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Dynamic Interactions Between the Shadow Economy and Economic Policy Uncertainty: A Panel Var Approach

Irem Cetin

Hacettepe University, Department of Public Finance, Beytepe, Ankara, Turkey

E-mail: iremyendi@hacettepe.edu.tr

Abstract

The literature on economic uncertainty has focused on the effects of uncertainty on the formal economy. Still, it has not addressed a relationship between uncertainty and shadow economy until now, to our knowledge. Therefore, this paper analyses the dynamic relationship between economic policy uncertainty and the shadow economy using panel vector autoregression estimates exploiting a dataset for 21 countries from 1997–2018. The impulse response analyses in this context reveal a mutual interaction of policy uncertainty and the shadow economy. In this respect, not only is the shadow economy found to respond to shocks in economic policy uncertainty, but also the uncertainty in economic policy appears to increase by a response to shocks in the shadow economy, implying a feedback effect from informal economic activities towards uncertainty. This effect is also thought to be responsible for aggravating negative influences of uncertainty on formal economic activities.

Keywords: Shadow economy, economic policy uncertainty, panel VAR

JEL Classification: O17, D80, C23

1. Introduction

Due to its features, the shadow economy is a concept that is difficult to define, measure or determine its underlying causes. Most economic activities are conducted informally, especially in developing countries (Medina and Schneider, 2018). Both theoretical and empirical literature has shown that there are economic, fiscal (Kuehn, 2007; Macias, 2006; Schneider and Enste, 2000, 2002; Torgler and Schneider, 2007) and institutional (Dreher *et al*., 2005; Johnson *et al*., 1999; Schneider and Enste, 2002) reasons for the prevalence of the shadow economy. A larger shadow

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economy reduces tax revenues, limits the supply of public goods and services, causes budget deficits, disrupts fiscal stability, leads to unfair competition against those working in the formal economy and reduces the effectiveness of fiscal and monetary policies.

In recent years, the interest in economic policy uncertainty and its influences have increased considerably as a result of the outbreak of several policy uncertainties led by, e.g., the 1997 Asian Financial Crisis, the Global Financial Crisis of 2008–2009, the Euro Area Sovereign Debt Crisis and the Brexit. The COVID-19 pandemic has recently generated severe concerns about policy uncertainty and its negative repercussions. The effects of policy uncertainty on the formal economy have already been a focus of interest in both theoretical and empirical works in the literature. Based on the seminal papers of Bernanke (1983), Dixit (1989) and Dixit and Pindyck (1994), uncertainty was blamed for delays in investment decisions. Accordingly, Bloom (2009) and Baker *et al*. (2016) pioneered the empirical studies that introduced an economic policy uncertainty index. The vast majority of the studies in the literature address the adverse impacts of uncertainty on macroeconomic variables. For example, higher economic policy uncertainty is deemed to decrease investment and output (Altig *et al*., 2020; Baker *et al*., 2016, 2020; Bloom, 2009), rising unemployment (Caggino *et al*., 2014) and stock prices (Arouri *et al*., 2016; Pastor and Veronesi, 2012) and decrease consumption (*e.g*., Colombo, 2013).

Previous literature on uncertainty has focused only on the effect of economic policy uncertainty on the formal economy and ignored its negative influences on the shadow economy. Economic policy uncertainty in the formal economy can cause economic agents to resort to informal activities, which, on the other hand, would complicate the predictability of the output, unemployment and prices and generate additional uncertainties through failures in economic policy targets. Hence, economic policy uncertainty may be more detrimental to the formal economy than predicted. To the best of our knowledge, no study has examined the interaction between the shadow economy and economic policy uncertainty in empirical terms, except Nguyen and Su (2021), who examined only the impact of economic policy uncertainty on the shadow economy, concluding that an increase in both the level and the volatility of economic uncertainty increases the shadow economy. In this respect, this study fills the gap in the relevant literature by utilizing the panel vector autoregression approach to account for the inherent simultaneity between economic policy uncertainty and the shadow economy. Moreover, an impulse response analysis is employed to reveal the dynamic relationship between the shadow economy and economic policy uncertainty over time.

