

Article

# What Determines the Shadow Economy? An Extreme Bounds Analysis

Mohammed Nayel Abu Alfoul <sup>1,\*</sup>, Ibrahim Naser Khatatbeh <sup>2</sup> and Fouad Jamaani <sup>3</sup>

<sup>1</sup> Department of Accounting, Economics and Finance, School of Business, Law and Entrepreneurship, Swinburne University of Technology, Hawthorn, VIC 3122, Australia

<sup>2</sup> Department of Banking and Financial Sciences, Faculty of Economics and Administrative Sciences, Hashemite University, Zarqa 591504, Jordan; ibrahim.khatatbeh@hu.edu.jo

<sup>3</sup> Department of Economics and Finance, College of Business Administration, Taif University, P.O. Box 11099, Taif 21944, Saudi Arabia; fjamaani@tu.edu.sa

\* Correspondence: mabualfoul@swin.edu.au

**Abstract:** The purpose of this paper was to identify the leading causes determining the shadow economy at the global level. The empirical analysis used was the Sala-i-Martin version of extreme bounds analysis (EBA) applied to a cross-sectional sample of 132 countries. The results suggested that the quality of institutions is the primary determinant of the shadow economy. The results showed that only four out of six factors of the quality of institutions proved to be robust determining factors of the shadow economy; they are bureaucracy quality, law and order, corruption, and internal conflict. Moreover, monetary freedom and secured property rights are also robust and negatively related to the shadow economy. An interesting result is that information and communication technology (ICT) development is vital to the shadow economy. Mainly, internet usage is robust and negatively associated with the shadow economy. Furthermore, inflation and poverty emerge as key determining factors of the shadow economy. Our findings will aid in the development of recommendations for potential strategies to minimize the international extent of the shadow economy.

**Keywords:** shadow economy; extreme bounds analysis; taxes; data mining

**JEL Classification:** O17; E26; C31



**Citation:** Abu Alfoul, M.N.; Khatatbeh, I.N.; Jamaani, F. What Determines the Shadow Economy? An Extreme Bounds Analysis. *Sustainability* **2022**, *14*, 5761. <https://doi.org/10.3390/su14105761>

Academic Editor: Luigi Aldieri

Received: 12 April 2022

Accepted: 5 May 2022

Published: 10 May 2022

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

It has become evident that the shadow economy varies across countries' economic components. The different causes that contribute to creating the shadow economy phenomenon increased questions concerning the justification of cross-country differences in the incidence of the shadow economy. One of these questions is what are the leading causes of shadow economy? The leading causes determining the shadow economy have been briefly presented in previous studies e.g., [1,2]. However, the previous literature typically centres on four or five causes at a time to estimate the shadow economy, therefore evoking the ceteris paribus condition. Several causes determine the shadow economy. Thus, it is difficult to determine all the causes that justify cross-country variations in the shadow economy. It has also become apparent that shadow economy rates do not necessarily go with some causes of the shadow economy, such as unemployment, inflation, or tax evasion.

Moreover, they certainly do not have to be determined equally by the same causes. For instance, the shadow economy is more reliant on the tax burden, unemployment rate, and inflation rate than the institutional quality or the educational level. Therefore, the current study investigated the majority of potential causes that determine the shadow economy using 36 explanatory variables over 132 countries.

In a recent study, Medina and Schneider [3] argued that knowing the leading causes behind the shadow economy is very important to measure the size of the shadow economy

in the world. They state that *“The link between theory and empirical estimation of the shadow economy is still unsatisfactory. In the best case, the theory provides us with derived signs of the causal and indicator variables. However, which are the core causal and core indicator variables is still a theoretically open question.”* [3]. Whereas it is clear that determining the causes of the shadow economy matters for policymakers, the literature remains equivocal about the core causes of the shadow economy. Based on this consideration, further investigation of all potential causes leading to the shadow economy may be of great importance in re-evaluating the future effects of the shadow economy for policymakers.

There are many significant reasons why policymakers should be particularly worried about the underlying causes that are going to be an increase in the shadow economy. Among the most significant of these are (i) an ever-increasing shadow economy can be interpreted as the response of people who feel burdened by the country and who decide on the “exit option” instead of the “voice option” [4]. If the rise in the shadow economy has been caused by an increase in the total tax and social security burden in conjunction with the “institutional sclerosis” [5], the “consecutive flight” to the shadow economy can erode the tax burden and social security bases. The outcome can be a vicious circle of an additional rise in the budget deficit or tax rates, further growth of the shadow economy, as well as the gradual deterioration of the economic and social basis (For a more detailed analysis of the effects of the shadow economy, please see [1]. Slightly more common implications for governments have been discussed, e.g., by [6,7].); (ii) a flourishing shadow economy can cause serious problems for politicians because formal indicators—on consumption, income, labour force, unemployment—are undependable. Policy based upon inaccurate formal indicators has the potential to be ineffectual, or even worse.

Recent researches suggest that a high level of shadow economy hinders economic and sustainable development, which means that higher levels of the shadow economy are associated with low levels of economic development and sustainable development [6,7]. A robust negative effect of the size of the shadow economy on economic growth was found in [8]. Additionally, [9] argued that the shadow economy harms sustainable economic development by slowing economic growth, which in turn adversely affects sustainable development.

There is a noticeable increase in the literature that investigates the shadow economy phenomena as well as its impact on the official economy. Furthermore, economists have a growing interest in understanding the shadow economy criteria and determining the most important causes that lead to the increase in this phenomenon around the world through implementing various econometric methods. Although a majority of the literature are about the characteristics of the shadow economy, our comprehensive study is lacking. Disputes continue regarding the definitions, estimation methods, and concerning the use of estimations in economic analysis and policies. The article [10] shows the feature “Controversy: On the Hidden Economy” and documents the differing opinions, e.g., [11,12]. The causes, indicators, size, and effects of the shadow economy differ depending on the various types of countries. However, certain analogies may be useful for social scientists and politicians who may ultimately have to deal with this phenomenon.

Against this backdrop, our study set up a shadow economy model covering all potential causes of the shadow economy. To the best of our knowledge, a few studies have recently briefly presented some of the causes of the shadow economy, such as Williams and Schneider [2] or, see, for instance, Medina and Schneider [3]; however, they only utilized a limited number of causes of the shadow economy by applying different methods such as ‘Multiple Indicators Multiple Causes (MIMIC)’ and the ‘currency demand approach (CDA)’ to measure the size of the shadow economy. They relied on their studies on the results of previous studies to know the most important causes that lead to the shadow economy. They did not take into consideration other causes that may have a strong impact on the shadow economy, such as governance indicators, religious differences, ethnic tensions, etc. This view is supported by [13], who showed that “the shadow economy is not only affected by hard factors like a tax pressure or regulation intensity. In addition, soft factors

like tax morals play a role". To alleviate this issue, we employed extreme bounds analysis (EBA) to identify the determining factors of the shadow economy across countries; hence, our paper presents a generalized view of the causes of the shadow economy. Two types of EBA were applied by [14,15]. The purpose of implementing these approaches was to address the problem of the findings' sensitivity to the selected set of independent factors and to avoid the data mining malpractice. Mainly, EBA is a form of sensitivity analysis that deals with model uncertainty problems arising from the choice of explanatory variables. In this sense, [16] argues that researchers often run hundreds of regressions—until they achieve the desired results—report a few that tell a good story and throw the rest in the bin. Therefore, this paper is the first one analysing all potential variables that cause the shadow economy. Additionally, we have undertaken the task of collecting all possibly accessible variables that might be one of the factors contributing to the expansion of the shadow economy.

This paper contributes to the literature by establishing a parsimonious list of robust determinants of the size of the shadow economy, which can be later adapted to evaluate their impacts on the shadow economy in different contexts. Hence, this paper main contribution is revisiting an intensively studied topic in economics by using a more robust statistical techniques and by providing results that may be helpful for economic and sustainable development. The rest of this research progresses in the following manner. Section 2 outlines the review of the literature. The data are presented in Section 3. The methodology and model specifications are discussed in Section 4. Our findings and discussion are summarized in Section 5, whereas conclusions are presented in Section 6.

## 2. Literature Review

Numerous studies have debated the shadow economy phenomenon, which, in turn, reflects the significance of this matter to economists. Earlier studies used both direct methods (survey methods) and indirect methods, which include the indicator approach and the model as a latent approach, which is a statistical method such as the Multiple Indicator Multiple Cause model (MIMIC) (For further details on the different benchmarking procedures, see [17,18].) to estimate the shadow economy (We will not go into great detail about the various methods for measuring a shadow economy (including the MIMIC method) due to the vast amount of literature available.). The shadow economy is determined by a variety of factors. Specific causes of the shadow economy are highlighted in the earlier literature. The leading causes of the shadow economy are presented in the Appendix A Table A1. In this section, we will discuss several researches have inspected shadow economies and provide the most prevalent shadow economy reasons identified in earlier researches.

Schneider's empirical results [17] indicated that the primary factors contributing to the growth of the shadow economy in 31 European nations and five additional OECD countries from 2003 to 2014 were tax policy and national regulation. They observed that the size of the shadow economies was 22.6 % of official GDP in 2003, but had decreased to 18.6 % in 2014. Hassan and Schneider [18] examined the development and size of 157 nations' shadow economies from 1999 to 2013. They discovered four major factors that boosted the size of these nations' shadow economies between 1999 and 2013 using the MIMIC approach: (i) increased taxation; (ii) increased regulatory burden; (iii) increased joblessness; and (iv) increasing self-employment rates. These data corroborated the conclusions of past research. [13,19–21].

