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Shadow Economies Around the World: What Did We Learn Over the Last 20 Years?**Prepared by Leandro Medina and Friedrich Schneider¹**

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Abstract

We undertake an extended discussion of the latest developments about the existing and new estimation methods of the shadow economy. New results on the shadow economy for 158 countries all over the world are presented over 1991 to 2015. Strengths and weaknesses of these methods are assessed and a critical comparison and evaluation of the methods is carried out. The average size of the shadow economy of the 158 countries over 1991 to 2015 is 31.9 percent. The largest ones are Zimbabwe with 60.6 percent, and Bolivia with 62.3 percent of GDP. The lowest ones are Austria with 8.9 percent, and Switzerland with 7.2 percent. The new methods, especially the new macro method, Currency Demand Approach (CDA) and Multiple Indicators Multiple Causes (MIMIC) in a structured hybrid-model based estimation procedure, are promising approaches from an econometric standpoint, alongside some new micro estimates. These estimations come quite close to others used by statistical offices or based on surveys.

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1. INTRODUCTION

The shadow economy is, by nature, difficult to measure, as agents engaged in shadow economy activities try to remain undetected. The request for information about the extent of the shadow economy and its developments over time is motivated by its political and economic relevance. Moreover, total economic activity, including official and unofficial production of goods and services is essential in the design of economic policies that respond to fluctuations and economic development over time and across space. Furthermore, the size of the shadow economy is a core input to estimate the extent of tax evasion and thus for decisions on its adequate control.

The shadow economy is known by different names, such as the hidden economy, gray economy, black economy or lack economy, cash economy or informal economy. All these synonyms refer to some type of shadow economy activities. We use the following definition: The shadow economy includes all economic activities which are hidden from official authorities for monetary, regulatory, and institutional reasons. Monetary reasons include avoiding paying taxes and all social security contributions, regulatory reasons include avoiding governmental bureaucracy or the burden of regulatory framework, while institutional reasons include corruption law, the quality of political institutions and weak rule of law. For our study, the shadow economy reflects mostly legal economic and productive activities that, if recorded, would contribute to national GDP, therefore the definition of the shadow economy in our study tries to avoid illegal or criminal activities, do-it-yourself, or other household activities.²

Empirical research into the size and development of the global shadow economy has grown rapidly (Feld and Schneider 2010, Gerxhani 2003, Schneider 2011, 2015, 2017, Schneider and Williams 2013, Williams and Schneider 2016, and Hassan and Schneider 2016). The main goal of this paper is to analyze the growth of knowledge about the shadow economy in a review covering the past 20 years, concentrating mainly on knowledge about established or new estimation methods; definition or categorization of the shadow economy and new measures of indicator variables such as the light intensity approach, as well as to present estimates of the size of the shadow economy for 158 countries over 25 years. The concrete goals are as follows:

- (1) To extensively evaluate and discuss the latest developments regarding estimation methods, such as the national accounts approach and new micro and macro methods, and the crucial evolution of the macro methodologies (Currency Demand Approach (CDA) or Multiple Indicators Multiple Causes (MIMIC)) tackling the problem of double counting.
- (2) To present shadow economy estimates for 158 countries all over the world for the period 1991 to 2015 while addressing early criticism. In particular: (a) When using the MIMIC approach it is often a problem that GDP per capita or growth rate of GDP or first differences in GDP are used as cause as well as indicator variables. We try to avoid this problem by using a light intensity approach instead of GDP as an indicator variable. We also run a variety of robustness tests to further assess the validity of our results; and (b) There has been a long and controversial discussion on how to calibrate the relative MIMIC estimates of the shadow economy (compare

² Of course, we are aware that there are overlapping areas, like prostitution, illegal construction firms, compare e.g. Williams and Schneider (2016), Schneider (2017), compare also section 3, where this problem is tackled.

(continued...)

Hashimzade and Heady (2016), Feige (2016a), Schneider (2016) and Breusch (2016)). In this paper, we additionally use a fully independent method, the Predictive Mean Matching Method (PMM) by Rubin (1987), which overcomes these problems. To our knowledge this is one of the first attempts to include both the light intensity approach as an indicator variable within MIMIC and to use a full alternative methodology, as PMM³.

(3) To compare the results of the different estimation methods, showing the strengths and weaknesses of these methods, and critically compare and evaluate them.

Our paper is organized as follows: In section 2 some theoretical considerations are drawn and the most important cause variables are discussed. Section 3 discusses methods available to estimate the shadow economy and presents new estimation results. It also discusses the econometric results of the MIMIC estimations and critically evaluates them. Moreover, it addresses the macro methods' shortcomings, as well as it introduces the use of night lights as a proxy for the size of an economy and discusses additional robustness tests. Section 3 presents results on the size of the shadow economy of the 158 countries. In section 4 a comparison of the MIMIC results with micro survey results and National Discrepancy Method results is undertaken. Section 5 summarizes and concludes.

2. THEORETICAL CONSIDERATIONS

Individuals are rational calculators who weigh up costs and benefits when considering breaking the law. Their decision to partially or completely participate in the shadow economy is a choice overshadowed by uncertainty, as it involves a trade-off between gains, if their activities are not discovered, and losses, if they are discovered and penalized. Shadow economic activities SE thus negatively depend on the probability of detection p and potential fines f , and positively on the opportunity costs of remaining formal, denoted as B . The opportunity costs are positively determined by the burden of taxation T and high labor costs W – individual income generated in the shadow economy is usually categorized as labor income rather than capital income – due to labor market regulations. Hence, the higher the tax burden and labor costs, the more incentives individuals have to avoid these costs by working in the shadow economy. The probability of detection p itself depends on enforcement actions A taken by the tax authority and on facilitating activities F accomplished by individuals to reduce the detection of shadow economic activities. This discussion suggests the following structural equation:

$$SE = SE \left[p \left(A, F \right); f; B \left(T, W \right) \right]$$

Hence, shadow economic activities may be defined as those economic activities and income earned that circumvent government regulation, taxation or observation. More narrowly, the shadow economy includes monetary and non-monetary transactions of a legal nature; hence all productive economic activities that would generally be taxable were they reported to the state (tax) authorities. Such activities are deliberately concealed from public authorities to avoid payment of income, value added or other taxes and social security contributions, or to avoid

³ To the best of our knowledge, both light intensity approach and PMM have only been used by Medina et al (2017) in the context of Sub-Saharan Africa.

compliance with certain legal labor market standards such as minimum wages, maximum working hours, or safety standards and administrative procedures. The shadow economy thus focuses on productive economic activities that would normally be included in national accounts, but which remain underground due to tax or regulatory burdens.⁴ Although such legal activities would contribute to a country's value added, they are not captured in national accounts because they are produced in illicit ways. Informal household economic activities such as do-it-yourself activities and neighborly help are typically excluded from the analysis of the shadow economy.⁵ What are the most important determinants influencing the shadow economy?

A. Causes and Signs/Indicators of Informality

The size of the shadow economy depends on various elements. The literature highlights specific causes and indicators of the shadow economy⁶. In Table 1 the main causes and indicators determining the shadow economy are presented.

3. ESTIMATION METHODS AND MIMIC ESTIMATION RESULTS

A. Measuring the Shadow Economy⁷

This subsection describes the methodologies used to measure the shadow economy, highlighting their advantages and drawbacks.⁸ These approaches can be divided into direct or indirect (including the model-based):

⁴ Although classical crime activities such as drug dealing are independent of increasing taxes and the causal variables included in the empirical models are only imperfectly linked (or causal) to classical crime activities, the footprints used to indicate shadow economic activities such as currency in circulation also apply for classic crime. Hence, macroeconomic shadow economy estimates do not typically distinguish legal from illegal underground activities; instead they represent the whole informal economy spectrum.

⁵ From a social perspective, maybe even from an economic one, soft forms of illicit employment such as moonlighting (e.g. construction work in private homes) and its contribution to aggregate value added may be assessed positively. For a discussion of these issues, see Thomas (1992) and Buehn, Karmann and Schneider (2009).

⁶ The causes and indicators are only briefly presented here, compare Schneider (2017), and Williams and Schneider (2016).

⁷ As a huge literature is available about the various methods available to measure a shadow economy, a detailed overview about it and problems using these methods (including the MIMIC method) are not discussed here. See e.g. Schneider and Enste (2002), Feld and Schneider (2010), Schneider, Buehn and Montenegro (2010), Schneider (2015), Schneider and Williams (2013), Williams and Schneider (2016).

⁸ Based on Schneider and Enste (2002), Feld and Schneider (2010), Williams and Schneider (2016).

(continued...)

Direct approaches

In this sub-section, four direct and micro methods of measuring the shadow economy⁹ are briefly presented¹⁰ and critically evaluated.

- (i) Measurement by the System of National Accounts Statistics – Discrepancy method;
- (ii) Survey technique approach;
- (iii) The use of surveys of company managers; and
- (iv) The estimation of the consumption-income-gap of households.