The remainder of the paper is structured as follows: Section 2 presents the literature review. Section 3 describes the data. Section 4 presents the empirical methodology. Section 5 discusses the empirical results, and finally, Section 6 offers concluding remarks.

2. Literature Review

Theoretically, a good start for understanding the impact of uncertainty on the economy can be made through the seminal papers of Bernanke (1983), Dixit (1989) and Dixit and Pindyck (1994). When reversing investment projects is costly, high levels of uncertainty encourage firms to delay investments and hiring (Bernanke, 1983), so firms prefer to wait rather than make costly mistakes. Uncertainty creates a reward for waiting; therefore, an increase in uncertainty reduces investment (Dixit, 1989; Dixit and Pindyck, 1994). This investment dynamic is justified by various studies in the empirical literature. Economic policy uncertainty decreases not only the investment but the output as well (Azqueta-Gavaldón *et al*., 2020; Baker *et al*., 2016; Bloom, 2009; Colombo, 2013; Gulen and Ion, 2015; Hardouvelis *et al*., 2018). Some other literature points out households who delay their consumption decisions as a precaution against increased uncertainty (Colombo, 2013; Demir and Gozgor, 2018) and to adverse effects of economic policy uncertainty on hiring decisions, which increases unemployment (Baker *et al*., 2016; Bloom, 2009; Caggiano *et al*., 2014; Hardouvelis *et al*., 2018; Leduc and Liu, 2016). Thus, a vast body of literature has shown that increased economic policy uncertainty can seriously affect the formal economy through several channels.

However, the impact of economic policy uncertainty is not limited to the formal economy. Due to the prevailing uncertainty in the formal economy, economic agents may find it more competitive to operate in the informal one. Studies on the shadow economy show that per capita income and employment are the crucial indicators of the decision to participate in the shadow economy (Feld and Schneider, 2010; Kuehn, 2007; Medina and Schneider, 2018; Schneider and Enste, 2000; Schneider and Williams, 2013). That is, any influences of economic policy uncertainty on per capita income and employment will force economic agents to prefer the formal and informal economies, which will most probably end up with involvement in informal activities due to lower opportunity costs of investment and production in the shadow sector. On the other hand, it is possible to face a higher economic policy uncertainty than expected in the formal economy due to an expanding shadow economy. The official statistics on which the economic policies and policy targets are based will represent biased unemployment, income and consumption figures. For example, if informal employment is widespread, official unemployment figures will appear higher than they are. Similarly, official income statistics will be underestimated (Schneider, 2000; Tanzi, 1980). In this situation, a self-fulfilling uncertainty will be inevitable due to biased official statistics, which are responsible for the repeated failures in achieving the policy targets and commitments. Moreover, tax-revenue losses due to increased shadow economic activities will put pressure on public finance by narrowing the fiscal space and increasing the economic policy uncertainty further. For these reasons, the shadow economy itself is a significant source of uncertainty for the economy and economic policies.

3. Data

To investigate the relationship between the shadow economy and economic policy uncertainty, we use data from 21 countries[1] between 1997 and 2018. Due to its characteristics, it is difficult to measure the shadow economy because individuals who operate informally want to hide themselves from the possibility of being detected and punished, and these activities are conducted entirely outside official records. However, Medina and Schneider (2018) and Elgin *et al*. (2021) provided model--based estimates of the shadow economy for many countries over an extended period. The size of the shadow economy estimated as a percentage of gross domestic product (GDP) by Elgin *et al*. (2021) is used in the present study because the time span of the shadow economy series is longer than those estimated by Medina and Schneider (2018). In the relationship between the shadow economy and the economic policy uncertainty, the latter variable is proxied by the economic policy uncertainty (EPU) index constructed by Baker *et al*. (2016). Using newspaper coverage frequency, Baker *et al*. (2016) constructed indices of EPU for several countries. They considered a set of newspapers for each country and counted the number of articles containing terms relating to three categories, *i.e*., the economy (E), policy (P) and uncertainty (U). The raw count was then scaled by the total number of articles in the same newspaper/month. Finally, the EPU index was obtained after standardizing the monthly series of scaled counts and averaging them across the selected newspapers. Following Nguyen *et al*. (2020) and Nguyen and Su (2021), we calculate the yearly mean of EPU data to proxy for the level of economic policy uncertainty.