Vo and Ly [22] evaluated the direction and size of the invisible economy in the Association of South-East Asian Nations (ASEAN) member nations, excluding Brunei and Singapore. Their research, which spanned the years 1995–2014, used the MIMIC technique. The findings demonstrated that labour flexibility, tax rates, and corporate freedom have all had a substantial impact on these Asian nations' shadow economies. Furthermore, Macias and Cazzavillan [20] used the MIMIC approach to quantify and analyze the growth of Mexico's shadow economy between 1970 and 2006. The researchers considered a variety of criteria, including the tax load, wage levels, inflation, joblessness, and heavy

governmental policies, while using real GDP and real currency as proxies for the shadow economy. The findings revealed a positive association between the invisible economy and the actual GDP; and, secondly, that the primary drivers of Mexico's invisible economy were heavy government restrictions and insufficiently high pay.

On the other hand, several researches used two distinct approaches to determine the direction and size of the shadow economy. For example, the CDA and structural equation modeling were both used by Hassan and Schneider [23] to estimate the size and trajectory of Egypt's shadow economy. Self-employment and agriculture were employed as proxy variables to gauge the strength of democratic institutions in Egypt's formal sector. It was shown that the invisible economy has shrunk from 50% in 1976 to a mere 32% in 2013. Utilizing a wider dataset covering 162 countries, the empirical paper of Schneider et al. [24] evaluated the influence of religion on the shadow economy in terms of the total degree of religiosity, the effect of various religions and religious competition, and the proximity of state and religion on the shadow economy using the MIMIC approach. The authors found that the degree of individual religiosity was extremely important as nations with more religious citizens had better functioning economies. This is because religion and religious standards simplify transactions through a formal alternative to the laws of the religious aspect of the provision.

Medina and Schneider [3] evaluated the size of the shadow economy in 158 nations between 1991 and 2015. They used the MIMIC technique to quantify the shadow economy and enhanced it with the CDA. Additionally, they used the predictive mean matching (PMM) methodology to avoid the problems the previous papers had with the usual calibration methods. The authors found that the PMM approach produces a reliable result that corroborates the MIMIC results. Furthermore, they found a decrease in the size of the shadow economy from 1991 to 2015, except in 2008, where, due to the world economic crisis in that year, the size of the shadow economy increased. Medina and Schneider [25] conducted another recent research in which they evaluated the extent of the shadow economy in 157 economies between 1991 and 2017. Furthermore, they examined the shadow economy's connection with the formal economy. The researchers discovered that the influence of the shadow economy on the formal economy and vice versa is conceptually unrestricted. Additionally, the shadow economy is fairly large in certain locations. Finally, the study recommended that policymakers should be taking into account enhancing the quality of governance indicators and improving business and competitiveness indicators in their countries to reduce the size of the shadow economy.

There is another strand in the literature supporting the impact of the shadow economy on economic growth and sustainable development. The authors of [26–28] showed that evading regulations and taxation results in lower tax revenues, higher public expenditures, and slower growth and productivity. Shadow economy is thus seen as a destructive activity, undermining democratic governance and the rule of law and economic and sustainable development. The shadow economy has a negative impact on a country's economic growth and sustainable development in a variety of ways [29], as it represents a variety of illegal and criminal activities such as corruption, drug trafficking, smuggling, gambling, bookmaking, and prostitution, among others. The shadow economy is characterised by a wide range of activities such as "black-market transactions, undeclared work, tax evasion, and tax avoidance" by individuals and businesses [30]. The smaller size of the shadow economy would eventually encourage sustainable development.

Several causes have been identified in the literature devoted to the shadow economy [31,32]. Many determinants include high tax rates and social security burdens because economic agents do not want to pay high taxes that may drive them out of the formal economy [11]. Some scholars have linked the shadow economy [33] to institutions that are not strong enough (due to bureaucracy, regulatory discretion, the rule of law, corruption, and a weak legal system). It is also worth noting that penalty rates and tax evasion detection/probabilities play a role in this effect. To some extent, the government has control over these aspects [1].

Among all of these empirical studies, one factor stands out as having a significant impact on the shadow economy: corruption. The study by [6] investigated the influence of corruption and shadow economy on the economic and sustainable development using a large cross-country database of 185 countries from 2005 to 2015. They concluded that corruption and the shadow economy are diseases of poverty, and they are particularly prevalent in countries with low incomes. Corruption is more associated with the shadow economy in lower levels of economic and sustainable growth. To that end, the main contribution of their work is to provide empirical evidence for the damaging effects of corruption and the shadow economy on states' economic and long-term development. The results also uncovered instances where corrupt practices were employed in an effort to gain an unfair advantage economically, and this served to further the growth of the economy. Furthermore, they found that corruption and the shadow economy more negatively impact economic and sustainable development in high-income countries than in low-income countries.

Many other causes contribute to a shadow economy, such as a weaker institutional quality context (i.e., regulatory inefficiency, bureaucracy, a weak rule of law, and corruption), which is typically considered a potential driver for the shadow economy [33]. Many laws and regulations affect labour costs and encourage people to work illegally in the shadow economy. Economists mainly investigate this by looking at how many laws and regulations there are, such as licences, market regulations, labour restrictions for foreigners, trade barriers, and so on [1]. As a result, the shadow economy can be reduced by reducing the density and complexity of regulations or by improving the transparency of laws and regulations (see [34]).

Not only is it important to consider institutions under different and diverse aspects, but it is also important to consider them as a traditional measure of the intensity of regulation or corruption [31,35,36]. A study conducted by [37] investigated how institutional quality interacted with the shadow economy and corruption in 145 countries from 2000 to 2002. Corrupt practices and shadow economy are substitutes, meaning that the existence of the shadow market is associated with lower levels of graft. Furthermore, their findings showed that the shadow economy is reduced when more well-functioning institutions are in place. Generally speaking, corruption does not only refer to the government's role but also affects both the quality of institutions as a whole and the shadow market in particular. In the study by [30], for 55 countries between 1990 and 1999, this negative effect of institutional quality on the shadow economy was confirmed. Many studies have been done on this topic [30,38] (using six governance indicators from Worldwide Governance Indicators), and they have also confirmed this result.

Institutions can provide some incentives for the growth of official economic activities by improving these economic aspects. A country's institutions can be defined as the set of rules regulating human behaviours [31,32,39–41]. According to [42,43], better legal systems (protection of property rights and disclosure of information) and more reliable political situations directly contribute to improving transactional trust between actors, thereby encouraging official economic activities. These rules limit the shadow economy's potential. For example, a better quality of institutions in a country reduces transaction costs [44] and risk [45,46], as well as the amount of information that is asymmetrically distributed in a country [47]. As a result, increased market efficiency and better resource allocation are both attributed to better institutional quality [48]. A lack of institutional quality, on the other hand, creates uncertainty regarding contractibility and information asymmetry, causing economic agents to temper their official entrepreneurial activities [27,35,49–51].

Similarly, indicators related to government effectiveness, political stability (absence of violence/terrorism), and control of corruption are expected to reduce the shadow economy. In the same vein, the regulatory quality indicator (capturing the government's ability to formulate and implement sound policies and regulations) and the rule of law indicator (capturing the confidence in society's rules) create a favourable context for official business activities. Indicators of freedom of expression, association, and the media may also help reduce the shadow economy.

Hence, based on the above discussion, a typical study will estimate a regression with four or five shadow economy causes, which cannot be adequately determined as the shadow economy's sole predictors across countries. All causes should be considered to determine which causes lead to an increase in the size of the shadow economy. Therefore, our study establishes a parsimonious list of robust explanatory variables of the shadow economy. As far as we are aware, our study is the first attempt to weigh all potential causes that may affect the shadow economy over the world in one study using the two types of EBA that were applied by [14,15]. The purpose for using these approaches is to avoid the issue of the sensitivity of the reported results to the selected combination of regressors, as well as to avoid data mining malpractice. Thus, our study will be a base for future related studies, for which this study will contain all potential causes that affect the shadow economy.

### 3. Data

The main objective of this study is to investigate whether the wide set of reported significant explanatory variables of the shadow economy by the previous literature remains significant when subject to sensitivity analysis. Therefore, we established a cross-sectional dataset of 36 potential explanatory variables for 132 countries, where data was averaged over the period (1991–2017). The variables' symbols, measurement units, and data sources are exhibited in the Appendix A Table A2. The dependent variable (shadow) is the size of the shadow economy, measured as a percentage of GDP. The source of the shadow economy data is Medina and Schneider [25].

This paper relies on the previous studies to select all potential variables that are deemed as a significant factors determining the shadow economy [3,13,17,18,21,23,24]. Some of the shadow economy causes have been widely used in the previous related studies, such as tax burden, unemployment rate, inflation, interest rate, population, and the remainder of the explanatory variables have been used one or two times in the previous studies (see Table A1 in the Appendix A). Therefore, this paper is the first attempt that considers all potential causes that may enhance the shadow economy.