(i) System of National Accounts Statistics – Discrepancy method

This method is described in detail in the paper by Gyomai and van de Ven (2014). The authors start with a classification for measuring the non-observed economy as follows (Gyomai and van de Ven, p. 1):

- (i) Underground hidden production: Activities that are legal and create a value added, but are deliberately concealed from public authorities.
- (ii) Illegal production: Productive activities that generate goods and services forbidden by law or which are unlawful when carried out by unauthorized procedures.
- (iii) Informal sector production: Productive activities conducted by incorporated enterprises in the household sector or other units that are registered and/or less than specified size in terms of employment and have some market production.
- (iv) Production of households for own (final) use: Productive activities that result in goods or services consumed or capitalized by the households that produced them.
- (v) Statistical “underground”: All productive activities that should be accounted for in basic data collection programs, but are missed due to deficiencies in the statistical system.

Gyomai and van de Ven (2014) provide a precise definition in order to reach the goal of exhaustive estimates, as follows:

(1) Hidden activities (System of National Accounts):

SNA 2008, § 6.40: Certain activities may clearly fall in the production boundary of the SNA and also be quite legal, but are deliberately concealed from public authorities for the following kinds of reasons:

- (i) to avoid the payment of income tax, value added or other payments;
- (ii) to avoid the payment of social security contributions;

⁹ The term *shadow economy* here means measuring the non-observed economy. This will be explained in detail in describing the first method of the National Accounts Statistics (Discrepancy method). Compare here Gyomai and van de Ven (2014), Schneider (2017), Feld and Schneider (2010) and Williams and Schneider (2016).

¹⁰ A critical evaluation is not undertaken here because this is covered in various other studies, including Feld and Schneider (2010), Williams and Schneider (2016) and Schneider (2017).

- (iii) to avoid having to meet certain legal standards such as minimum wages, maximum hours, safety or health standards, etc.;
- (iv) to avoid complying with certain administrative procedures, such as completing statistical questionnaires or other administrative forms.

(2) Illegal activities:

SNA 2008, § 6.43: There are two kinds of illegal production:

- (i) The production of goods or services whose sale, distribution or possession is forbidden by law;
- (ii) Production activities that are usually legal but become illegal when carried out by unauthorized producers; for example, unlicensed medical practitioners.

In SNA 2008, § 6.45 it is written that both kinds of illegal production are included within the production boundary of the SNA provided they are genuine production processes whose outputs consist of goods or services for which there is an effective market demand.

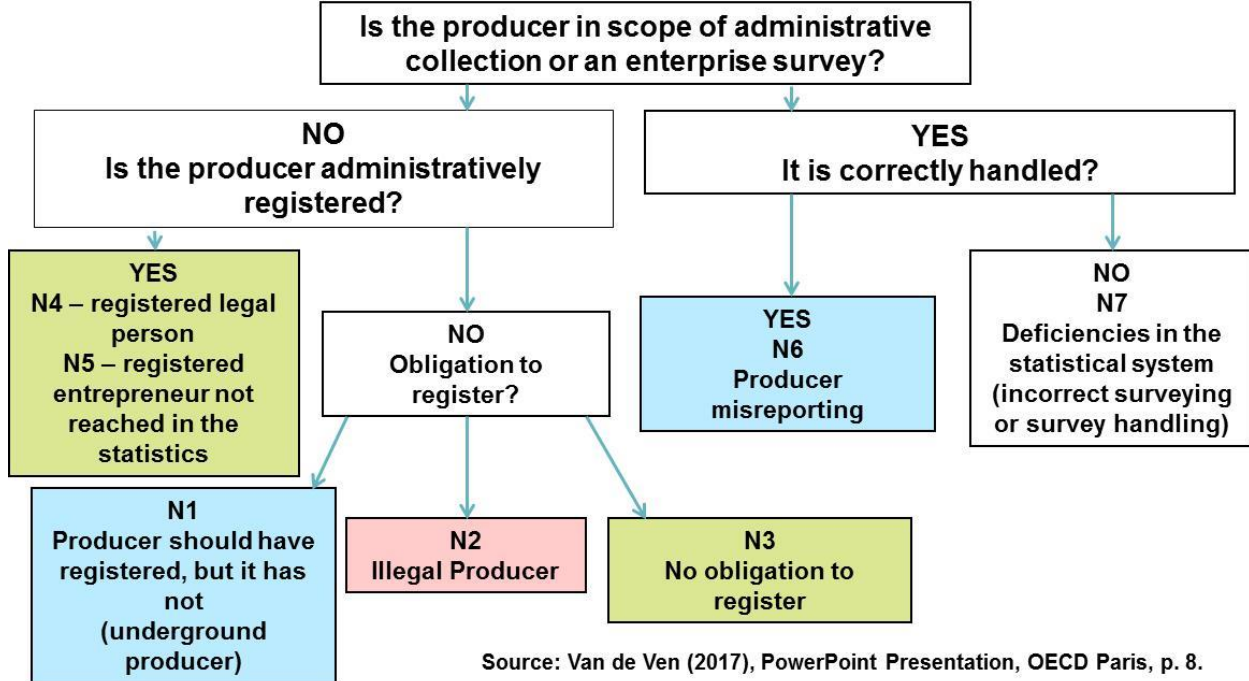
With this classification, the authors provide a comprehensive and useful categorization of the various shadow economy/underground activities. This estimation method is applied by National Statistical Offices and is explained in detail in the Handbook for Measuring the Non-Observed Economy, OECD (2010). The authors argue that non-observed economy estimates take place at various stages of the integrated production process of national accounts:

First, data sources with identifying biases on reporting on scope are corrected via imputations.

Second, upper-bounded estimates are used to access the maximum possible amount of non-observed economy (NOE) activity for a given industrial activity or product group based on a wide array of available data.

Third, special purpose surveys are carried out for areas where regular surveys provide little guidance and small scale models are built to indirectly estimate areas where direct observation and measurement is not feasible.

In Figure 3.1 the classification of the NOE in order to reach estimates with the National Accounts Method (NAM) is shown.

Figure 3.1: Classification of NOE (Non-Observed Economy)

We clearly see that this is a careful procedure which considers all possible situations to achieve an exhaustive estimation. The concept of the national accounts method (NAM) to capture all non-observed economic activities is the following:

It includes the following non-observed economy categories:

- Economic underground: $N1+N6$
- Informal (and own account production): $N3+N4+N5$
- Statistical underground: $N7$
- Illegal: $N2$

Much work has been done on the first three categories, less so on illegal activities. However, there is increased interest in illegal activities in the European Union nowadays, since its inclusion has become mandatory with the introduction of ESA 2010.

In general, discrepancy analysis is performed at a disaggregated level and the nature of adjustment has the effect that various NOE categories can be at least partly identified. The methodological descriptions provided by countries reveal that country practices in many areas of adjusting for NOE are often quite similar.

Still, substantial differences show up between various OECD countries. Table 2 presents NOE adjustments by informality type for 16 developed OECD countries over the years 2011 to 2012. It

shows that the total non-observed economy varies considerably among countries¹¹. Also the adjustments in the different categories are quite considerable. Using this method, some countries such as Italy have relatively large shadow economies with 17.5 percent, followed by the Slovak Republic with 15.6 percent and Poland with 15.4 percent of official GDP. The smallest one here is Norway with 1 percent.

(ii) Micro approach: Representative surveys

Representative surveys¹² are often used to get some micro knowledge about the size of the shadow economy and shadow labor markets. This method is based on representative surveys designed to investigate public perceptions of the shadow economy, actual participation in shadow economy activities and opinions about shadow practices. As an example we present some results of such surveys which were designed by the Lithuanian Free Market Institute and its partner organizations for Belarus, Estonia, Latvia, Lithuania, Poland and Sweden. The surveys took place between May 22 and June 15, 2015. The target audience included local residents aged 18–75. The total sample size comprised 6,000 respondents across the six countries. For our purpose the most important results of the surveys are presented in Tables 3 and 4¹³. Table 3 contains undeclared working hours as a proportion of normal working hours from the year 2015. Undeclared hours, as a share of normal working hours based on a weekly calculation, vary between 4.2 percent in Sweden and 20.7 percent in Poland which is quite a huge variation. This is not unexpected, because the shadow economy in Sweden is much smaller than the one in Poland. If one considers the average weekly undeclared hours worked by respondents with shadow experience, the range is much narrower. The work ranges between 25.5 hours in Poland and 16.8 hours in Lithuania. Table 4 shows the extent of aggregated shadow wages as a proportion of GDP. Obviously Sweden has by far the lowest with 1.7 percent of GDP as shadow employment, Belarus the largest with 32.8 percent, followed by Poland with 24 percent. We also notice quite considerable variance here.