In the study, real per capita GDP and unemployment rate are also considered in estimating the relationship between the shadow economy and EPU because per capita income and development level are among the main economic factors that determine the size of the shadow economy (Schneider and Enste, 2000) and increased unemployment will lead to more people being involved in the informal economy (Torgler and Schneider, 2007). On the other hand, as EPU increases, investment and output decrease, firms' hiring decisions are affected negatively and unemployment rises (Baker *et al*., 2016; Bloom, 2009). In this respect, our analyses are based on a basic model, in which only the dynamics between the shadow economy and EPU are considered and on an extended model, in which the real GDP per capita and unemployment rate are included as additional dynamics. Besides providing a richer economic analysis, this extension allows checking the robustness of basic findings to the inclusion of additional information into the model. The real per capita GDP and unemployment data are taken from the World Development Indicators Database. The descriptive statistics are listed in Table 1.

1 These countries are Australia, Brazil, Canada, Chile, Colombia, France, Germany, Greece, India, Ireland, Italy, Japan, Korea, the Netherlands, Russia, Spain, the United Kingdom, the United States, Sweden and Mexico.

Table 1: Descriptive statistics

Variable	Mean	Std. dev.	Min	Max	Observations
Shadow	21.53750	9.792890	8.238206	49.28838	462
EPU	116.0384	57.67314	27.00091	542.7656	462
GDP	9.869974	1.026047	6.501920	11.19242	462
Unemployment	7.689545	4.204525	2.120000	27.47000	462

Note: The GDP variable is in logarithms.
Source: Authors´ elaboration

4. Methodology

The vector autoregression (VAR) model, which was introduced by Sims (1980), was first applied to panel data by Holtz-Eakin *et al*. (1988). In the existing literature (Baker *et al*., 2016; Bloom, 2009), VAR is one of the most preferred methods to address the impact of EPU on the economy. The present study will use the PVAR model to examine the relationship between the informal economy and EPU as all the variables are treated as endogenous in the PVAR model and the PVAR model allows the dynamic relationship between the variables to be examined using the impulse response functions. It is more apparent in our study because, as discussed in Section 2, there is a mutual interaction between the informal economy and EPU, so it is impossible to classify the variables as dependent and independent.

Following Abrigo and Love (2016), the PVAR model is expressed as follows:

$$Y_{it} = Y_{it-1}A_1 + Y_{it-2}A_2 + \cdots + Y_{it-p}A_p + \mu_i + \varepsilon_{it} \quad (1)$$

$$i \in \{1, 2, ..., N\}, \; t \in \{1, 2, ..., T_i\}$$

where Y_{it} is a vector containing endogenous variables, *i.e*., EPU and shadow economy in the basic model and additionally the real per capita GDP and the unemployment rate in the extended model. μ_i and ε_i are the vectors of country fixed effects and idiosyncratic errors, respectively. The matrices $A_1, A_1, \ldots A_p$ contain parameters to be estimated. The parameters mentioned above can be estimated simultaneously with the fixed effects or separately using ordinary least squares (OLS). However, the literature argues the limitations of the fixed effect approach to the panel VAR model (Canova and Ciccarelli, 2013). The inclusion of the variables' lagged values in the PVAR model will cause the fixed effects of the dependent variable to be correlated with the lagged variables. The Helmert procedure (Arellano and Bover, 1995), also referred to as the forward mean-differencing method,

is applied to overcome the effect of this correlation. The Helmert procedure removes the fixed effects from the model. Since this method will ensure orthogonality between the transformed variables and lagged dependent variables, the parameters can be estimated with the generalized method of moments (GMM) using the lagged variables as a tool (Arellano and Bover, 1995). This paper uses a PVAR model based on the generalized method of moments (GMM) with the Helmert procedure in order to overcome the effect of the aforementioned correlation,

PVAR analysis is based on selecting the appropriate lag length and thus determining the panel VAR model and moment conditions. The moment and model selection criteria (MMSC) based on Hansen's (1982) J statistics, which is intended to be used in GMM models, was proposed by Andrews and Lu (2001). MMSC parallels the widely used maximum likelihood-based model selection criteria, namely, the Akaike information criteria (AIC), the Bayesian information criteria (BIC) and the Hannan–Quinn information criteria (HQIC) (Abrigo and Love, 2016). Similarly, Abrigo and Love (2016) suggested using the panel versions of these three information criteria, such as modified AIC (MAIC), modified BIC (MBIC) and modified HQIC (MHQIC), in calculating the optimal lag length.