### 4. Methodology and Model Specification

This article's primary contribution is methodological. We used EBA to overcome the model uncertainty issue associated with the selection of regressors, which is inevitable in empirical work due to the findings being very sensitive to the set of covariates chosen. In a typical cross-sectional study, the regression takes the following form:

$$Y_i = \alpha_0 + \sum_{j=1}^m \beta_j X_{ji} + \epsilon. \quad (1)$$

The problem is that, when there is a large number of explanatory variables, researchers tend to locate various combinations and report one or a few that tell a good story [52]. A direct solution to this issue would be doing a systematic sensitivity analysis such as the extreme bounds analysis, which has been introduced by Edward Leamer [14,53]. EBA is a type of sensitivity analysis that can be used to alleviate model uncertainty arising from the specification problem (variable selection bias), where economic theories do not reveal or rarely say the exact set of variables that should appear as regressors in the estimated model [54–56]. This has been a hindrance for empirical work since the findings are more likely to be sensitive to the chosen set of explanatory variables. Therefore, we aimed to be less simplistic and more accurate: beyond a relatively broad set of potential explanatory variables, we tried to identify which determinants are robustly associated with the shadow economy.

EBA needs calculating a large number of regressions in order to exhaust all conceivable combinations of variables from a predefined collection of factors that are potentially relevant determining factors of the shadow economy. Particularly, in Equation (2), every potential variable is treated as the variable of interest ( $Q$ ) in turn. For each variable of interest, an  $m$

number of regressions are run, with the free variable  $Y_i$  and different combinations of  $Z$  variables out of the remaining potential variables in the pool such that (In practice, for every variable of interest,  $m$  regressions are run, where  $m = (N! / [(Z! (N-Z)!])$ .  $N$  is the number of potential explanatory variables, and  $Z$  is the number of additional control variables included in the model. We set  $Z$  to three following [15].)

$$Shadow_i = \alpha_0 + \delta_i Y_i + \beta_i Q_i + \sum_{j=1}^m \gamma_j Z_{ji} + \varepsilon_i \quad (2)$$

where the outcome variable  $Shadow_i$  is the size of the shadow economy, measured as a percentage of GDP, which is obtained from [3,56]. The traditional form of EBA (Leamer's EBA) has been considered stringent and hard to pass. It requires extreme bounds of the variable coefficients ( $\beta_{min} - 2\sigma$ ,  $\beta_{max} + 2\sigma$ ) to be significant and of the same sign for the variable to be labelled as "robust"; otherwise, it is deemed as "fragile". Therefore, [15] has introduced a relaxed form of EBA that considers the entire distribution of coefficients rather than merely extreme bounds. Sala-i-Martin's EBA considers the variable robust if at least 95% of coefficients lie on either side of the distribution of coefficients (i.e., the cumulative density function CDF(0) is greater than 95%). Thus, when EBA is used, the focus is shifted away from significance (in a single estimated regression) and toward robustness (in a large set of estimated projected regressions). (The coefficient estimates  $\beta_i$  are assumed to be normally distributed, and they are weighted proportionally to the likelihood ratio. For technical details, see [17]).

Nevertheless, two statistical problems may emerge as a result of using EBA, which are multicollinearity and heteroskedasticity. First, we dealt with multicollinearity following [25] and set an exclusion criterion based on variance inflation factor (VIF), whereby the models with  $VIF > 7$  were excluded from the results. Second, was heteroskedasticity which results in biased estimates of the standard errors. Therefore, we used robust standard errors to obtain more efficient coefficient estimates to tackle this issue, following [57].

## 5. Results and Discussion

We applied the extreme bound analysis to statistically examine the robustness of the shadow economy determinants often reported by the literature. The results show that only 10 out of 36 potential variables are robust determining factors of the shadow economy in our sample. The main results of robust variables are exhibited in Table 1, sorted according to their CDF(0) values. Following is a discussion of the main results.

**Table 1.** The CDF(0) of robust determinants of shadow economy (full sample).

| Variable | $\beta$ | CDF(0) | Sign |
|----------|---------|--------|------|
| LAW      | −3.29   | 99.0%  | −    |
| INCONF   | −2.12   | 98.8%  | −    |
| BUREAU   | −3.56   | 98.7%  | −    |
| INFLCP   | 0.02    | 98.5%  | +    |
| MONFREE  | −0.19   | 98.1%  | −    |
| TIMEBUS  | 0.03    | 98.1%  | +    |
| POVERTY  | 0.16    | 97.8%  | −    |
| CORRUP   | −2.95   | 97.7%  | −    |
| INTERNET | −0.19   | 97.0%  | −    |
| PRORIG   | −0.15   | 96.8%  | −    |

Source: Authors' processing.

To begin with, the quality of institutions (measured by national governance indicators) is a crucial factor in the development of the shadow economy. A higher value of these variables indicates the greater quality of institutions. Therefore, a negative coefficient implies that a lower quality of institutions (e.g., high rates of corruption) is associated with a bigger shadow economy's size. The findings indicate that only four out of six proxies of the quality of institutions proved to be robust determining factors of the shadow economy:

they are bureaucracy quality, law and order, corruption, and internal conflict. It follows that bureaucracy with high corruption tends to associate with the larger size of the shadow economy, whereas a good role of law increases the benefits of being part of the formal economy, and therefore is negatively related to the shadow economy. These results align with the previous findings [2,58–60].

Corruption is robust and with a negative sign, which implies that the association between the size of the shadow economy and corruption is complementary: that is, a higher value of the corruption index is concomitant with a higher size of the shadow economy. This result is consistent with previous studies by Batrancea et al. [2,61]. However, it is slightly different from the findings of Dreher and Schneider [28]. They discovered a positive correlation between corruption and the extent of the shadow economy in low-income nations exclusively. (In fact, the majority of our study sample is within lower-income quartiles countries.). In this sense, Hoinaru, Buda, Borlea, Văidean and Achim [6] found a negative association between corruption and the level of economic and sustainable development, where higher levels of corruption tend to relate with lower levels of development. Moreover, internal conflict proved to be a robust determinant of the shadow economy's size, which suggests that the increase in political violence in one country boosts the incentives for informal activities (see, [58]). In contrast, external conflict is not robust as a determinant of the shadow economy.

Additionally, monetary freedom and secure property rights are robust and negatively connected to the shadow economy's size. These findings corroborate prior research indicating a favorable association between effective regulation and the extent of the shadow economy. [18,33,62]. Moreover, the longer the time required to start a business is positively connected with the shadow economy's size. In fact, over-regulation induces entrepreneurs to operate in the shadow to reduce the burden of regulatory barriers [33].

Furthermore, the development of information and communication technology (ICT) is vital to the shadow economy. Mainly, internet usage is robust and negatively associated with the size of the shadow economy, whereas fixed telephone subscriptions (per 100 people) is considered as fragile. Internet usage may lessen the size of the shadow economy in the event of sufficient regulatory framework and supervision infrastructure, and vice versa [63]. Elgin [64] argued that the sign of the relationship between internet usage and the shadow economy is contingent upon the level of economic development (GDP per capita).

Lastly, macroeconomic variables such as inflation and poverty emerge as important determinants of the size of the shadow economy in line with the literature. The positive coefficient of the inflation variable suggests that a higher inflation rate increases the size of the shadow economy, which is in line with the previous literature [65–67]. According to Goel and Nelson [67], this should not be surprising as inflation is an input used to calculate the shadow economy proxy used in the analysis. Similarly, poverty is robust and positively related to the size of the shadow economy. A recent study by Berdiev et al. [68] shows that poverty has the most considerable effect on the size of the shadow economy.

Over the course of an economic cycle, Owolabi, et al. [69] discovered that the shadow economy exhibited countercyclical behavior. Therefore, the set of shadow economy determinants is also expected to change over time. Hence, the results are also examined for three subsample average periods to check whether robust variables are time-specific for subperiods (The extreme bounds analysis is a cross-sectional technique, and the observations are taken to be averages over the sample (subsample) period(s)). We divided the full sample period (1991–2017) into three “approximately” equal subsamples. The results for the three subsamples are presented in Table 2. The results show that 13 different variables are considered robust (core) determining factors of the shadow economy. These variables can be sorted into three categories: (i) variables that are robust in the full sample and some of the subsamples, which are monetary freedom (MONFREE), corruption index (CORRUP), and internal conflict index (INCONF); (ii) variables that are only robust in the full sample, these are, law and order index (LAW) and bureaucracy quality index (BUREAU); and (iii) variables that are only robust in subsamples but not the full period sample, these

are, business freedom index (BUSFREE), government stability index (GOVSTAB), religion in politics index (RELIGION), democratic accountability index (DEMAC), and the fixed telephone subscriptions per 100 people (TELEPHONE). These results can be attributed to different factors such as economic development, technological development, social changes, and globalisation [70].

**Table 2.** The CDF(0) of robust determinants of shadow economy (subsamples).

| Variable  | 1991–1999 | 2000–2008 | 2009–2017 |
|-----------|-----------|-----------|-----------|
| INFLCP    | 99.4%     | 98.9%     | 90.1%     |
| TIMEBUS   | 98.6%     | 97.5%     | 96.4%     |
| POVERTY   | 99.5%     | 99.9%     | 96.9%     |
| PRORIG    | 96.6%     | 99.7%     | 99.9%     |
| BUSFREE   | 98.8%     | 99.2%     | 95.3%     |
| MONFREE   | 99.8%     | 97.8%     |           |
| GOVSTAB   |           |           | 96.7%     |
| INCONF    |           |           | 90.1%     |
| CORRUP    | 96.5%     |           |           |
| RELIGION  | 97.9%     | 93.0%     | 96.3%     |
| DEMAC     | 99.0%     | 96.0%     | 91.8%     |
| TELEPHONE | 99.6%     | 96.5%     |           |
| INTERNET  | 100.0%    | 100.0%    | 96.2%     |

Source: Authors' processing.