(iii) Micro approach: Measuring the shadow economy using surveys of company managers

Putnins and Sauka (2015) and in a similar way Reilly and Krstic (2017) use surveys of company managers to measure the size of the shadow economy. They combine misreported business income and misreported wages as a percentage of GDP. The method produces detailed information on the structure of the shadow economy, especially in the service and manufacturing sectors. It is based on the premise that company managers are most likely to know how much business, income and wages go unreported due to their unique position in dealing with both types of income. They use a range of survey-designed features to maximize the truthfulness of responses. Their method combines estimations of misreported business income, unregistered or hidden employees and unreported wages in order to calculate a total estimate of the size of the shadow economy as a percentage of GDP. In their opinion their approach differs from most other studies of the shadow economy, which largely focus either on macroeconomic indicators or on surveys about households. Putnins and Sauka have developed first results for Estonia, Latvia and

¹¹ A comparison with respect to other methods is presented in chapter 4.

¹² Compare e.g. Feld and Larsen (2005, 2008, 2009), and Zukauskas and Schneider (2016).

¹³ Here, we do not concentrate on various results about the attitudes which can be seen in detail in the paper Zukauskas and Schneider (2016).

Lithuania. Results are shown in Table 5. For all countries, there is a decline over the period 2009 to 2015 and the largest shadow economy is Latvia with 27.8 percent average over 2009 to 2015, followed by Estonia with 17.4 percent and Lithuania with 16.4 percent.

Indirect approaches

Indirect approaches, alternatively called “indicator” approaches, are mostly macroeconomic in nature. These are in part based on: the discrepancy between national expenditure and income statistics; the discrepancy between the official and actual labor force; the “electricity consumption” approach of Kauffman and Kaliberda (1996); the “monetary transaction” approach of Feige (1979); and the “currency demand” approach of Cagan (1958) and Tanzi (1983) among others.

- (i) ***Discrepancy between national expenditure and income statistics:*** If those working in the shadow economy were able to hide their incomes for tax purposes but not their expenditure, then the difference between national income and national expenditure estimates could be used to approximate the size of the shadow economy. This approach assumes that all components on the expenditure side are measured without error and constructed so that they are statistically independent from income factors.¹⁴
- (ii) ***Discrepancy between official and actual labor force:*** If the total labor force participation is assumed to be constant, a decline in official labor force participation can be interpreted as an increase in the importance of the shadow economy. Fluctuation in the participation rate might have many other explanations, such as the position in the business cycle, difficulty in finding a job and education and retirement decisions, but these estimates represent weak indicators of the size of the shadow economy.¹⁵
- (iii) ***Electricity approach:*** Kaufmann and Kaliberda (1996) endorse the idea that electricity consumption is the single best physical indicator of overall (official and unofficial) economic activity. Using findings that indicate that electricity-overall GDP elasticity is close to one, these authors suggest using the difference between growth of electricity consumption and growth of official GDP as a proxy for the growth of the shadow economy. This method is simple and appealing, but has many drawbacks, including: (i) not all shadow economy activities require a considerable amount of electricity (e.g. personal services) or they may use other energy sources (such as coal, gas, etc.), hence only part of the shadow economy growth is captured; and (ii) electricity-overall GDP elasticity might significantly vary across countries and over time.¹⁶
- (iv) ***Transaction approach:*** Using Fischer’s quantity equation, $Money * Velocity = Prices * Transactions$, and assuming that there is a constant relationship between the money flows related to transactions and the total (official and unofficial) value added, i.e. $Prices * Transactions = k (official\ GDP + shadow\ economy)$, it is reasonable to derive the following equation $Money * Velocity = k (official\ GDP + shadow\ economy)$. The stock of

¹⁴ See for example MacAfee (1980), and Yoo and Hyun (1998).

¹⁵ See for example Contini (1981), Del Boca (1981), and O’Neil (1983).

¹⁶ See for example Del Boca and Forte (1982), Portes (1996) and Johnson et al. (1997).

money and official GDP estimates are known, and money velocity can be estimated. Thus, if the size of the shadow economy as a proportion of the official economy is known for a benchmark year, then the shadow economy can be calculated for the rest of the sample. Although theoretically attractive, this method has several weaknesses, for instance: (i) the assumption that k would be constant over time seems quite arbitrary; and (ii) other factors like the development of checks and credit cards could also affect the desired amount of cash holdings and thus velocity.¹⁷

- (v) ***Currency demand approach (CDA)***: Assuming that informal transactions take the form of cash payments, in order not to leave an observable trace for the authorities, an increase in the size of the shadow economy will, consequently, increase demand for currency. To isolate this “excess” demand for currency, Tanzi (1980) suggests using a time series approach in which currency demand is a function of conventional factors, such as the evolution of income, payment practices and interest rates, and factors causing people to work in the shadow economy, like the direct and indirect tax burden, government regulation and the complexity of the tax system. However, there are several problems associated with this method and its assumptions: (i) this procedure may underestimate the size of the shadow economy because not all transactions take place using cash as means of exchange; (ii) increases in currency demand deposits may occur because of a slowdown in demand deposits rather than an increase in currency used in informal activities; (iii) it seems arbitrary to assume equal velocity of money in both types of economies; and (iv) the assumption of no shadow economy in a base year is arguable.¹⁸
- (vi) ***Multiple Indicators, Multiple Causes (MIMIC) approach***: This method explicitly considers several causes, as well as the multiple effects, of the shadow economy. The methodology makes use of associations between the observable causes and the effects of an unobserved variable, in this case the shadow economy, to estimate the variable itself (Loayza, 1996).¹⁹ This methodology is described in detail in subchapter 3.1.3.

The model or macro MIMIC approach

The MIMIC model is a special type of structural equation modeling (SEM) that is widely applied in psychometrics and social science research and is based on the statistical theory of unobserved variables developed in the 1970s by Zellner (1970) and Joreskog and Goldberger (1975). The MIMIC model is a theory-based approach to confirm the influence of a set of exogenous causal variables on the latent variable (shadow economy), and also the effect of the shadow economy on macroeconomic indicator variables. At first, it is important to establish a theoretical model explaining the relationship between the exogenous variables and the latent variable. Therefore, the MIMIC model is considered to be a confirmatory rather than an explanatory method. The hypothesized path of the relationships between the observed variables and the latent shadow economy based on our theoretical considerations is depicted in Figure 3.1. The pioneers to apply the MIMIC model to measure the size of the shadow economy in 17 OECD countries were Frey

¹⁷ See for example Feige (1979), Boeschoten and Fase (1984) and Langfeldt (1984).

¹⁸ See for example Cagan (1958), Gutmann (1977), Tanzi (1980, 1983), Schneider (1997) and Johnson et al. (1998a).

¹⁹ See Schneider (2010, 2015) Feld and Schneider (2010), Abdih and Medina (2016), Vuletin (2008), and Williams and Schneider (2016).

et al. (1984). Following them, various scholars such as Schneider et al. (2010), Hassan et al. (2016), and Buehn et al. (2009) applied the MIMIC model to measure the size of the shadow economy. Formally, the MIMIC model has two parts: the structural model and the measurement model.

In the following, we briefly explain the MIMIC estimation procedure (compare also Figure 3.2):

- (1) Modeling the shadow economy as an unobservable (latent) variable;
- (2) Description of the relationships between the latent variable and its causes in a structural model: $\eta = \Gamma x + \zeta$; and
- (3) The link between the latent variable and its indicators is represented in the measurement model: $y = \Lambda_y \eta + \varepsilon$.