Before estimating the relationships, it is necessary to determine whether the employed variables contain a unit root. We use ADF Fisher and PP Fisher panel unit root tests to check stationarity. According to Table 2, all the variables are non-stationary at a level. Thus, they enter the model in the first difference.

Table 2: Unit root tests

Test	UE	Δ*UE*	EPU	Δ*EPU*	GDP	Δ*GDP*	UNEMPLOY-MENT	Δ*UNEPLOY*
ADF Fisher	53.0980	193.707***	59.0436**	184.384***	54.3516	124.941***	94.2507***	138.827
PP Fisher	50.8318	332.821***	52.0166	252.037***	87.1346***	175.044***	47.3750	155.767

Note: Null hypothesis: all panels have a unit root. *** and ** represent 1% and 5% significance levels, respectively.
Source: authors' elaboration

The dynamic relations between variables in the PVAR model are examined using impulse response functions and variance decompositions. The impulse response functions analyse the effect of a one standard deviation shock (*i.e.*, EPU) in one variable on other variables (*i.e.*, the shadow economy) in the system. The variance decomposition, on the other hand, reveals what percentages of a shock in a variable are caused by itself and by other variables.

5. Empirical Results

5.1 Baseline model results

As stated in the literature (Abrigo and Love, 2016), we use the Cholesky decomposition to identify shocks; hence, the order of the variables is crucial. All the variable placements are affected contemporaneously by the variables that come before them. However, they are unaffected by the variables that come after them contemporaneously, so the variables are ordered as follows: EPU and the shadow economy. This ordering is based on the assumption that shocks in EPU initially affect the shadow economy. In light of the reasoning behind this situation, an EPU shock will affect the shadow economy initially because the economic agents may find it more advantageous to conduct business in the informal economy in the case of widespread economic policy uncertainty.

As a first step, the optimal lag length is calculated. We select the model that does not reject Hansen's null hypothesis that overidentifying restrictions are valid and has the lowest (most negative) value of the model selection criteria. Consequently, the optimal length is determined to be 2. In this case, Hansen's J-test does not reject the null hypothesis. Accordingly, the PVAR (2) is estimated to obtain impulse response functions in the baseline model.

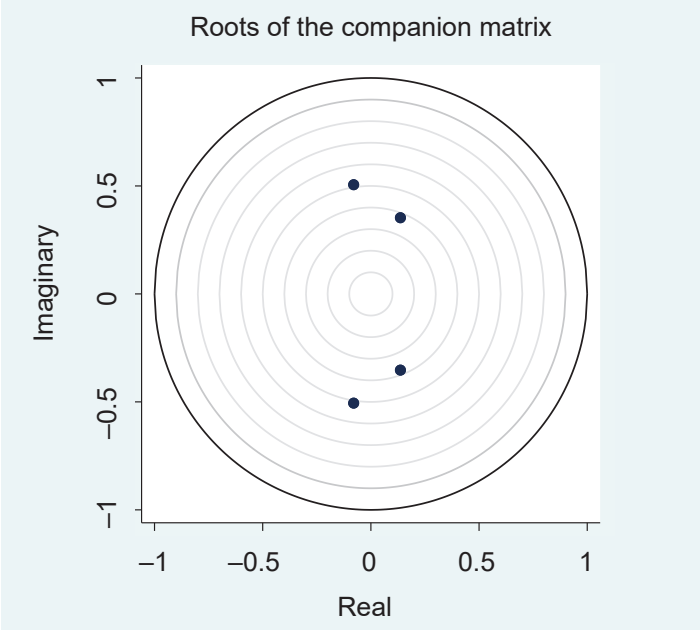
Table 3: Baseline model lag length selection

lag	J	J value	MBIC	MAIC	MQIC
1	39.31865	0.0000932	–30.48668	15.31865	–2.94064
2	9.05665	0.3375396	–37.48024	–6.94335	–19.11621
3	9.733659	0.451613	–13.53479	1.733659	–4.352771

Source: Authors' elaboration

Stationarity and stability are two crucial presumptions regarding the data variables and the system as a whole that support the validity of multivariate modelling in terms of the PVAR[p] model. The stationarity of the variables used is confirmed earlier. Formally, the PVAR model is stable if all absolute eigenvalues of the coefficient matrix are below 1. As can be seen from Figure 1, the characteristic roots of the model are within the unit circle, meaning that the PVAR(2) model fulfils the stability condition.

