality interacts strongly with the relationship between the shadow economy and the unemployment rate. In countries with a good institutional quality, the unemployment rate is associated with a weak informal economy, whereas in countries with low institutional quality, it strongly drives the informal economy.

This is an interesting, purely empirically written paper. However as it stands now, I can NOT recommend it for publication; it has to undergo a major revision and then it might become a publishable piece.

I have the following 3 critical points:

1) **What is really new?**

Reading carefully 1.) introduction and 2.) the literature review it is not clear for me, what is really new in this paper, or what do I read and/or learn for the first time!

(i) Is it the simultaneous estimation of unemployment (ue) and the shadow economy (se)? If so, what is new then?

(ii) Is it the influence of political and economic institutions on both ue and se and then the interaction between ue and se? If so, the authors should show this, especially what they found out for the first time.

(iii) Is it the difference in the results between developing and highly developed countries? The authors should clearly tell the reader what is new. A reader should really know what is new; especially they provided a quite careful and well done literature review.

Reply: We strengthened the contributions of the paper to clarify the new for the reader by adding the following paragraphs on page 3: “The debates on the relationship between the unemployment rate (UR) and the shadow economy (SE) is of key importance given that such a nexus could be influenced by the institutional quality and specificities of countries (developed and developing). Nevertheless, to the best of our knowledge, none studies have used dynamic simultaneous-equation models for a comparative study between the developed and developing countries and have take into account the potential influence of political and economic institutions on both UR and SE and then the interaction between them. For this reason, we attempt to provide an explanation to the possible dynamic relationship in order to shed light on the role of the institutional quality which interacts strongly with the relationship between unemployment and shadow economy”.

(2) Missing theoretical considerations and core hypotheses

What is amazing that the authors start in chapter 3 at once with the empirical testing. They should include a small chapter "theoretical considerations", where they summarize in a very condensed way the theoretical findings and end with 2-3 core hypotheses. Here it does NOT matter whether they can derive the expected signs on ue and or on se in clear cut way. If they can theoretically justify it they can leave the sin open or undecided; but they have to do this!

Reply: We have added a third chapter "theoretical considerations" which presents a summary table that summarizes the theoretical results and then gives us 2 basic hypotheses.

In this chapter 3, we added the following paragraph: “Based on the literature review, the expected signs of the estimated coefficients are described in Table 1.

Table 1: Expected signs of the estimated coefficient

Dependent variables	UR	SE
UR	n.a	+/-
SE	+/-	n.a
INFLATION	-	n.a
SELF-EMMPLOYMENT	n.a	+
OPENNESS	-	n.a
GDP PER CAPITA	n.a	+/-
GFCF	-	n.a
POLITICAL SATBILITY	n.a	-
CORRUPTION	n.a	+
GOVERNANCE EFFECTIVENESS	n.a	-

In summary, this chapter examines the main assumptions on which it should be emphasized that institutional quality is the most important factor influencing the shadow economy which affects the relationship between unemployment rate and shadow economy. Thus, the following hypotheses are formulated:

Hypothesis 1: The unemployment rate leads to a weak informal economy in the countries with good institutional quality.

Hypothesis 2: The shadow economy leads to the growth of unemployment rate in the countries with low institutional quality compared to those with good institutional quality."

(3) Ad chapters 3, 4, and 5.

In general the empirical investigation is well done. I have the following critical points:

5.1.) In table 4 the regression results for all countries are missing; and on page 17, table 2 should be table 5 and again the regression results for all countries are missing.

Reply: -It is true that on page 11 in the chapter 4 (Main results and discussions), we have mentioned that table 4 refers to the three panels (developed, developing and all the countries in the sample) except that we have forgot to delete the word (all sample countries) because our work consists essentially of a comparative analysis between developed and developing countries so we have no interest in estimating the model for all sample countries. So, we delete the notion (all sample countries) and we keep the same table.

-We have corrected the table number on page 17 (Table 5).

5.2) What is a more severe problem, that in tables 4 and 5 partly the same independent variables are used as independent variables (e.g. tax burden, openness,) in the SE equation. However these variables already have been used to construct the SE variable which it is not directly observable bud a using the MIMIC-procedure a calculated one. I suggest the authors use here the data set by C. Elgin and O.Oztunali " Shadow economies around the world: model based estimates", Bogazici University, Department of Economics, Working paper No.:2012/15. Applying this data set of the SE they can use all independent variables, they use in their regression in tables 4 and 5. With the current data set they should provide a regression NOT using the independent variables: Size of governmemt, Tax burden, Government effectiveness.

Reply: For the variable of OPENESS (independent variable) is found in the UR equation and not in the SE equation. You are correct about the problem of using the other independent variables (size of government, Tax burden) in the SE equation that have already been used to construct the SE variable. However, using data from C. Elgin and O.Oztunali (2012) for the Computed Procedure MIMIC, the authors does not use the variable government effectiveness rather they used the government spending that we have not used it.