where

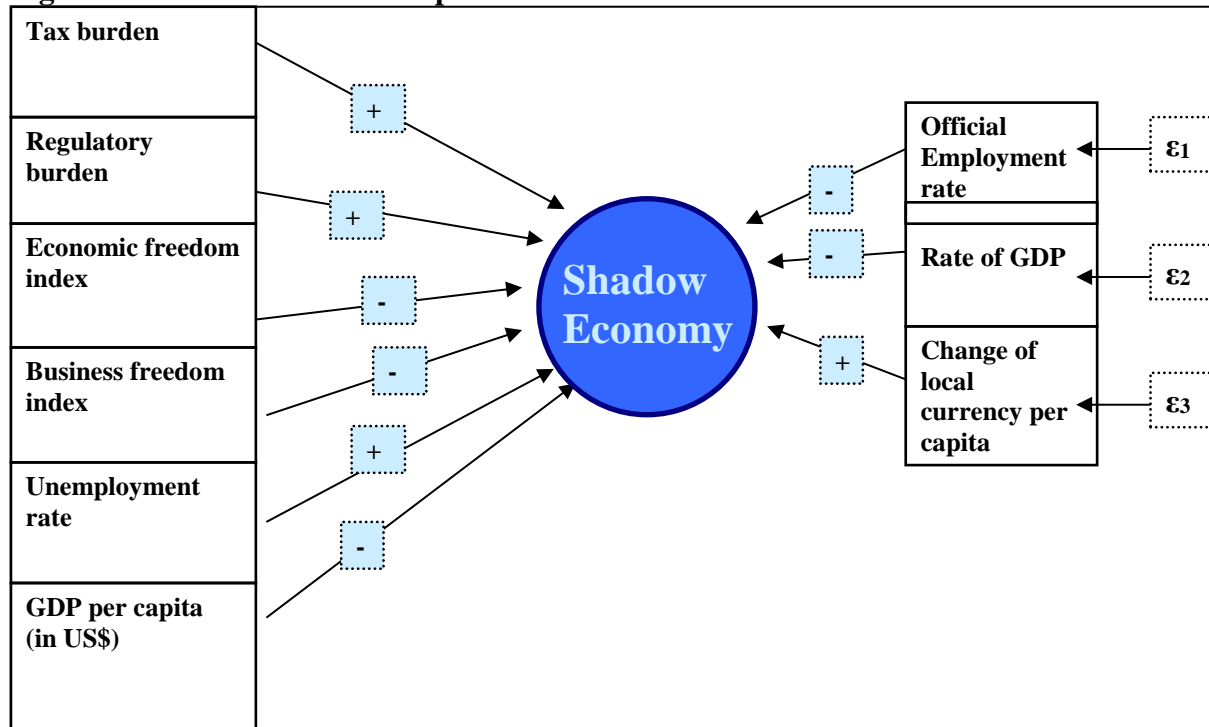
η : latent variable (shadow economy);
 X : ($q \times 1$) vector of causes in the structural model;
 Y : ($p \times 1$) vector of indicators in the measurement model;
 Γ : ($1 \times q$) coefficient matrix of the causes in the structural equation;
 Λ_y : ($p \times 1$) coefficient matrix in the measurement model;
 ζ : error term in the structural model and ε is a ($p \times 1$) vector of measurement error in y .
 The specification of the structural equation is:

$$[\text{shadow economy}] = [\gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5, \gamma_6, \gamma_7, \gamma_8] \times \begin{matrix} [\text{Share of direct taxation}] \\ [\text{Share of indirect taxation}] \\ [\text{Share of social security burden}] \\ [\text{Burden of state regulation}] \\ [\text{Quality of state institutions}] \\ [\text{Tax morale}] \\ [\text{Unemployment quota}] \\ [\text{GDP per capita}] \end{matrix} + [\zeta]$$

The specification of the measurement equation is:

$$\begin{matrix} \text{Employment Quota} \\ \text{Change of local currency} \\ \text{Average working time} \end{matrix} = \begin{matrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \end{matrix} \times \text{Shadow Economy} + \begin{matrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \end{matrix}$$

where γ_i and λ_i are coefficients to be estimated.

Figure 3.2: MIMIC estimation procedure

Source: Schneider, Buehn and Montenegro (2010).

How do we proceed to get the absolute figures? We use the following steps:

1. The first step is that the shadow economy remains an unobserved phenomenon (latent variable) which is estimated using causes of illicit behavior, e.g. tax burden and regulation intensity, and indicators reflecting illicit activities, e.g. currency demand and official work time. This procedure “produces” only relative estimates of the size of the shadow economy.
2. In the second step the currency demand method is used to calibrate the relative estimates into absolute ones by using absolute values of the currency demand method as starting values for the shadow economy.

The benchmarking procedure used to derive “real world” figures of shadow economic activities has been criticized (Breusch, 2005a, 2005b). As the latent variable and its unit of measurement are not observed, SEMs only provide a set of estimated coefficients from which one can calculate an index that shows the dynamics of the unobservable variable. Application of the so-called calibration or benchmarking procedure, regardless which one is used, requires experimentation, and a comparison of the calibrated values in a wide academic debate. Unfortunately, at this stage of research it is not clear which benchmarking method is the best or most reliable.²⁰

The economic literature using SEMs is well aware of these limitations. It acknowledges that it is not an easy task to apply this methodology to an economic dataset, but also

²⁰ See Dell’Anno and Schneider (2009) for a detailed discussion on different benchmarking procedures. Compare also the latest discussion and critique of the MIMIC procedure by Breusch (2016), Feige (2016a,b), Schneider (2016) and Hashimzade and Heady (2016).

argues that this does not mean one should abandon the SEM approach. On the contrary, following an interdisciplinary approach to economics, SEMs are valuable tools for economic analysis, particularly when studying the shadow economy. Moreover, the objections mentioned should be considered incentives for further research in this field rather than a reason to abandon the method.

Identification problem with MIMIC estimates

We have already discussed that the MIMIC approach estimations “produce” only relative weights. Hence, we need another approach to normalize these estimates and their validity depends on the reliability of this second approach. Hence it is very difficult to draw statistically confirmed conclusions about the causal relations in the real world and not only in the estimated model from these estimates.

Why is this so? As Kirchgaessner (2016, page 103) correctly argues... “A necessary condition for testing whether a variable x has a causal impact on a variable y , is that the two variables are measured independently. The MIMIC Model approach assumes, that causal relations exists and , therefore, estimates are linear combination of these (supposedly) causal variables, that more or less fits several indicator variables. This linear combination is assumed to be a representation of the unknown variable shadow economy.”

We should be aware that this calculation of the shadow economy is not an empirical test either of the actual existence of this calculated shadow economy or that the used causal or explanatory variables have a statically significant impact on the “true” shadow economy. Kirchgaessner (2016, page 103) argues further, that ...” significant test statistics in the structural model only show, that the used explanatory (or causal) variables contribute significantly to the variance of the constructed variable, shadow economy. We have to assume, that this construction represents the shadow economy to make statements about possible causal relations.” Hence these causal variables cannot be used again in subsequent studies to indent iffy policy variables that might reduce or increase the shadow economy. If this is done, a statistically significant relation must trivially result argue Feld and Schneider 2016, page 115).

To overcome this problem Kirchgaessner (2016, p. 103) suggests, to use other macro approaches like the electricity one, which measures the size of the shadow economy independently from the causes used in the MIMIC model. Then one can check whether a tax increase leads to a rise in the shadow economy. To conclude: we have to very careful when using shadow economy figures in order to test the impact of a tax reduction on the shadow economy. This is only possible if the shadow economy series is derived from an approach, where the tax variable has not been used for the construction of the shadow economy.

A new macro method of currency demand and MIMIC models: structured, hybrid-model based estimation approach

Dybka, Kowalczyk, Olesinski, Rozkrut and Torój (2017) developed a novel hybrid procedure that addresses previous critique of the currency demand approach (CDA) and MIMIC models by Feige and Breusch, and particularly the misspecification issues in the CDA equations and the

“vague” transformation of latent variable obtained via the MIMIC model into interpretable levels and paths of the shadow economy.²¹

This proposal is based on a new identification scheme for the MIMIC model, referred to as “reverse standardization”. It supplies the MIMIC model with panel-structured information on the latent variable's mean and variance obtained from the CDA estimates, treating this information as given in the restricted full-information maximum likelihood function. This approach does not require choosing an externally estimated reference point for benchmarking or adopting other ad hoc identifying assumptions (like unity restriction on a selected parameter in the measurement equation).

Furthermore, the proposed estimation procedure directly addresses the numerical problem of negative variances in the MIMIC estimation that was largely disregarded in the previous, off-the-shelf software. The non-negativity restriction on variances within the MIMIC framework can materially affect the significance, specification decisions and measurement results. Paying due respect to the (intuitive) constraint on the non-negativity of variances may in fact lead to a surprising result of flattening the trajectory of the shadow economy.

Also, the ANOVA decomposition of SE estimated by means of our hybrid strategy confirms the findings from the previous literature by showing that as much as 97.2–98.2 percent of the SE variance in the panel is due to the CDA component (between cross-sections), while only the small remaining fraction is due to MIMIC's fine-tuning job. The latter finding may lead to a legitimate question on the actual contribution of MIMIC models to shadow economy measurement.

Firstly, the authors estimate and extend a panel version of the CDA-equation using both frequent and neglected variables (describing the development of an electronic payment system) and abandon the controversial assumption that the share of the shadow economy in the total economy is zero.

Secondly, the authors estimate a MIMIC model by maximizing a (full-information) likelihood function reformulated in two ways: (i) instead of anchoring the index of an arbitrary time period and using arbitrary normalizations or other discretionary corrections, they use the means and variance estimated in the CDA model; (ii) they constrain the parameter vector to explicitly assume away the negative variances of structural errors and measurement errors. Their hybrid model proposes a solution to the long-standing problem of identification in the MIMIC model which, in a number of ways, outperforms previous approaches to just-identification. Their approach clearly implies a scale and unit of measurement, avoids obscure ad hoc corrections and paves the way to the construction of a sensible confidence interval. This new method is a promising approach to overcome the usual critiques of the CDA and MIMIC model.

In Table 6 a comparison of the shadow economy estimates by statistical offices provided by Gyomai and van de Ven (2014) and Dybka et al. (2017) with MIMIC estimates in this paper is undertaken. We show here the MIMIC macro and the MIMIC adjusted figures. If we compare the

²¹ This pioneering work was developed by Dybka et al. (2017), and the authors provided the following three paragraphs.