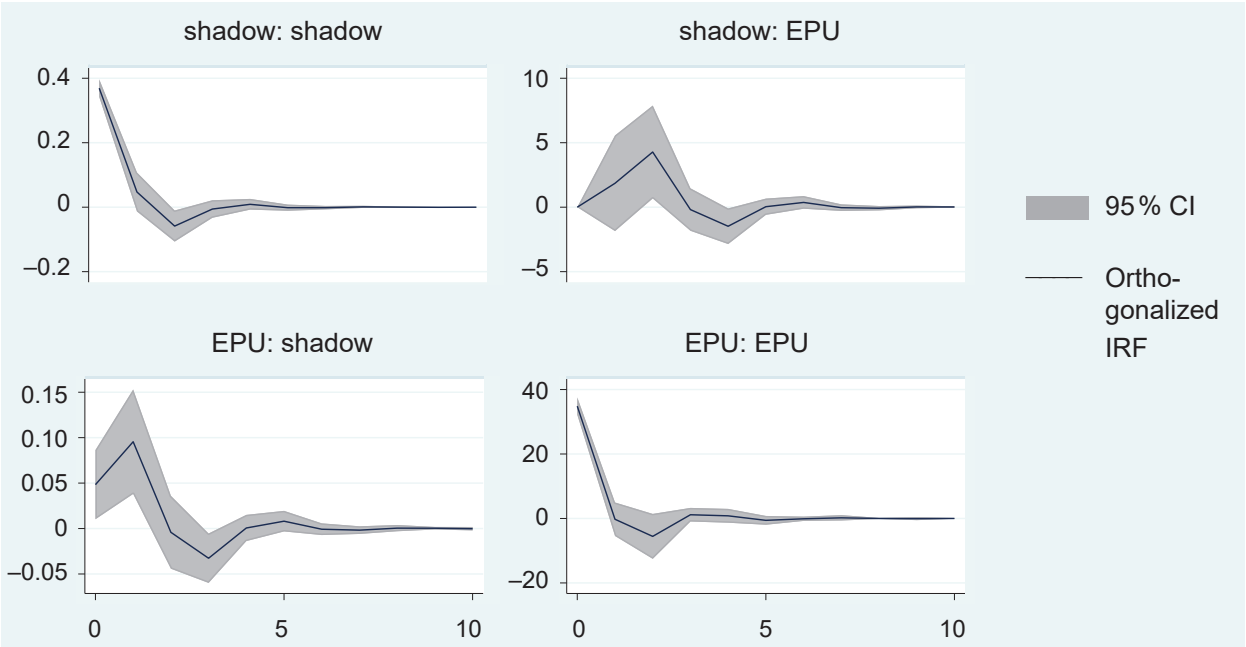
Figure 1: Characteristic roots of PVAR model



Source: Authors' elaboration

The impulse response functions of the baseline model with variables of shadow economy and EPU are presented in Figure 2, where the solid lines show the impulse response of one variable (*e.g.*, shadow economy) to a one-standard-deviation shock to a different variable (*e.g.*, EPU).

Figure 2: Impulse response functions. Variables: EPU and shadow economy



Source: Authors' elaboration

The response of the shadow economy to a shock to EPU is positive and significant. The shock of one standard deviation in the EPU increases the size of the shadow economy and the impulse response functions show that a shock to the shadow economy increases the EPU. These results support the literature suggesting the reciprocal relationship between economic policy uncertainty and the shadow economy.