## 6. Policy Recommendations

To derive policy recommendations, we recalled the list of the robust variables: quality of institution proxies (bureaucracy quality, law and order, corruption, and internal conflict), monetary freedom, secured property rights, internet usage, poverty, and inflation. According to the study findings, people's perceptions and motivation to participate in informal activities are negatively influenced by the level of institutions quality and the legal environment. In order to improve the quality of institutions, we recommend that policymakers create a more democratic and transparent environment as well as reduce bureaucracy and over-regulation. All citizens' views and priorities are taken into account in public policy through democracy.

The policies that have been put in place are effective, reflect the preferences of the general public, and result in higher public expenditure on goods and services. The public's civic virtue and tax morality increase as a result of this democratic public involvement, which in turn reduces participation in the shadow economy. The "voice option" provided by democracy allows the public to hold the government accountable for its actions. As a result, the government's legitimacy is enhanced because citizens can influence its policies through referendums or the threat of a ballot. This option also reduces conflicts of interest and rent-seeking activities among policymakers, which in turn improves the public perception of government performance [58,59]. To summarize, the results imply that policymakers need to formulate policies to enhance the quality of institutions as, without a good quality of institutions, we will not be able to reduce the size of the shadow economy.

Moreover, internet usage as a proxy for ICT has a negative effect on the size of the shadow economy. Therefore, governments must consider policies that encourage and facilitate innovation in the ICT industry, access to new technologies and processes, access to capital, and the generation of knowledge-based firms. In this sense, Elgin [64] recommended subsidizing ICT investment and better infrastructure.

Finally, the levels of inflation and poverty positively affect the size of the shadow economy. Hence, government policies to halt inflation and alleviate poverty would reduce the size of the shadow economy. Esaku [71] recommended reforming the macroeconomic environment to address inflation and closing the gap between rich and poor to remedy the growing shadow economy.

## 7. Limitations of the Study

This study is certainly not without limitations. First and foremost, research on shadow activities is constrained by the quality of the shadow economy measures, given the nature of shadow activities. We will gain a better understanding of the factors that drive the shadow economy as more accurate metrics are developed. There is still no consensus about the shadow economy measurement [7]. More information could be gleaned from surveys of businesses in different countries, as well as information on the various regulatory obstacles they face. As a final note, we extol the virtues of robustness checks of findings by using other metrics of the shadow economy.

Moreover, cross-country studies cover much diversified countries. Perhaps a more disaggregated classification will produce more revealing results using different country income groups. Furthermore, we must also bear in mind some data-related problems, particularly with respect to the set of potential determining factors of the shadow economy at the macro and micro levels. These limitations can be dealt with in future studies.

## 8. Conclusions

Despite the global prevalence of the shadow economy, researchers and policymakers have not agreed on reliable and consistent drivers of shadow activity (see [72]). The lack of clarity has theoretical as well as empirical roots. There seems to be an incompatibility between theoretical models and empirical results in theory. Additionally, there is the more fundamental issue of how to measure and model the shadow economy, as well as a lack of agreement on acceptable model specification (or modelling uncertainty) [73–75].

Model uncertainty arising from the choice of the set of explanatory variables to appear in the model more often leads to different conclusions. Hence, the results presented in this study are based on [15] extreme bounds analysis, whereby inference is not derived from a single regression equation but a large number of equations containing different subsets of explanatory variables chosen systematically. Thus, departing from statistical significance judged based on *t* statistics to robustness judged by cumulative density function (CDF). Therefore, this paper contributes to the literature by establishing a parsimonious list of robust (core) determinants of the size of the shadow economy, which can be later adapted to evaluate their impacts on the shadow economy in different contexts.

Using EBA, the results show that only 10 out of 36 potential variables are robust determining factors of the shadow economy in the full sample. We also found that out of six factors of institutional quality, only four (bureaucracy, law and order, corruption, and internal conflict) are robust determining factors of the shadow economy. Moreover, monetary freedom, secured property rights, internet usage, poverty, and inflation are also robust determining factors of the shadow economy. Furthermore, the subsample analysis suggests that some robust variables are time-specific, and the set of shadow economy robust determinants may change over time.

On the practical side, the results provided several policy recommendations on how to hamper the growth of the shadow economy. For instance, the quality of institution variables leads over other causes of the shadow economy. In order to improve institutions, we recommend that policymakers create a more democratic and transparent environment as well as reduce bureaucracy and over-regulation. Hence, policymakers need to formulate policies to enhance the quality of institutions. Without a good quality of institutions, we will not be able to reduce the size of the shadow economy. Moreover, facilitate access and use of ICT through subsidizing ICT investment and infrastructure. Finally, addressing inflation by reforming the macroeconomic environment and closing the gap between rich and poor also helps as a remedy to the growing shadow economy.

The limitations of this study, which are presented in Section 7, serve as avenues for future research. Moreover, we believe that investigating the COVID-19 effect is a matter of importance and requires timely research. Subject to the availability of data, one might be interested in measuring the impact of the COVID-19 pandemic on the size of the shadow economy.

**Author Contributions:** Conceptualization, M.N.A.A., I.N.K.; formal analysis: I.N.K.; methodology: M.N.A.A., I.N.K.; resources, M.N.A.A.; writing—original draft, M.N.A.A., I.N.K.; writing—review & editing, M.N.A.A., I.N.K. and F.J.; funding acquisition, F.J. All authors have read and agreed to the published version of the manuscript.

**Funding:** Taif University Researchers Supporting Project number (TURSP-2020/337), Taif, Saudi Arabia, sponsored this study.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** The data sources are described in the Appendix A Table A2, and the data are available upon request from the Authors.

**Acknowledgments:** The authors are grateful to Taif University’s Deanship of Scientific Research for their support and assistance, which substantially aided this research. The authors are also grateful to the anonymous reviewers for their insightful remarks, which helped to moderate this paper and, as a result, significantly improve the manuscript.

**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A

**Table A1.** The main causes determining the shadow economy.

| Causal Variable   | Theoretical Reasoning  | References   |
|---|--|--|
| Tax and social security contribution burdens (Personal income tax, Indirect taxes).   | Over-taxation distorts labour-leisure choices, which can lead to a rise in the supply of labour in the unofficial economy. For every dollar difference in labour costs, there is an equal motive to minimize the tax spread and operate in the shadow economy. The total tax burden and social security are key determinants of the existence of the shadow economy, and together they form a tax wedge to enhance the shadow economy.   | Thomas (1992), Johnson, Kaufmann, and Zoido-Lobaton (1998a,b), Giles (1999), Tanzi (1999), Schneider (2005), Dell’Anno (2007), Dell’Anno, Gomez-Antonio and Alanon Pardo (2007), Buehn and Schneider (2013).   |
| Quality of Institutions (Bureaucracy Quality, Corruption, Democratic Accountability, Law and Order, Government Stability, Investment Profile, Socioeconomic Conditions) | The quality of formal institutions contributes to the growth of the informal sector. It is far more important for the government to be able to apply the taxation system and regulations arbitrarily defined than for the taxes and regulations themselves to be high enough for people to work off the books. A bureaucracy with corrupt officials tends to increase unofficial activity, whereas securing property rights and contract enforceability increases the benefits of formality. Effective policies levy some taxation, mostly on competitive government services. Indeed, higher supply of public services promotes the formal sector. If government systems can be enhanced and fiscal policies made more in line with the average voter’s wishes, the informal sector will expand as a consequence of political institutions’ failure to support an efficient market economy. | Johnson, Kaufmann, and Zoido-Lobaton (1998a,b), Friedman, Johnson, Kaufmann, and Zoido-Lobaton (2000), Dreher and Schneider (2010), Dreher, Kotsogiannis and Macorriston (2009), Schneider (2010), Buehn and Schneider (2013), Teobaldelli (2011), Teobaldelli and Schneider (2012), Amendola and Dell’Anno (2010), Losby et al., (2002), Schneider and Williams (2013). |

Table A1. Cont.