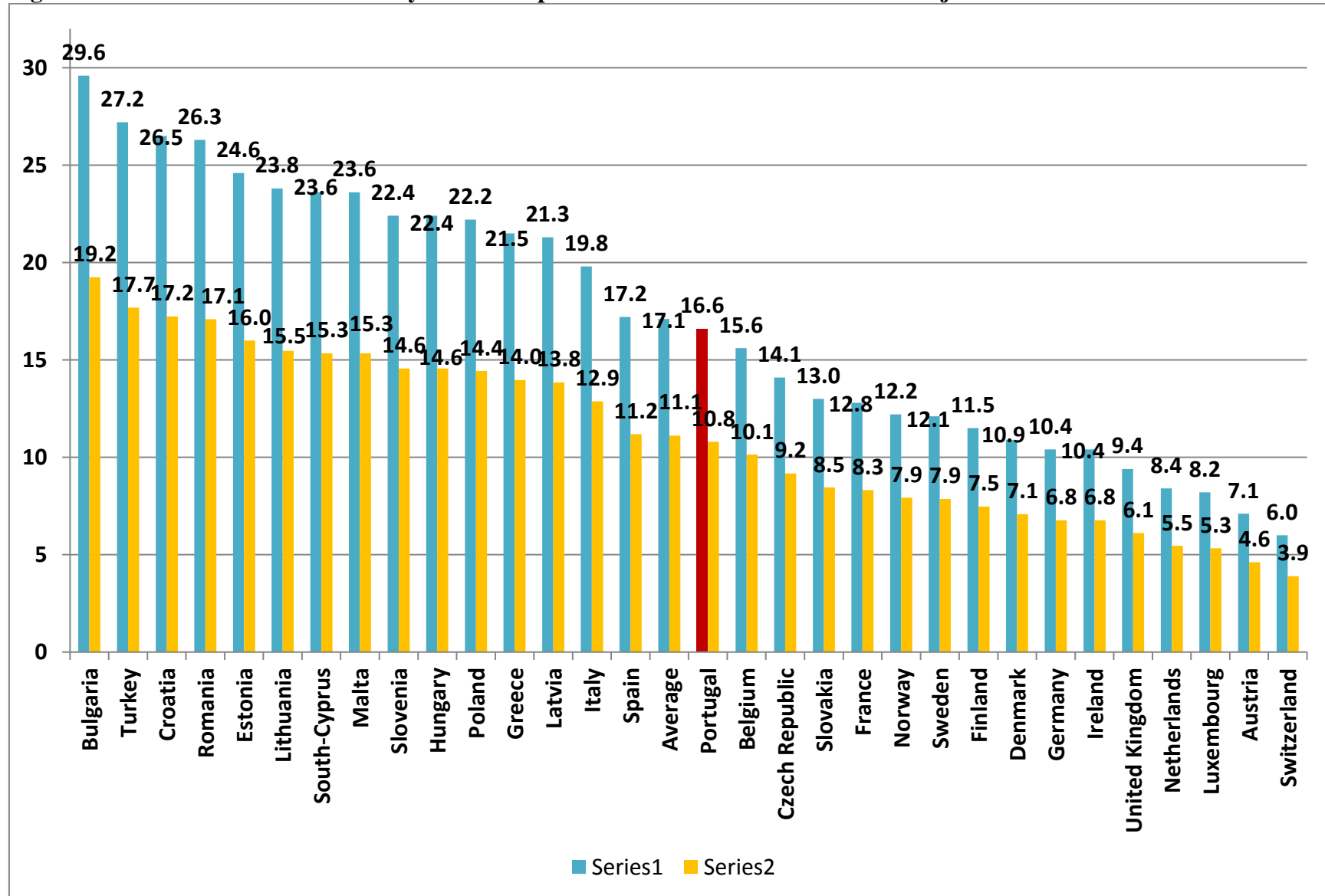
results of Dybka et al. (2017), we see that within the three methods the size of the shadow economy varies considerably, but is on average much lower than the MIMIC macro and MIMIC adjusted ones. If one considers the MIMIC adjusted values, they come close to the values of Dybka et al. (2017) for Bulgaria and Switzerland. Comparing the values of Dybka et al. (2017) with the statistical offices, they are in a similar range for Bulgaria, Israel, Mongolia, Sweden, UK and Croatia if we take the FGLS44-AR variant. In the case of Croatia, Dybka et al. (2017) obtain considerably higher values than those provided by the statistical offices. In the case of Moldova it is the opposite; the statistical office has with 23.7 percent a considerably higher value of the size of the shadow economy than Dybka et al. (2017). To summarize, this new estimation method is promising and most of the values are considerably lower than those obtained using the traditional macro methods of the CDA and/or MIMIC.

The problem of “double counting”

One big problem with macro approaches such as the MIMIC or CDA is that they use causal factors like tax burden, unemployment, self-employment and regulation, which are also responsible for people undertaking do-it-yourself activities or asking friends and neighbors to do things. Hence, do-it-yourself activities, neighbors’ or friends help and legally bought material for shadow economy activities are included in these macro approaches. This means that in these macro approaches (including the electricity approach, too) a “total” shadow economy is estimated which includes do-it-yourself activities, neighbors’ help, legally bought material and smuggling.

In Table 7 a decomposition of the shadow economy activities for the countries Estonia and Germany is undertaken. Table 7 starts with line (1) of the macro MIMIC estimates of 24.94 percent in Estonia as an average value for 2009 to 2015 and 9.37 percent for Germany for an average over 2009 to 2015. Legally bought material for shadow economy or do-it-yourself activities and friends’ help are deducted. Then illegal activities such as smuggling are deducted. Furthermore, do-it-yourself activities and neighbors’ help are deducted. Due to these factors from lines (2) to (4) one gets a corrected shadow economy which is roughly two thirds of the macro size of the shadow economy. It is 65 percent for Estonia and 64.2 percent for Germany. In the following, this correction factor is used to calculate an adjusted size of the shadow economy using the MIMIC method. The results for 31 European countries for 2017 are presented in Figure 3.3. The shadow economy appears considerably smaller and this might be a more realistic value of the actual size of the shadow economy using a macro method.

Figure 3.3: Size of the shadow economy of 31 European countries in 2017 – macro and adjusted MIMIC estimates



Source: Own calculations.

B. MIMIC Estimation Results

In tables 8, 9, and 10, which include six specifications per table, the MIMIC estimation results over the period 1991–2015 for 158 countries (maximum sample) are presented.²² Table 8 contains the estimation results for all countries. All cause variables (trade openness, unemployment, size of government, fiscal freedom, rule of law, control of corruption, government stability), have the theoretically expected signs, and most of them are highly statistically significant. The indicator variables also have the theoretical expected signs and are highly statistically significant. The test statistics are satisfactory.

Table 9 contains the estimation results for 105 developing countries (maximum sample). Here the cause variable rule of law is not statistically significant in specification 1, nor is control of corruption in specification 2. These variables are significant and show the expected sign in the other specifications. The indicator variable labor force is again highly statistically significant.

Finally, results for 26 advanced countries are presented in Table 10. Here trade openness is not statistically significant in all specifications, but in all other specifications most cause variables have the expected sign and are statistically significant, except government stability and size of government.²³ The indicator variables are all statistically significant and have the expected signs.

C. Addressing Potential Shortcomings

Night Lights Intensity Approach

Even though the standard MIMIC model of Schneider (2010) and others has been widely used in the literature for many years, it has also been the subject of criticism. Mainly on: (i) the use of GDP (GDP per capita and growth of GDP per capita) as cause and indicator variables, (ii) the fact that the methodology relies on another independent study to calibrate from standardized values to estimate the size of shadow economy in percent of GDP, and (iii) the estimated coefficients are sensitive to alternative specifications, the country sample and

²² The MIMIC regression includes 151 countries. This estimation generated the coefficients and standard deviations. Following this, during the calibration phase, eight countries were dropped as the time series were not long enough. Specifically, Afghanistan, Macao, Macedonia, Serbia, St. Lucia, St. Vincent and the Grenadines, Sudan, and Tonga. Moreover, for 15 additional countries availability on the drivers' information permitted the estimation of the informal economy, and therefore, were added to the sample. Specifically, Austria, Belgium, Ethiopia, Finland, France, Germany, Greece, Ireland, Italy, Mauritania, Netherlands, Niger, Rwanda, Togo, and United Kingdom. This completes the list of 158 countries with shadow economy estimates (Table 3.6, all specifications).

²³ This is plausible, as in advanced countries one would already expect good institutions.