5.2 Extended model results

In light of the discussions in Sections 2 and 3, the baseline model is expanded by adding two other endogenous variables: GDP and unemployment. The variables are ordered as the EPU, shadow economy, GDP and unemployment. According to the MBIC value and the J statistics in Table 4, the optimal lag length for the extended model is determined to be 2, and PVAR(2) is estimated to obtain impulse response functions for the extended model.[2]

Table 4: Extended model lag length selection

lag	J	J value	MBIC	MAIC	MQIC
1	70.35327	0.0194061	–208.8681	–25.64673	98.6838
2	71688	0.2979066	150.4307	–28.28312	–76.97456
3	10.82943	0.8198894	–82.24435	–21.17057	–45.51629

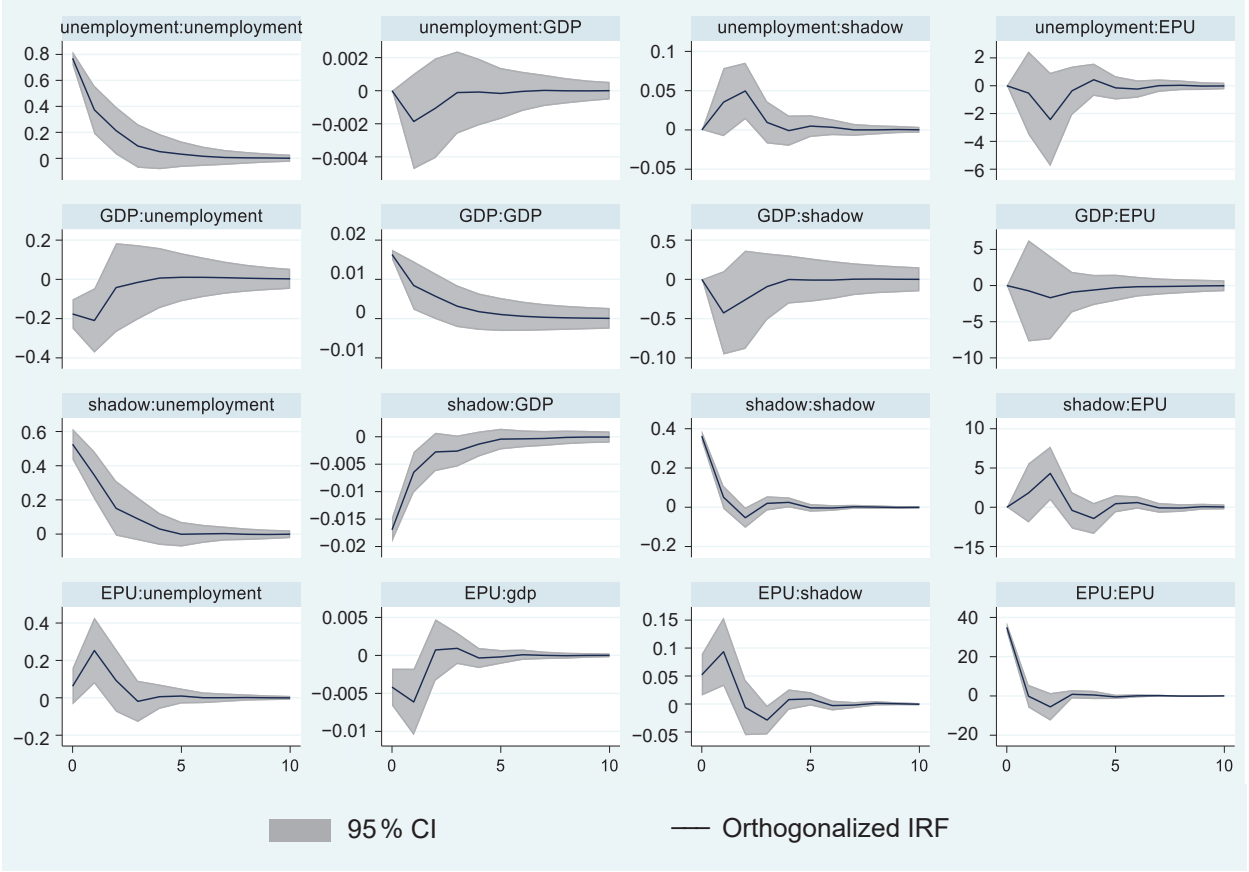
Source: Authors' elaboration

Figure 3 displays the impulse response functions of the extended model. The response of the shadow economy to a shock in the EPU is positive and significant. As in the baseline model, one standard deviation shock in the EPU increases the shadow economy, which reaches its maximum and then disappears. Similarly, as a result of a shock to the shadow economy, the EPU first increases, then the effect disappears. Overall, the main results remain robust to the inclusion of additional variables.