| Causal Variable   | Theoretical Reasoning   | References  |
|---|---|---|
| External Conflict and Internal Conflict   | Individuals and businesses will be driven to the shadow economy if citizens are uneasy and uncertain and believe that the country's legal system has failed, undermining the official economy. Diplomatic pressures, trade restrictions, sanctions, civil war, and terrorism all limit the functioning of markets, increasing the incentives for people to engage in illegal activities. This results in widespread corruption, and since the government is unable to safeguard the populace via the legal system, the temptation for individuals to work in the informal sector increases. | Torgler and Schneider (2007), Sørensen, J.S., (2006).   |
| Development of the Official Economy   | A further critical component in the creation of the shadow economy is the expansion of the formal economy. The bigger the joblessness rate (GDP growth), the higher the motivation to engage in shadow economy activity.  | Schneider and Williams (2013), Feld and Schneider (2010).   |
| Self-Employment   | The bigger the self-employment rate, the more shadow economy activities are possible.   | Schneider and Williams (2013), Feld and Schneider (2010).   |
| Unemployment  | The likelihood of working in the shadow economy increases with the level of unemployment.   | Schneider and Williams (2013), Williams and Schneider (2016), Dell'Anno et al., (2007).   |
| Liquid Liabilities  | An increase in the per capita income due to easier access to the financial and credit markets reduces the size of the shadow economy.   | Gharleghi and Jahanshahi (2020).  |
| Share of the Labour Force   | The lower the official labour force participation rate, the higher the shadow economy.  | Schneider and Williams (2013), Feld and Schneider (2010).   |
| GDP Per Capita (Economic Growth)  | A greater shadow economy is correlated with a shift of economic activity away from the formal economy, implying a slowing of economic growth.   | Medina, Jonelis, and Cangul (2017).   |
| Regulations (Monetary Freedom, Business Freedom, Financial Freedom, Investment Freedom, Trade Freedom, Property Rights) | Regulations, such as those governing the labour market or trade barriers, also serve to limit individual freedom of choice in the official economy, thus providing the incentive to work in the shadow economy. There is a clear association between nations with stronger regulatory standards and a greater proportion of the shadow economy as a proportion of (GDP). Enforcement, not the entire scope of regulation—which is often not enforced—is the primary element determining the cost imposed on enterprises and people, inducing them to participate in the shadow economy.     | Johnson, Kaufmann, and Shleifer (1997), Johnson, Kaufmann, and Zoido-Lobaton (1998b), Friedman, Johnson, Kaufmann, and ZoidoLobaton (2000), Kucera and Roncolato (2008), Schneider (2011), Hassan and Schneider (2016). |
| Education   | A higher level of educational participation reduces shadow economic activities. Education decreasing the size of the shadow economy through increasing income and opportunity cost.   | Gërkhani and Werfhorst (2013), Hanousek and Palda (2004), Buehn, and Farzanegan, (2013), Berritella (2015).   |
| ICT variables   | The shadow economy shrinks as a result of information and communication technologies (ICTs). With the help of ICTs, the shadow economy could be reduced because more people would be employed and educated, and by reducing the number of burdensome bureaucratic processes.  | Garcia-Murillo and Velez Ospina (2014), Remeikienė et al., (2021), Elgin, (2013).   |

Table A1. Cont.

| Causal Variable                      | Theoretical Reasoning   | References  |
|--------------------------------------|---|---|
| Poverty                              | <p>The shadow economy could be fuelled by a greater demand for goods and services from low-income households. Poverty-stricken people may be able to purchase goods and services at lower prices in the shadow economy, thereby promoting the spread of shadow production. In addition, the prevalence of poverty may lead low-income people to look for work in the underground. To put it another way, the informal economy is a way for people who are struggling to make ends meet. Welfare recipients may choose informal jobs since working in the official sector entails a large implicit tax. In this situation, poverty drives individuals into the shadow economy.</p>   | Amuedo-Dorantes (2004), Canelas, (2015), Devicienti, Groisman and Poggi (2010), Kim (2005), Schneider and Enste (2013). |
| Military in Politics                 | <p>The nations that have Military in Politics, increased the Military spending. As a result, countries that spend more on their armed forces have lower shadow economies. In terms of controlling the underground sector's size, military build-ups could have a positive impact. This could be because such spending is more centrally managed or because there are not as many middlemen involved (compared to nonmilitary spending).</p>   | Goel and Saunoris (2014)  |
| Inflation, the Consumer Prices Index | <p>It turns out that as long as wages are sticky and inflation is rising steadily, price increases could lead to more people participating in the shadow economy. In the "official economy", citizens in developing nations have numerous options to earn decent incomes and "extra money" (Schneider et al., 2010, p. 446). When demand for goods and services is reduced during a recession, inflation is reduced, which in turn encourages more people into the shadow economy to make up for lower-income and shrinking official job opportunities. The extent of informal transactions is influenced by religious affiliation. In countries with a higher percentage of religious citizens, religious norms simplify informal transactions and provide an alternative to legal contract enforcement laws. There are significant linkages between the major church and the state in nations with limited informal economic activity, such as via religious law. When religion and the state are mutually beneficial, religion acts as "supernatural police" to safeguard the state's interests.</p> | Dell'Anno and Davidescu (2018), Schneider et al., (2010).   |
| Religion in Politics                 | <p>Entrepreneurs enter the shadow economy primarily to alleviate bureaucratic burdens, and one of these factors assessing the costs and time necessary to establish a company looks to be a logical instrument for expanding the shadow economy.</p>  | Schneider, Linsbauer, and Heinemann (2015), Achim et al., (2019).   |
| Time Required to Start a Business    | <p>Entrepreneurs enter the shadow economy primarily to alleviate bureaucratic burdens, and one of these factors assessing the costs and time necessary to establish a company looks to be a logical instrument for expanding the shadow economy.</p>  | Dreher and Schneider (2010), Friedman et al., (2000).   |

Table A1. Cont.

| Causal Variable                                  | Theoretical Reasoning   | References  |
|--|---|---|
| General Government Final Consumption Expenditure | Final consumption expenditures of the general government include things like unemployment compensation benefits and supplements, family allowances (such as food stamps), accident injury and sick pay (including survivor's aids), pensions (including old-age, disability, and survivor's aids), and reimbursements for healthcare expenses (such as the stipulation of a particular healthcare service). As a result, employee remuneration will rise, and the shadow economy will shrink as a result of the increase in wages. Companies have more incentive to operate in shadow economies when government spending as a percentage of GDP is higher. In other words, both resource allocation distortions and (potential) higher levels of corruption serve as economic justifications to work in the shadow economies. | Gasparėnienė, Remeikienė, and Heikkilä (2016).                      |
| Government Spending                              | As the population grows, the formal sector is under more pressure to employ large numbers of human resources, which raises the unemployment rate and opens the door to the possibility of the shadow economy's absorption of large numbers of human resources.  | Dell'Anno (2007), Dell'Anno and Davidescu (2018), Schneider (2011). |
| Population                                       |   | Joshi et al., (1975), Schneider and Enste (2013).                   |

Source: Authors' processing.

Table A2. Variable symbols, definition and data sources.

| Code   | Symbol | Variable Name/Units           | Definition   | Source  |
|--------|--------|-------------------------------|--|---|
| SHADOW | $Y_1$  | Shadow Economy (% of GDP)     | It is constituted of economic activities that evade expenses and are excluded from the right and advantages included in statutes and administrative norms governing ownership agreements, commercial licenses, contractual arrangements, taxes, financial credit, and welfare systems, among others.   | Medina, L. and Schneider, M.F., 2018. Shadow economies around the world: what did we learn over the last 20 years? International Monetary Fund. |
| EXCONF | $X_1$  | External Conflict (index 0–4) | It is a risk analysis of the existing government's vulnerability to foreign action, which may take the form of peaceful external influence (diplomatic pressures, withdrawal of assistance, economic barriers, border disputes, and sanctions) or violent external forces (cross-border conflicts to all-out war). Each subcomponent of the risk assessment is assigned a maximum of four points and a minimum of zero points on a four-point scale. Four points equals very low risk; zero points equals very high risk. Subcomponents include foreign pressures, war, and cross-border conflict. | The International Country Risk Guide (ICRG)   |

Table A2. Cont.

| Code    | Symbol         | Variable Name/Units                   | Definition  | Source                                      |
|---------|----------------|---------------------------------------|---|---|
| BUREAU  | X <sub>2</sub> | Bureaucracy Quality                   | <p>The quality of the bureaucracy acts as a shock absorber, in which it is reducing policy revisions when governments change. Thus, countries with strong bureaucracies that can govern without major policy changes or service interruptions receive high marks. In low-risk countries, the bureaucracy is usually independent of political pressure and has a well-established recruitment and training system. Changes in government are traumatic for policy formulation and day-to-day administrative functions in countries lacking a strong bureaucracy.</p> <p>This is a political corruption evaluation. Corruption is a danger to foreign capital for numerous reasons: it disrupts the financial and economic atmosphere; it decreases corporate and government efficiency by enabling individuals to obtain power by favour rather than talent; and it adds inherent political turmoil. The risk rating assigned is six points with a minimum of zero. 6 points = Very Low Risk, 0 points = Very High Risk.</p> | The International Country Risk Guide (ICRG) |
| CORRUP  | X <sub>3</sub> | Corruption (index 0–6)                | <p>This metric indicates how receptive the government is to its constituents. For example, in a democratic society, a less responsive government is more likely to fall peacefully, but in a nondemocratic society, it may fall violently. The risk rating assigned is six points with a minimum of zero. In general, democracies have the most risk points (lowest risk), while autocracies have the least risk points (highest risk).</p>   | The International Country Risk Guide (ICRG) |
| DEMAC   | X <sub>4</sub> | Democratic Accountability (index 0–6) | <p>This component assesses racial, nationality, or language tensions within a country. The risk rating assigned is six points with a minimum of zero. Countries with high racial and nationality tensions receive lower ratings due to intolerance and unwillingness to compromise. Countries with low tensions are given higher ratings.</p>   | The International Country Risk Guide (ICRG) |
| ETHNIC  | X <sub>5</sub> | Ethnic Tensions (index 0–6)           | <p>It assesses the government's capacity to deliver and maintain power. Each sub-component of the risk assessment is assigned a maximum of four points and a minimum of zero. 4 points = Very Low Risk, 0 points = Very High Risk. There is unity in government, legislative strength, and popular support.</p>   | The International Country Risk Guide (ICRG) |
| GOVSTAB | X <sub>6</sub> | Government Stability (index 0–4)      | <p>It is scored as a single component with two parts. The risk rating assigned is six points with a minimum of zero. The "Law" element assesses the legal system's strength and impartiality, while the "Order" element assesses public observance of the law. A nation's court system may be rated three stars, yet its crime rate may be ranked one star if the law is habitually disregarded without effective enforcement (For instance, massive unlawful strike activity).</p>   | The International Country Risk Guide (ICRG) |
| LAW     | X <sub>7</sub> | Law and order (index 0–3)             |   | The International Country Risk Guide (ICRG) |