(continued...)

time span chosen. Points (ii) and (iii) will not be discussed in our paper; as they are extensively discussed in Schneider (2016).²⁴

We address the main criticism of (i) as follows:

Instead of using GDP per capita and growth of GDP per capita as cause and indicator variables, we use the night lights approach by Henderson, Storeygard, and Weil (2012) to independently capture economic activity. In their paper, they use data on light intensity from outer space as a proxy for the “true” economic growth achieved by countries.²⁵ They also use the estimated elasticity of light intensity with respect to economic growth to produce new estimates of national output for countries deemed to have low statistical capacity. Therefore, by using the night lights approach we address MIMIC criticisms related to the endogeneity of GDP in a novel way, which is totally independent from problematic GDP measures traditionally used (See Medina et al (2017)).

Estimation Results using the Night Lights Intensity Approach

In tables 11, 12, and 13, which include five alternative specifications per table, the MIMIC estimation results are shown for the period 1991–2015 for different country samples depending on data availability. Table 11 contains the estimation results for all countries, and uses light intensity as an indicator variable. All cause variables (trade openness, unemployment, size of government, fiscal freedom, rule of law, control of corruption, government stability), have the theoretically expected signs, and most of them are highly statistically significant, except control of corruption. The indicator variables also have the theoretical expected signs and are highly statistically significant. The test statistics are satisfactory.

Table 12 contains the estimation results for 103 developing countries. Here the cause variable unemployment is not statistically significant; nor are rule of law and control of corruption. The indicator variable labor force is again highly statistically significant.

The results for 24 advanced countries are presented in Table 13. Here trade openness is not statistically significant in all specifications, but in all other specifications most cause variables are statistically significant, except government stability. The indicator variables are all statistically significant and have the expected signs.

An alternative procedure: Predictive Mean Matching

Predictive Mean Matching (PMM), (Rubin, 1987) treats the empirical challenge in the estimation of the size of the shadow economy as a missing data problem: for a number of

²⁴ Light intensity offers many benefits as a proxy for economic activity. However, there are some weaknesses of light intensity as well which are worth considering. In rural areas, for example, you can have economic activity in the absence of additional light.

²⁵ Data on night lights used in this paper has been obtained from Henderson, Storeygard, and Weil database.

(continued...)

countries, we have survey-based estimates of the size of the shadow economy,²⁶ but for other countries this is missing.

Missing data can result from three types of mechanisms: missing completely at random (MCAR), missing at random (MAR) or missing not at random (MNAR), (Little and Rubin, 1987). The PMM analysis assumes that for the shadow economy, the mechanism is MAR. This means that the probability that an observation is missing can depend on observed co-variates of non-missing units and missing units, but it cannot depend on missing data on the size of the shadow economy. In other words, we assume that the probability that a country is missing data on its shadow economy can depend on characteristics relevant for the shadow economy, but the size of the shadow economy itself should not be a factor. This assumption can be challenged because one can argue that a large shadow economy would be difficult to measure, resulting in missing data. Furthermore, a large shadow economy can be associated with institutional weaknesses that would also make it less likely to be measured due to capacity constraints. However, when we look at the survey data available, we see that there are data available for large informal economies as well, such as Niger and Burundi. Therefore, at least in practice, the MAR assumption is somewhat validated, but would have to be checked through sensitivity analyses that would operate under MNAR.

The objective is to match the countries where data exist to the those where data are missing using characteristics that would be relevant to the size of the shadow economy.

One of the challenges inherent in the empirical problem of estimating the size of the shadow economy is that, for many countries, it is hard to estimate due to institutional capacity constraints. The shadow economy is complex, encompassing many related factors that in any estimation procedure may produce problems of endogeneity and other empirical challenges. A principal constraint in this exercise is that those countries for which some estimation of the shadow economy is available are not very similar to countries where this is missing.

Predictive Mean Matching (PMM) circumvents this challenge somewhat by producing multiple datasets using a Bayesian setup. Therefore, where we lack the data for similar countries, the method is able to compensate by taking advantage of the inherent uncertainty associated with a missing data problem.

The other advantage of the PMM method is that in its actual estimation step, it is non-parametric. It does not suffer from any of the problems associated with a regular regression method in which dissimilar countries would be estimated using the same co-variates, and assuming linear extrapolations across co-variate distributions that may be different and far apart from each other. The principle of similarity in PMM avoids this fundamental problem: it matches countries lacking data to countries that have data, based on their similarity. But how is this similarity itself estimated? This is the crux of the methodology. Similar to PMM, Propensity Score Matching (PSM) is also a promising candidate. However, the constraint with PSM in this case is that not enough similar observations are matched to be able to then

²⁶ There were 49 countries that were identified to have survey-based estimates of the size of their informal economies, including 9 in Sub-Saharan Africa.

run separate regressions or even make non-parametric estimates for each group due to the number of estimations required.

The similarity principle for PMM is established using a linear regression. Here, we estimate the following simple OLS model:

$$Y_{it} = \alpha + \beta_{geo} * GE_0 + \beta_{rq} * RQ + \beta_c * C + \beta_{rol} * \beta * ROL + \beta_{bf} * BF + \beta_{se} * SE + \beta_{HDI} * HDI + \beta_E * E$$

Where Y is the size of the shadow economy as a percentage of GDP, GE is a government effectiveness index, RQ is a regulatory quality index, C is a corruption index, ROL is a rule of law index, BF is a business freedom index, SE is self-employment levels, HDI is the Human Development Index, and E is an education variable.

The distinctive feature of the PMM is that this regression is not actually used for the estimation of the size of the shadow economy, but rather as a matching tool. For this we have the following seven stages that are computed using the SAS Proc MI procedure²⁷:

- (1) A random draw is made from the posterior predictive distribution of the estimated co-variate coefficient matrix β_{\cdot} , resulting in a new co-variate coefficient matrix $\beta_{\bar{\cdot}}$.
- (2) Using $\beta_{\bar{\cdot}}$, we predict Y^* for all countries.
- (3) The algorithm then identifies countries where we had actual Y_i and whose predicted Y^* , are closest to the predicted Y^* of the countries missing the data. Hence we have matches between Y^*_{jobs} and Y^*_{imiss} : predicted values for the outcome variable originally missing and originally having an estimate of the size of the shadow economy.
- (4) Each country with missing data is assigned to a group that has similar countries with data from the previous procedure.
- (5) In each group, the MI algorithm randomly selects a match to the countries originally missing the outcome, and assigns the observed outcome from the match to be the estimated outcome variable for the country missing the outcome.
- (6) Steps 1–5 are repeated five times, generating five distinct datasets with imputed values of the shadow economy, mimicking the inherent variability due to the uncertainty associated with the missing data mechanism.
- (7) To produce a final estimate, we take the average of the five datasets for the size of the shadow economy.²⁸

The results are consistent with the rankings produced by the MIMIC method (see Table 14), with Spearman's rank correlation at 61 percent and significant at one percent statistical

²⁷ SAS, STAT 14.1 User's Guide The MI Procedure, SAS Institute, 2015.

²⁸ Here, we can of course weigh these datasets based on a separate estimation procedure that would give certain "matches" more weight. For example, we could separately estimate a propensity score for each country, and use the propensity scores to weigh the matches in each dataset. For simplicity, in this paper, we use a simple average.

significance. Furthermore, when the MIMIC and PMM samples are divided into three subgroups of countries, specifically “lower than 20 percent of GDP,” “between 20 and 40 percent of GDP,” and “higher than 40 percent of GDP,” most countries coincide between samples (over 60 percent).

Additional Robustness Test: Excluding GDP and GDP per capita from the regressions

This section further tests the robustness of the results by fully removing the effects of GDP, by dropping both GDP per capita as cause and growth of GDP per capita as indicator.

MIMIC estimation results for the period 1991–2015 for different country samples depending on data availability are presented in tables 15, 16, and 17; they include six alternative specifications per table. These results are consistent with those in the previous sections.

D. Results on the Size of the Shadow Economy of 158 Countries using the MIMIC Approach

In Table 18 the most important results for the 158 countries, listed in alphabetical order, are shown²⁹. The mean value of the size of the shadow economy of the 158 countries is 31.9. The median is 32.3, indicating that both values are quite close to each other, so there is not a strong deviation. The three largest shadow economies are Zimbabwe with 60.6, Bolivia with 62.3 and Georgia with 64.9. The three smallest shadow economies are Austria with 8.9, the United States with 8.3 and Switzerland with 7.2. The average shadow economy comes close to Equatorial Guinea with 31.8 percent and Suriname with 32.2 percent of official GDP.

Figures 3.4 and 3.5 show some disaggregated results. Figure 3.4 presents the shadow economy by region; the OECD countries are by far the lowest with values below of 20 percent and the Sub-Saharan African countries and Latin American countries are the highest with average values above 36 percent (both averages over 1991–2015). In all country groups we see a significant decline in the size of the shadow economy over time; the average decline from 1991 to 2015 was 5.3 percentage points. Figure 3.5 presents the results grouped by income. High income countries have the lowest shadow economy and low income countries vice versa.^{30 31}

²⁹ For a detailed presentation of the results over all countries and all years see Table A.1 of the Appendix.