Consistent with earlier literature (Schneider and Enste, 2000), there is evidence that a shock to the shadow economy lowers GDP. In addition, a shock to the shadow economy increases unemployment and a shock to unemployment increases the shadow economy as a result of individuals operating in the informal economy due to increased unemployment in the formal economy. In parallel with the existing literature (Baker *et al*., 2016; Bloom, 2009), we also find that a shock to EPU decreases GDP and increases unemployment.

2 The extended model satisfies the stability condition, the characteristic roots of the extended PVAR model are available upon request.

Figure 3: Impulse response functions. Variables: EPU, shadow economy, GDP and unemployment



Source: Authors' elaboration

To complement the impulse response functions, we report variance decompositions in Tables 5 and 6. According to the results in Table 5, changes in the shadow economy are explained mainly by its own shocks. EPU is the second most effective variable in explaining the shadow economy as of the second year.

Table 5: Variance decomposition of shadow economy

Year	EPU	Shadow	GDP	Unemployment
1	0.0202735	0.9797265	0	0
2	0.0770215	0.9023171	0.0122458	0.0084155
3	0.0742774	0.8856157	0.0161171	0.0239899
4	0.0788793	0.8802449	0.0165113	0.0243644
5	0.0789298	0.8803700	0.0164385	0,0242617
6	0.0793997	0.8797728	0.0164312	0.0243962
7	0.0794319	0.8796704	0.0164324	0.0244654
8	0.0794510	0.8796539	0.0164315	0.0244637
9	0.0794593	0.8796453	0.0164322	0.0244632
10	0.0794601	0.8796429	0.0164321	0.0244649

Source: Authors‘ elaboration

Table 6 shows that changes in EPU are explained mainly by its own shocks, then by the shadow economy and GDP, respectively. These results show that, not surprisingly, the effect of unemployment is relatively insignificant compared to those of EPU, the shadow economy and GDP.

Table 6: Variance decomposition of EPU

Year	EPU	Shadow	GDP	Unemployment
1	1	0	0	0
2	0.9966220	0.0027207	0,0004285	0.0002288
3	0.9754742	0.0171118	0.0026009	0.0048132
4	0.9746346	0.0172082	0.0032490	0.0049082
5	0.9726766	0.0187492	0.0035327	0.0050415
6	0.9724372	0.0189020	0.0036035	0.0050574
7	0.9721003	0.0191781	0.0036211	0.0051004
8	0.9720827	0.0191816	0.0036355	0.0051003
9	0.9720687	0.0191882	0.0036430	0.0051010
10	0.9720607	0.0191930	0.0036447	0.0051015

Source: Source: Authors‘ elaboration

6. Conclusion

This study examined the dynamic relationship between the size of the shadow economy and economic policy uncertainty using panel data from 21 countries for the period from 1997 to 2018. Our dynamic analysis enabled us to treat all the variables as endogenous in the system so that we were able to capture bi-directional changes in the relationship between the shadow economy and economic policy uncertainty over time. The findings of the study provide new insights into understanding the intricate relationship between the shadow economy and economic policy uncertainty. Firstly, the impulse response functions show that economic policy uncertainty increases the size of the shadow economy. Secondly, there is some evidence of reverse causality between these variables – *i.e.*, a shock to the shadow economy increases the economic policy uncertainty. The results are also robust when control variables are added to the model.

The results of this study provide a useful policy tool for governments. While previous studies have emphasized only the effects of economic policy uncertainty and the shadow economy on the formal economy, this study has revealed the interactions between the shadow economy and economic policy uncertainty, thus showing that the success of policies aimed at reducing the shadow economy and economic policy uncertainty may have a more positive impact on the formal economy than that discussed in the previous literature. In particular, the fact that fighting against the shadow economy is among the policy priorities in developing countries with high shadow economies and economic policy uncertainty will contribute to reducing uncertainty in economic policy and have a more positive effect on the overall economic performance.

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