Table A2. Cont.

| Code     | Symbol          | Variable Name/Units                  | Definition  | Source                                      |
|----------|-----------------|--------------------------------------|---|---|
| SOCIOECO | X <sub>8</sub>  | Socioeconomic Conditions (index 0–4) | It measures the socioeconomic pressures that may limit government action or fuel social discontent. There are three components that make up the risk rating, each with a maximum of four points and a minimum of zero. 4 points = Very Low Risk, 0 points = Very High Risk, which include subcomponents: consumer confidence, poverty, and unemployment.  | The International Country Risk Guide (ICRG) |
| RORIG    | X <sub>9</sub>  | Property Rights (index 0–100)        | The property rights component assesses individuals' ability to accumulate private property. It assesses how well a country's laws protect private property rights and how well its government enforces them. Additionally, it considers the risk of seizure, the independence of the court, and the capacity of people and enterprises to implement. The score is calculated on a scale of 0 to 100, with higher values indicating stronger protection of property rights.                              | The International Country Risk Guide (ICRG) |
| INVPRO   | X <sub>10</sub> | Investment Profile (index 0–4)       | This component assesses factors affecting investment risk that are not covered by political, economic, or financial risk components. There are three components that make up the risk rating, each with a maximum of four points and a minimum of zero. 4 points = Very Low Risk, 0 points = Very High Risk. Contract Viability/Expropriation; Profit Repatriation; Payment Delays.   | The International Country Risk Guide (ICRG) |
| INCONF   | X <sub>11</sub> | Internal Conflict (index 0–4)        | It assesses the level of political turmoil in the nation and its influence on governance. Most highly rated countries have no armed or civil opposition and no arbitrary violence, direct or indirect, against their own people. A country in a civil war gets the lowest rating. There are three components that make up the risk rating, each with a maximum of four points and a minimum of zero. 4 points = Very Low Risk, 0 points = Very High Risk. Terrorism/Political Violence; Civil Disorder. | The International Country Risk Guide (ICRG) |
| RELIGION | X <sub>12</sub> | Religion in Politics (index 0–6)     | Index of religion in government that results from a single religious group's dominance of society and/or governance—or a thirst for power—in such a fashion that civil law is replaced by religious law, other religions are excluded from political systems, and religious freedom and expressions of religious identity are suppressed. The dangers vary from unskilled individuals imposing ineffective policies to civil disobedience or civil conflict.  | The International Country Risk Guide (ICRG) |

Table A2. Cont.

| Code     | Symbol          | Variable Name/Units   | Definition  | Source   |
|----------|-----------------|---|---|--|
| MILRPOL  | X <sub>13</sub> | Military in Politics (index 0–6)                            | The military's influence in politics is represented through an index. The national guard is not chosen, and hence its participation, even at a peripheral level, undermines democratic responsibility. Military engagement may be prompted by an external or internal danger, may be a sign of underlying troubles, or may constitute a full-scale military takeover of the country. Over the long run, a military-dominated administration would almost likely deteriorate the effectiveness of government operations, become corrupt, and create an unpleasant environment for foreign firms.   | The International Country Risk Guide (ICRG)  |
| GFCF     | X <sub>14</sub> | Gross Fixed Capital Formation (% of GDP)                    | Gross domestic fixed investment as a percentage of GDP.   | World Bank Development Indicators (WDI)  |
| GOVCONS  | X <sub>15</sub> | General Government Final Consumption Expenditure (% of GDP) | It encompasses all current government acquisitions of products and services, whether large and small (including compensation of employees). It also comprises the vast majority of national defence and security spending, with the exception of military and government capital spending, which are excluded.  | World Bank Development Indicators (WDI)  |
| INFLCP   | X <sub>16</sub> | Inflation, Consumer Prices (annual %)                       | It quantifies the proportional change in the cost of a set basket of goods and services to the typical consumer over a certain period of time.  | World Bank Development Indicators (WDI)  |
| INTERNET | X <sub>17</sub> | Individuals Using the Internet (% of the Population)        | Individuals who have used the internet in the previous three months are considered internet users. The Internet may be accessed via a variety of devices, including computers, mobile phones, PDAs, gaming consoles, and digital televisions. They consist of the sum of time and savings deposits, foreign currency transferable deposits, certificates of deposit, and securities repurchase agreements (M2), transferable deposits and electronic currency (M1),) currency and central bank deposits (M0) as well as visitor checks, foreign currency time deposits, commercial paper, and resident-held mutual funds or market funds. | World Bank Development Indicators (WDI)  |
| LIQUID   | X <sub>18</sub> | Liquid Liabilities (% of GDP)                               |   | Global Financial Development (GFDD)   Data Catalog ( <a href="https://datacatalog.worldbank.org/dataset/global-financial-development">worldbank.org</a> )<br><a href="https://datacatalog.worldbank.org/dataset/global-financial-development">https://datacatalog.worldbank.org/dataset/global-financial-development</a> |
| GDPPCG   | X <sub>19</sub> | GDP Per Capita Growth (%)                                   | GDP growth rate per capita in fixed national currency. The aggregates are calculated in constant 2010 United States dollars. GDP per capita is calculated as follows: GDP at purchase prices is the sum of all resident producers' gross value-added plus any product taxes and minus any subsidies not included in the product value. It excludes depreciation of manufactured assets and depletion and degradation of natural resources.  | World Bank Development Indicators (WDI)  |
| OPENNESS | X <sub>20</sub> | Trade (% of GDP)  | It is the total value of imports and exports of services and goods as a percentage of the GDP.  | World Bank Development Indicators (WDI)  |

Table A2. Cont.

| Code      | Symbol          | Variable Name/Units   | Definition  | Source                                  |
|-----------|-----------------|---|---|---|
| SCHPRI    | X <sub>21</sub> | School Enrollment, Primary (% gross)                                      | Primary school teaches students the fundamentals of reading, writing, and arithmetic, as well as the fundamentals of natural science, geography, history, art, music, and social science.   | World Bank Development Indicators (WDI) |
| SCHSEC    | X <sub>22</sub> | School Enrollment, Secondary (% gross)                                    | Secondary school strives to create the basis for continuous education and learning by providing more subject- or skill-focused training with the aid of more trained instructors. It concludes the supply of basic education that started with elementary education.  | World Bank Development Indicators (WDI) |
| SCHTER    | X <sub>23</sub> | School Enrolment, Tertiary (% gross)                                      | Higher education, either leading to an advanced research credential or not, often needs satisfactory completion of secondary school as a minimum entry requirement.   | World Bank Development Indicators (WDI) |
| SELFEMP   | X <sub>24</sub> | Self-Employed, total (% of total employment) (modelled ILO estimate)      | Self-employed workers are those who work for themselves, with one or a few partners, or in a cooperative. Jobs whose pay is directly linked to the profits made from the goods and services produced. Employers, own-account workers, producers' cooperative members, and contributing family workers are all self-employed.  | World Bank Development Indicators (WDI) |
| TELEPHONE | X <sub>25</sub> | Fixed Telephone Subscriptions (Per 100 People)                            | The term "fixed telephone subscriptions" represents the total number of permanent wireless local loop (WLL) memberships, operational analogue landlines, fixed public payphones, voice-over-IP (VoIP) memberships, and ISDN voice channel equivalents.  | World Bank Development Indicators (WDI) |
| UNEMP     | X <sub>26</sub> | Unemployment, total (% of the total Labour Force) (Modelled ILO Estimate) | It represents the proportion of the workforce that is unemployed yet available for and actively looking for work.   | World Bank Development Indicators (WDI) |
| POVERTY   | X <sub>27</sub> | Population Living Below National Poverty Line (% Population)              | It is the percentage of people who live below the country's poverty threshold. Nationwide calculations are based on sample survey subpopulations estimates. Each nation has its own definition of poverty.  | Euromonitor International               |
| GOVSPEN   | X <sub>28</sub> | Government Spending   | This component looks at government spending as a percentage of GDP. The total is made up of government spending on consumption and transfers. The ideal level varies by country, depending on factors like culture, geography, and development. Because the methodology assumes no government spending, underdeveloped countries with limited government capacity may receive inflated scores. In most cases, general government expenditure data includes federal, state, and local governments. In the absence of general government spending data, central government expenditure data are used. | Euromonitor International               |

Table A2. Cont.