³⁰ Many countries, specifically those in the middle east, have been affected by massive refugee inflows in the recent past. Unfortunately, our model does not capture this dimension and therefore, the shadow economy in countries such as Jordan, Lebanon and Turkey could potentially be underestimated. For the same reason Syria’s last five year results should be taken with caution.

³¹ China results should be taken with caution, as it is partly a market economy and partly a planned economy. Therefore, the results might be capturing the informal economy only partially.

4. A COMPARISON OF THE MIMIC (MACRO AND ADJUSTED) RESULTS WITH MICRO SURVEY RESULTS AND NATIONAL ACCOUNTS DISCREPANCY METHOD

A. MIMIC Results Versus National Accounts – Discrepancy Method Results

The first comparison will be made between the calculation of the shadow economy of the System of National Accounts – discrepancy method and the MIMIC method (macro and adjusted). The results are shown in Table 4.1 which contains 16 OECD countries for the years 2011 and 2012 (averages). For most countries, the MIMIC results are considerably larger, especially in the cases of Norway, Mexico, Belgium and Israel. Remarkably, some MIMIC estimates come very close to the National Accounts Discrepancy method (both macro and adjusted). For example, in Austria the non-observed economy is 7.5 percent by the National Accounts Discrepancy method and 8.4 percent using the macro MIMIC estimation while the adjusted figure is only 5.5 percent, hence, even lower than the National Accounts Discrepancy method. Also somewhat close are the results for the Czech Republic and for the Slovak Republic, but the MIMIC macro results are considerably higher than those achieved with the National Accounts Discrepancy method. If one makes a comparison between the MIMIC adjusted values and the National Accounts Discrepancy method, the differences shrink considerably. While we have large differences for Norway with 9.7 percentage points, the Slovak Rep. with -7.9 (here the MIMIC adjusted value is lower than that from the National Accounts) and Belgium with 7.1 percentage points, for a number of countries the differences are less than three to four percentage points.

What can we conclude from Table 19? There are still considerable differences between the macro MIMIC approach and the National Accounts Discrepancy method, however, the variance, especially in the National Accounts Discrepancy method, is quite large and the MIMIC results for at least for two or three countries come quite close to this calculation of the shadow economy. Hence, the statement by Gyomai and van de Ven (2014) that the estimates by Schneider would be on average three times as large as the estimates for the non-observed economy in the System of National Accounts and 6.7 times larger than the relevant underground economy estimates should be reconsidered. Also, their statement that macroeconomic MIMIC models produce a large size for the shadow economy and the differences are likely to be in great part caused by unrealistic model assumptions and calibration decisions, at least with the adjusted MIMIC results, should be reconsidered.

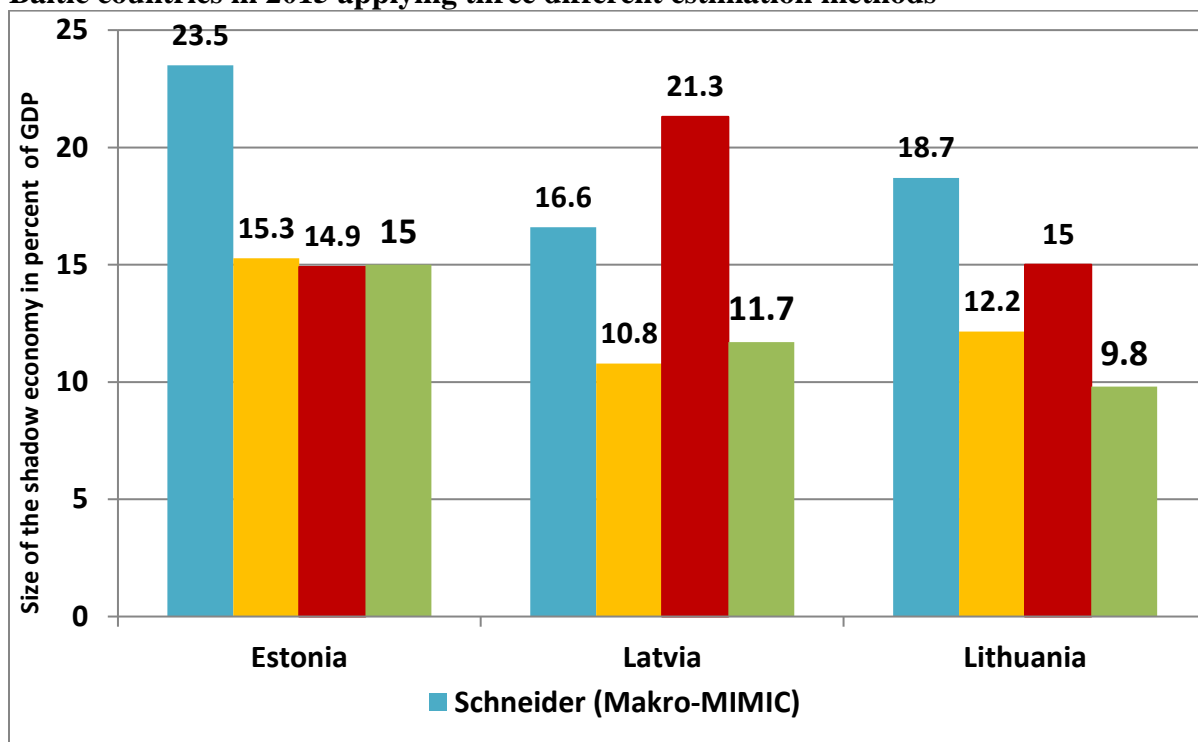
Table 20 shows a comparison between the National Accounts Statistics Discrepancy method and the MIMIC results for eight Sub-Saharan African countries over 2010 to 2014. Here we have exactly the opposite result compared to Table 4.1. For most countries, the discrepancy method is considerably higher than the MIMIC results; the same is true when compared to the MIMIC adjusted results. Hence, again, the criticism that the MIMIC estimates are unrealistically large and high may be not true, at least not for these eight Sub-Saharan African countries. In seven out of the eight Sub-Saharan African countries the MIMIC estimation is considerably lower than that obtained using the discrepancy method. For example, in Guinea-Bissau the National Accounts Statistics Discrepancy method estimate is 53.4 percent and the MIMIC result is 37.6 percent, a difference of 15.8 percentage points.

In Table 6, a comparison of the shadow economy with the new CDA and MIMIC procedure of Dybka et al. (2017) and estimates of the statistical offices obtained from Gyomai and van de Ven (2014) and our values is undertaken. For these European countries we see that the values obtained from statistical offices are considerably lower than the MIMC macro and MIMIC adjusted ones. However, for Poland the MIMIC adjusted figures with 11.8 percent and the Polish statistical office with 13.3 percent come close. This is also true for Moldova and Switzerland.

B. MIMIC Versus Micro Survey Methods Results

In Figure 4.1 a comparison of the size of the shadow economy as a percentage of GDP of the Baltic countries for the year 2015 is shown, using three different estimation procedures. The survey of firm managers by Putnins and Sauka (2016) and the classical survey results of Zukauskas and Schneider (2016) are compared with the MIMIC macro and adjusted results from this paper. If one compares the adjusted MIMIC results with the other two approaches for the case of Estonia, they are quite close. The MIMIC adjusted value is 15.3 percent of GDP, the survey method of firm managers is 14.9 percent and the pure survey method by Zukauskas and Schneider is 15 percent. Somewhat different results are achieved for Latvia, where the macro MIMIC estimates with 16.6 percent and the adjusted ones with 10.8 percent are much lower than the 21.3 percent figure produced in the survey of firm managers; also the pure survey method of Zukauskas and Schneider with 11.7 percent is considerably lower. In the case of Lithuania, the results of the adjusted MIMIC estimates and those of Putnins and Sauka are somewhat close with 12.2 percent and 15 percent and the pure survey results of Zukauskas are again lower with 9.8 percent. Again, one clearly sees, applying two different survey methods and comparing them with the MIMIC estimations, that the results show adjusted the MIMIC estimations are quite close to the other estimations. Only the pure macro MIMIC estimations are considerably higher.

Figure 4.1: A comparison of the size of the shadow economy (in percent of GDP) of the Baltic countries in 2015 applying three different estimation methods



Source: Putnins and Sauka (2015), Zukauskas and Schneider (2016) and own calculations.