-So, we will restimate the model by removing just the variables (Size of government, Tax burden, which seem to be the same variable (please see the next comment 5.3)) from the regression (Table 4 and 5). Hence, table 4 and 5 will be modified (specially model 2) and the result of these variables will be removed in the interpretation. Please find below the new tables 4 and 5 after the restimation. We also deleted all these variables from the model (equation of SE) and from all the tables (1, 2 and 3).

Table 4: Results of dynamic simultaneous-equation

Independent variables	Developed countries		Developing countries	
	Model 1	**Model 2**	**Model 1**	**Model 2**
UNEMP	-	0.078** (0.002)	-	0.282*** (0.048)
$(\text{UNEMP})_{t-1}$	0.851*** (0.010)	-	0.568*** (0.007)	-
SE	-0.041* (0.061)	-	0.004 (0.101)	-
$(\text{SE})_{t-1}$	-	0.793*** 0.023	-	0.772*** (0.015)
Inflation	-0.054*** (0.003)		-0.021*** (0.001)	
Openness	-0.002*** (0.001)		-0.003*** (0.0007)	
GFCF	-0.423 (0.012)		-0.220 (0.062)	
Corruption index		0.282** (0.140)		0.434*** (0.032)
GDP		-0.418** (0.011)		-2.065 (2.116)
Self-employed		0.189*** (0.009)		0.157** (0.060)
Governance effectiveness		-0.803*** (0.202)		-0.256** (0.226)
Political stability		-1.256 *** (0.026)		-0.171 (0.111)
Observations	560	559	523	517
Instruments	50	65	65	82
Constant	5.234*** (0.638)	5.209*** (1.453)	1.687*** (0.173)	19.442*** (2.537)
AR2 test (p-value)	0.983	0.960	0.368	0.308
Sargan test (p-value)	0.747	0.777	0.996	0.910
DWH test (p-value)	0.0001	0.0001	0.0002	0.0002

Table 5: Model with interaction

Independent variables	Developed countries		Developing countries	
	Model 1	Model 2	Model 1	Model 2
UNEMP	-	0.179* (0.016)	-	0.230*** (0.062)
$(UNEMP)_{t-1}$	0.545*** (0.006)	-	0.873*** (0.005)	-
SE	-0.306** (0.023)	-	0.013 (0.102)	-
$(SE)_{t-1}$	-	0.811*** (0.151)	-	0.734*** (0.056)
Inflation	-0.065*** (0.002)		-0.013*** (0.0009)	
Openness	-0.001** (0.002)		-0.001*** (0.0006)	
GFCF	0.392 (0.014)		-0.010*** (0.0015)	
GDP		-0.625*** (0.206)		-1.220 (1.685)
Self-employed		0.372** (0.170)		0.123** (0.018)
Governance effectiveness		-0.776** (0.334)		-0.325** (0.217)
Shadow economy* Corruption		0.025 (0.074)		0.003*** (0.0014)
Shadow economy* Political stability		-0.062*** (0.004)		-0.038*** (0.001)
Observations	560	559	523	517
Instruments	50	98	65	113
Constant	7.661*** (0.872)	9.448*** (3.959)	0.726*** (0.055)	15.522*** (3.989)
AR2 test (p-value)	0.934	0.997	0.378	0.172
Sargan test (p-value)	0.993	0.981	0.998	0.965
DWH test (p-value)	0.00012	0.0001	0.0000	0.0001

Notes: Standard errors are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 % levels, respectively. Model 1 and Model 2, respectively refer to unemployment and shadow economy, the two dependent variables.

5.3.) The SIZE GOV and TAX BURDEN both measure the "same thing", I suggest, to use only one of them.

Reply: Following the previous comment 5.2 these two variables have been already removed.

5.4.) The SE variable is NOT statistically significant in UNEMP regression for the developing countries (in both tables 4 and 5!). Can the authors at least try to give an explanation?

Reply: We have added in the manuscript this paragraph: “This result may be due to the main explanations. First, in developing countries, informal economy explained by the weakness of job creation tends to develop and occupy an essential place. This informal sector has the capacity to appease major social tensions by allowing the unemployed to earn income. On the

one hand, this creation remains insufficient to satisfy a growing demand due to demographic development. On the other hand, competition in the formal sector encourages the growth of the informal sector, which leads to a reduction in jobs and wages in the formal economy and, consequently, an increase in the unemployment rate. Secondly, as the activities created in the informal sector are not declared and which escape any tax declaration, the people who occupy it, however, do not benefit from any social security or pension plan. Subsequently, these people tend to escape from this sector and maintain the hope of having access to the security of public employment".

(4) Overall evaluation This paper is interesting and brings out some interesting results. However, it needs a major revision. If the authors carefully tackle all my three critical points, I can recommend it for publication.