| Code      | Symbol          | Variable Name/Units                      | Definition   | Source                                  |
|-----------|-----------------|--|--|---|
| TAXBUR    | X <sub>29</sub> | Tax Burden (index 0–100)                 | It is a metric for the government's tax burden. It consists of both direct taxes (highest marginal rates on individual and business income) and cumulative taxes (all forms of direct and indirect taxation at all levels of government). As a consequence, the fiscal freedom element contains three measurement: the highest marginal tax rates on individual and corporate income, as well as the overall tax burden as a share of GDP. Each of these quantitative factors contributes one-third to the fiscal freedom component. Fiscal freedom scores reflect the diminishing revenue returns associated with extremely high tax rates. The data for each factor is normalized to 100 points. | Euromonitor International               |
| POPUL     | X <sub>30</sub> | Population, total                        | It is calculated according to the de facto definition of population, which includes all inhabitants irrespective of age or citizenship.  | World Bank Development Indicators (WDI) |
| BUSFREE   | X <sub>31</sub> | Business Freedom (index 0–100)           | Business freedom measures the effectiveness of government regulation of business. It is calculated using a variety of measures of the difficulties associated with beginning, running, and ending a firm. The business freedom score for each nation varies from 0 to 100, with 100 being the most free.   | Euromonitor International               |
| TIMEBUS   | X <sub>32</sub> | Time Required to Start a Business (days) | It refers to the time in days required to complete all the formalities for starting a firm lawfully.   | World Bank Development Indicators (WDI) |
| MONFREE   | X <sub>33</sub> | Monetary Freedom (index 0–100)           | It integrates a price stability metric with an evaluation of price regulations. Market activity is distorted by both inflation and price regulations. Without microeconomic interference, price stability is the optimum situation for the free economy.   | Euromonitor International               |
| TRADFFREE | X <sub>34</sub> | Trade Freedom (index 0–100)              | It represents the absence of tariff and nontariff barriers to goods and services imports and exports. The trade-weighted average tariff rate and nontariff barriers comprise the trade freedom score (NTBs). The Trade freedom scale where 20 points mean extensively used NTBs and 0 points are given when NTBs are not used to limit international trade.  | Euromonitor International               |
| INVFREE   | X <sub>35</sub> | Investment Freedom (index 0–100)         | There would be no restrictions on the movement of investment money in an economically free nation. Individuals and corporations would have the freedom to shift resources into and out of certain activities on a domestic and international level. The score runs from 0 to 100; the ideal nation would have a score of 100 on the Index of Economic Freedom's investment freedom component.  | Euromonitor International               |

Table A2. Cont.

| Code    | Symbol          | Variable Name/Units             | Definition   | Source                    |
|---------|-----------------|---------------------------------|--|---------------------------|
| FINFREE | X <sub>36</sub> | Financial Freedom (index 0–100) | It is defined as freedom from government control and interference in banking. Banking, insurance, and capital markets state ownership reduces competition and service. Finance, capital markets, government influence on credit allocation, and openness to foreign competition are all factors measured by the Index. To assess an economy's overall financial freedom, these five areas are used. A country's financial freedom is rated from 0 to 100, with 0 representing total government interference. | Euromonitor International |

Source: Authors' processing.

## References

- Schneider, F.; Enste, D.H. Shadow economies: Size, causes, and consequences. *J. Econ. Lit.* **2000**, *38*, 77–114. [[CrossRef](#)]
- Williams, C.C.; Schneider, F. *Measuring the Global Shadow Economy: The Prevalence of Informal Work and Labour*; Edward Elgar Publishing: Cheltenham, UK, 2016.
- Medina, L.; Schneider, M.F. *Shadow Economies around the World: What Did We Learn over the Last 20 Years*; International Monetary Fund: Washington, DC, USA, 2018.
- Hirschman, A.O. *Exit, Voice, and Loyalty: Responses to Decline in Firms, Organizations, and States*; Harvard University Press: Cambridge, MA, USA, 1970; Volume 25.
- Olson, M. Stagflation and the political economy of the decline in productivity. *Am. Econ. Rev.* **1982**, *72*, 143–148.
- Hoinaru, R.; Buda, D.; Borlea, S.N.; Văidean, V.L.; Achim, M.V. The impact of corruption and shadow economy on the economic and sustainable development. Do they “sand the wheels” or “grease the wheels”? *Sustainability* **2020**, *12*, 481. [[CrossRef](#)]
- Elgin, C.; Erturk, F. Informal economies around the world: Measures, determinants and consequences. *Eurasian Econ. Rev.* **2019**, *9*, 221–237. [[CrossRef](#)]
- Elgin, C.; Erturk, F. Is informality a barrier to convergence? *Econ. Bull.* **2016**, *36*, 2556–2568.
- Caurkubule, Ž.; Rubanovskis, A. Shadow economy as an obstacle to sustainable economic development. *J. Secur. Sustain. Issues* **2014**, *4*, 175–186. [[CrossRef](#)]
- Dixon, H. Controversy: On the use of the ‘hidden economy’ estimates. *Econ. J.* **1999**, *109*, 335–337. [[CrossRef](#)]
- Tanzi, V. Uses and abuses of estimates of the underground economy. *Econ. J.* **1999**, *109*, F338–F347. [[CrossRef](#)]
- Giles, D.E.A. Measuring the hidden economy: Implications for econometric modelling. *Econ. J.* **1999**, *109*, F370–F380. [[CrossRef](#)]
- Feld, L.P.; Schneider, F. Survey on the shadow economy and undeclared earnings in OECD countries. *Ger. Econ. Rev.* **2010**, *11*, 109–149. [[CrossRef](#)]
- Leamer, E.E. Sensitivity analyses would help. *Am. Econ. Rev.* **1985**, *75*, 308–313.
- Sala-i-Martin, X. *I Just Ran Four Million Regressions*; National Bureau of Economic Research Cambridge: Cambridge, MA, USA, 1997.
- Gilbert, C.L. *Professor Hendry's Econometric Methodology; Modelling Economic Series*; Earlier Published in Oxford Bulletin of Economics and Statistics; Oxford University Press: Oxford, UK, 1986; Volume 48, pp. 283–307.
- Schneider, F. Size and development of the shadow economy of 31 European and 5 other OECD countries from 2003 to 2014: Different developments? *J. Self-Gov. Manag. Econ.* **2015**, *3*, 7–29.
- Hassan, M.; Schneider, F. Size and development of the shadow economies of 157 countries worldwide: Updated and new measures from 1999 to 2013. *Available SSRN 2861026* **2016**, *4*, 1–14. [[CrossRef](#)]
- Feige, E.L. Reflections on the meaning and measurement of unobserved economies: What do we really know about the ‘shadow economy’. *J. Tax Adm.* **2016**, *2*, 5–41. [[CrossRef](#)]
- Macias, J.B.; Cazzavillan, G. Modeling the informal economy in Mexico. a structural equation approach. *J. Dev. Areas* **2010**, *4*, 345–365. [[CrossRef](#)]
- Schneider, F.; Buehn, A.; Montenegro, C.E. New estimates for the shadow economies all over the world. *Int. Econ. J.* **2010**, *24*, 443–461. [[CrossRef](#)]
- Vo, D.H.; Ly, T.H. Measuring the shadow economy in the ASEAN nations: The MIMIC approach. *Int. J. Econ. Financ.* **2014**, *6*, 139–148. [[CrossRef](#)]
- Hassan, M.; Schneider, F. Modelling the Egyptian shadow economy: A MIMIC model and a currency demand approach. *J. Econ. Political Econ.* **2016**, *3*, 309–339. [[CrossRef](#)]
- Schneider, F.; Linsbauer, K.; Heinemann, F. Religion and the shadow economy. *Kyklos* **2015**, *68*, 111–141. [[CrossRef](#)]

25. Medina, L.; Schneider, F. Shedding Light on the Shadow Economy: A Global Database and the Interaction with the Official One. In *Munich Society for the Promotion of Economic Research—CESifo*; CESifo: Munich, Germany, 2019; Volume SSRN 3502028.
26. Mauro, P. Corruption and growth. *Q. J. Econ.* **1995**, *110*, 681–712. [[CrossRef](#)]
27. Alfoul, M.N.A. Effects of ICT Investment and Usage on Economic Growth in MENA Countries: Does Governance Matter? Ph.D. Thesis, Swinburne University of Technology, Hawthorn, VIC, Australia, 2022.
28. Dreher, A.; Schneider, F. Corruption and the shadow economy: An empirical analysis. *Public Choice* **2010**, *144*, 215–238. [[CrossRef](#)]
29. Gharleghi, B.; Jahanshahi, A.A. The shadow economy and sustainable development: The role of financial development. *J. Public Aff.* **2020**, *20*, e2099. [[CrossRef](#)]
30. Torgler, B.; Schneider, F. The impact of tax morale and institutional quality on the shadow economy. *J. Econ. Psychol.* **2009**, *30*, 228–245. [[CrossRef](#)]
31. Canh, N.P.; Kim, S.; Thanh, S.D. Entrepreneurship and natural resource rent-seeking: The roles of institutional quality. *Econ. Bull.* **2020**, *40*, 1159–1177.
32. Canh, N.P.; Dinh Thanh, S. Exports and the shadow economy: Non-linear effects. *J. Int. Trade Econ. Dev.* **2020**, *29*, 865–890. [[CrossRef](#)]
33. Friedman, E.; Johnson, S.; Kaufmann, D.; Zoido-Lobaton, P. Dodging the grabbing hand: The determinants of unofficial activity in 69 countries. *J. Public Econ.* **2000**, *76*, 459–493. [[CrossRef](#)]
34. Johnson, S.; Kaufmann, D.; Shleifer, A. *The Unofficial Economy in Transition*, *Brookings Papers on Economic Activity*, Fall; Brookings Institution: Washington, DC, USA, 1997.
35. Nguyen, B.; Canh, N.P.; Thanh, S.D. Institutions, human capital and entrepreneurship density. *J. Knowl. Econ.* **2021**, *12*, 1270–1293. [[CrossRef](#)]
36. Su, D.T.; Nguyen, P.C.; Christophe, S. Impact of foreign direct investment, trade openness and economic institutions on growth in emerging countries: The case of Vietnam. *J. Int. Stud.* **2019**, *12*, 243–264. [[CrossRef](#)]
37. Dreher, A.; Kotsogiannis, C.; McCorriston, S. How do institutions affect corruption and the shadow economy? *Int. Tax Public Financ.* **2009**, *16*, 773–796. [[CrossRef](#)]
38. Kaufmann, D.; Kraay, A.; Mastruzzi, M. Governance matters III: Governance indicators for 1996, 1998, 2000, and 2002. *World Bank Econ. Rev.* **2004**, *18*, 253–287. [[CrossRef](#)]
39. Canh, N.P.; Binh, N.T.; Thanh, S.D.; Schinckus, C. Determinants of foreign direct investment inflows: The role of economic policy uncertainty. *Int. Econ.* **2020**, *161*, 159–172. [[CrossRef](#)]
40. Canh, N.P.; Thanh, S.D. Financial development and the shadow economy: A multi-dimensional analysis. *Econ. Anal. Policy* **2020**, *67*, 37–54. [[CrossRef](#)]
41. Thanh, S.D.; Canh, N.P. Local governance: Impacts of fiscal decentralization on government size and spending composition in Vietnam. *Asian Econ. J.* **2019**, *33*, 311–340. [[CrossRef](#)]
42. La Porta, R.; Lopez-de-Silanes, F.; Shleifer, A.; Vishny, R.W. Legal determinants of external finance. *J. Financ.* **1997**, *52*, 1131–1150. [[CrossRef](#)]
43. Porta, R.L.; Lopez-de-Silanes, F.; Shleifer, A.; Vishny, R.W. Law and finance. *J. Political Econ.* **1998**, *106*, 1113–1155. [[CrossRef](#)]
44. Hoffman, R.C.; Munemo, J.; Watson, S. International franchise expansion: The role of institutions and transaction costs. *J. Int. Manag.* **2016**, *22*, 101–114. [[CrossRef](#)]
45. Busse, M.; Hefeker, C. Political risk, institutions and foreign direct investment. *Eur. J. Political Econ.* **2007**, *23*, 397–415. [[CrossRef](#)]
46. Hallerberg, M.; Wolff, G.B. Fiscal institutions, fiscal policy and sovereign risk premia in EMU. *Public Choice* **2008**, *136*, 379–396. [[CrossRef](#)]
47. Canh, N.P. The effectiveness of fiscal policy: Contributions from institutions and external debts. *J. Asian Bus. Econ. Stud.* **2018**.
48. Park, J. Corruption, soundness of the banking sector, and economic growth: A cross-country study. *J. Int. Money Financ.* **2012**, *31*, 907–929. [[CrossRef](#)]
49. Nguyen, C.P.; Su, T.D.; Nguyen, T.V.H. Institutional quality and economic growth: The case of emerging economies. *Theor. Econ. Lett.* **2018**, *8*, 1943. [[CrossRef](#)]
50. Nguyen, C.P.; Nguyen, T.V.H.; Schinckus, C. Institutions, economic openness and stock return co-movements: An empirical investigation in emerging markets. *Financ. Res. Lett.* **2019**, *28*, 137–147. [[CrossRef](#)]
51. Nguyen, C.P.; Schinckus, C.; Su, T.D.; Chong, F. Institutions, inward foreign direct investment, trade openness and credit level in emerging market economies. *Rev. Dev. Financ.* **2018**, *8*, 75–88. [[CrossRef](#)]
52. Moosa, I.A.; Khatatbeh, I.N. Robust and fragile determinants of the infection and case fatality rates of COVID-19: International cross-sectional evidence. *Appl. Econ.* **2021**, *53*, 1225–1234. [[CrossRef](#)]
53. Leamer, E.E. Let's take the con out of econometrics. *Am. Econ. Rev.* **1983**, *73*, 31–43.
54. Young, C.; Holsteen, K. Model uncertainty and robustness: A computational framework for multimodel analysis. *Sociol. Methods Res.* **2017**, *46*, 3–40. [[CrossRef](#)]
55. Khatatbeh, I. The Macroeconomic Consequences of Financialisation. Ph.D. Thesis, RMIT University, Melbourne, VIC, Australia, 2019.
56. Khatatbeh, I.N.; Moosa, I.A. Financialization and income inequality: An extreme bounds analysis. *J. Int. Trade Econ. Dev.* **2021**, 1–16. [[CrossRef](#)]
57. Levine, R.; Renelt, D. A sensitivity analysis of cross-country growth regressions. *Am. Econ. Rev.* **1992**, *82*, 942–963.

58. Sturm, J.-E.; De Haan, J. Determinants of long-term growth: New results applying robust estimation and extreme bounds analysis. *Empir. Econ.* **2005**, *30*, 597–617. [[CrossRef](#)]
59. Torgler, B.; Schneider, F. *Shadow Economy, Tax Morale, Governance and Institutional Quality: A Panel Analysis*; CREMA Working Paper Series 2007-02; Center for Research in Economics, Management and the Arts (CREMA): Zürich, Switzerland, 2007.
60. Teobaldelli, D.; Schneider, F. *Beyond the Veil of Ignorance: The Influence of Direct Democracy on the Shadow Economy*; Working Paper No. MO3749; Center for Economic Studies and Ifo Institute for Economic Research, University of Munich CESifo: Munich, Germany, 2012.
61. Amendola, A.; Dell'Anno, R. Institutions and human development in the Latin America shadow economy. *Estud. Derecho Gob.* **2010**, *3*, 9–25.
62. Batrancea, L.; Nichita, A.; Batrancea, I.; Gaban, L. The strenght of the relationship between shadow economy and corruption: Evidence from a worldwide country-sample. *Soc. Indic. Res.* **2018**, *138*, 1119–1143. [[CrossRef](#)]
63. Berdiev, A.N.; Saunoris, J.W.; Schneider, F. Give me liberty, or I will produce underground: Effects of economic freedom on the shadow economy. *South. Econ. J.* **2018**, *85*, 537–562. [[CrossRef](#)]
64. Remeikienė, R.; Gasparėnienė, L.; Bayar, Y.; Ginevičius, R.; Ragaišytė, I.M. ICT development and shadow economy: Empirical evidence from the EU transition economies. *Econ. Res.-Ekon. Istraživanja* **2021**, *5*, 1–16. [[CrossRef](#)]
65. Elgin, C. Internet usage and the shadow economy: Evidence from panel data. *Econ. Syst.* **2013**, *37*, 111–121. [[CrossRef](#)]
66. Abu Alfoul, M.; Mishal, Z.A.; Schneider, F.; Magableh, K.; Alabdulraheem, A.R. The hidden economy in Jordan: A MIMIC approach. *Cogent Econ. Financ.* **2022**, *10*, 2031434. [[CrossRef](#)]
67. Dell'Anno, R.; Davidescu, A.A. Estimating shadow economy in Tanzania: An analysis with the MIMIC approach. *J. Econ. Stud.* **2018**, *45*, 100–113. [[CrossRef](#)]
68. Goel, R.K.; Nelson, M.A. Shining a light on the shadows: Identifying robust determinants of the shadow economy. *Econ. Model.* **2016**, *58*, 351–364. [[CrossRef](#)]
69. Berdiev, A.N.; Saunoris, J.W.; Schneider, F. Poverty and the shadow economy: The role of governmental institutions. *World Econ.* **2020**, *43*, 921–947. [[CrossRef](#)]
70. Owolabi, A.O.; Berdiev, A.N.; Saunoris, J.W. Is the shadow economy procyclical or countercyclical over the business cycle? International evidence. *Q. Rev. Econ. Financ.* **2022**, *84*, 257–270. [[CrossRef](#)]
71. OECD. *Shining Light on the Shadow Economy: Opportunities and Threats*; OECD Paris: Paris, France, 2017.
72. Esaku, S. Does income inequality increase the shadow economy? Empirical evidence from Uganda. *Dev. Stud. Res.* **2021**, *8*, 147–160. [[CrossRef](#)]
73. Schneider, F.; Buehn, A. *Shadow Economies in Highly Developed OECD Countries: What Are the Driving Forces?* Discussion Paper No. 6891; Institute for the Study of Labor (IZA): Bonn, Germany, 2012.
74. Restrepo-Echavarría, P. Measuring underground economy can be done, but it is difficult. *Reg. Econ.* **2015**, *1*, 10–11.
75. Schneider, F.; Buehn, A. *Estimating the Size of the Shadow Economy: Methods, Problems and Open Questions*; CESifo Working Paper No. 4448 (November); CESifo: Munich, Germany, 2013.