C. Macro Versus Micro Methods – Newer Results

Finally, in Table 21 a detailed comparison is undertaken using most different known methods. Here, for the case of the Czech and Slovak Republics, mostly for the year 2008, the table is ranked according to the size of the shadow economy. The Currency Demand Deposit Ratio by Alm and Embaye (2013) gets the largest results with 23.2 percent and 25.1 percent for the Czech and Slovak Republics, respectively. But in place number two is the Consumption-Income-Gap method by Lichard et al. (2014), calculating sizes of 17.6 percent and 22.6 percent. They are considerably lower than the Currency Demand approach from Alm and Embaye, but considerably higher than the Deterministic Dynamic Simulation approach by Elgin and Öztunali (2012) with 16.8 percent and 16.6 percent for the Czech and Slovak Republics, respectively. They are also considerably higher than the MIMIC macro approach from Buehn and Schneider for the year 2008 with 15.2 percent and 16.0 percent. The other results from the Statistical Office Discrepancy Method, Currency Deposit Ratio and another Structural MIMIC model are considerably lower compared to the four first results. Table 20 shows that even using similar approaches, the MIMIC or structural model is used in this table three times; the size of the shadow economy can vary considerably which again leads to the question of how these results can be evaluated with respect to their plausibility. Table 21 demonstrates that the micro approach using household survey Consumption-Income-Gap leads to as high results as have been achieved with most macro Currency Demand or MIMIC approaches. Hence, the question is really open why the macro results are seen as unreliably high.

5. SUMMARY AND CONCLUDING REMARKS

A. Summary

Certainly, the macro approaches provide upper bound estimates as they include crime activities, do-it-yourself activities and voluntary activities in the shadow economy, because these are at least partly performed for the same reasons as “pure” shadow economy activities. MIMIC estimations of the size of the shadow economy depend to a large extent on the starting values and if they are taken from other macro estimates, we have the same problem. A promising approach here is the structured hybrid approach by Dybka et al. (2017), who contribute to the CDA and MIMIC method in a new way avoiding a number of statistical/econometric problems. One result is that they achieve much lower sized shadow economy estimates.

In this survey we first briefly discuss the reason why people work in the shadow economy and the traces a shadow leaves. Then we extensively discuss the various methods of estimating a shadow economy and provide a new classification of underground activities. We also describe two conventional and three new methods that measure the size of the shadow economy. The two new ones are the survey method using the expertise of managers and their detailed knowledge about firms’ shadow economy, and a modified version of estimating the consumption-income-gap, relaxing the assumption that one has to solve how many people are working in the shadow economy and especially assuming that the self-employed have a higher share of shadow economy activity. The third is a structured hybrid approach by Dybka et al. (2017) which combines the CDA and MIMIC method. The statistical discrepancy method is briefly described and all methods are used as a benchmark for the MIMIC macro and adjusted methods. Then a detailed comparison of the results from the latest studies is undertaken, showing that macro MIMIC estimates are in some cases much higher than the Statistical Discrepancy methods. However, in the case of eight Sub-Saharan African countries we observe the opposite, finding that the National Accounts Discrepancy method leads to considerably higher results than the MIMIC procedures. For a number of countries the MIMIC approaches (especially when the MIMIC procedure is adjusted due to a double counting problem) come in quite close range to the other three approaches, so claims that they are unrealistically high and rely on unrealistic assumptions, either in calibration or estimation, need to be reconsidered.

Then we estimate the size and development of the shadow economies of 158 countries over the period 1991 to 2015 using different methods and alternative specifications. Using a MIMIC method we are one of the first to apply (i) the light intensity approach instead of GDP, avoiding the problem that GDP is often used as a cause and indicator variable; and (ii) the PMM methodology, which provides robust results and confirms those of the MIMIC.

The additional robustness tests also clearly show that in most cases trade openness, unemployment rate, GDP per capita, size of government, fiscal freedom and control of corruption are highly statistically significant. The results are robust when using the light intensity approach. The results are also robust to dropping GDP and GDP per capita, again the results show that trade openness unemployment rate, size of government, fiscal freedom, rule of law and corruption are statistically significant. This holds also for the sub-samples. Hence, these two kinds of robustness tests demonstrate that the MIMIC results lead to quite robust results.

B. What Types of Conclusions Can We Draw From These Results?

1. The MIMIC estimations of the 158 countries over 1991 to 2015 produce quite plausible results which are comparable to Schneider (2010), Hassan and Schneider (2016) and other studies.
2. Using the lights approach as an indicator variable proved to be an alternative to GDP per capita or GDP growth rate. Hence, if we have more or better data from this variable it might be used as an indicator.
3. In order to avoid the problems of calibrating relative estimates from the MIMIC methodology we used a new method, the Predictive Mean Matching method, developed by Rubin (1987). This method produced plausible results and avoids the problems one has with the usual calibration methods used in Schneider (2010), Hassan and Schneider (2016) and other papers.
4. Overall, we again find one stable result, a declining size and development of the shadow economy from 1991 to 2015. The continuous decline is only interrupted in the year 2008 due to the world economic crisis.

C. Open Research Questions

- (i) There is no superior method. All methodologies, without exception, have their own advantages as well as weaknesses. If possible, one should use multiple methods.
- (ii) Much more research is needed with respect to the estimation methodology and the results for different countries and periods.
- (iii) Satisfactory validation of the empirical results should be developed, so that it is easier to judge the empirical results with respect to their plausibility. An attempt has been made in this paper in chapters 3 and 4.
- (iv) An internationally accepted definition of the shadow economy is missing. Such a definition is needed in order to make comparisons easier between countries and methods, and also to avoid a double counting problem.
- (v) The link between theory and empirical estimation of the shadow economy is still unsatisfactory. In the best case, 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.

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7. TABLES AND FIGURES

Table 1. The main causes/indicators determining the shadow economy

Causal/indicator variable	Theoretical reasoning	References
(1) Tax and social security contribution burdens	The distortion of the overall tax burden affects labor-leisure choices and may stimulate labor supply in the shadow economy. The bigger the difference between the total labor cost in the official economy and after-tax earnings (from work), the greater the incentive to reduce the tax wedge and work in the shadow economy. This tax wedge depends on social security burden/payments and the overall tax burden, making them key determinants in the existence of the shadow economy.	E.g. Thomas (1992), Johnson, Kaufmann, and Zoido-Lobaton (1998a,b), Giles (1999a), Tanzi (1999), Schneider (2003, 2005), Dell'Anno (2007), Dell'Anno, Gomez-Antonio and Alanon Pardo (2007)
(2) Quality of institutions or corruption	The quality of public institutions is another key factor in the development of the informal sector. In particular, the efficient and discretionary application of the tax code and regulations by the government plays a crucial role in the decision to work off the books, even more important than the actual burden of taxes and regulations. A bureaucracy with highly corrupt government officials tends to be associated with larger unofficial activity, while good rule of law through securing property rights and contract enforceability increases the benefits of being formal. A certain level of taxation, mostly spent in productive public services, characterizes efficient policies. In fact, production in the formal sector benefits from higher provision of productive public services and is negatively affected by taxation, while the shadow economy reacts in the opposite way. An informal sector developing as a consequence of the failure of political institutions to promote an efficient market economy, and entrepreneurs going underground due to inefficient public goods provision, may reduce if institutions can be strengthened and fiscal policy moves closer to the median voter's preferences.	E.g. Johnson et al. (1998a,b), Friedman, Johnson, Kaufmann, and Zoido-Lobaton (2000), Dreher and Schneider (2009), Dreher, Kotsogiannis and McCorriston (2009), Schneider (2010), Teobaldelli (2011), Teobaldelli and Schneider (2012), Amendola and Dell'Anno (2010), Losby et al. (2002), Schneider and Williams (2013), Hassan and Schneider (2016), Williams and Schneider (2016)
(3) Regulations	Regulations, for example labor market regulations or trade barriers, are another important factor that reduces freedom (of choice) for individuals in the official economy. They lead to a substantial increase in labor costs in the official economy and thus provide another incentive to work in the shadow economy: countries that are more heavily regulated tend to have a higher share of the shadow economy in total GDP. Especially the enforcement and not the overall extent of regulation – mostly not enforced – is the key factor for the burden levied on firms and individuals, inducing them to operate in the shadow economy.	E.g. Johnson, Kaufmann, and Shleifer (1997), Johnson, Kaufmann, and Zoido-Lobaton (1998b), Friedman, Johnson, Kaufmann, and Zoido-Lobaton (2000), Kucera and Roncolato (2008), Schneider (2011), Hassan and Schneider (2016)
(4) Public sector services	An increase in the shadow economy may lead to fewer state revenues, which in turn reduces the quality and quantity of publicly provided goods and services. Ultimately, this may lead to increasing tax rates for firms and individuals, although deterioration in the quality of public	E.g. Johnson, Kaufmann, and Zoido-Lobaton (1998a,b), Feld and Schneider (2010)

	goods (such as public infrastructure) and of the administration continues. The consequence is an even stronger incentive to participate in the shadow economy. Countries with higher tax revenues achieved by lower tax rates, fewer laws and regulations, a better rule of law and lower corruption levels should thus have smaller shadow economies.	
(5) Tax morale	The efficiency of the public sector also has an indirect effect on the size of the shadow economy because it affects tax morale. Tax compliance is driven by a psychological tax contract that entails rights and obligations from taxpayers and citizens on the one hand, but also from the state and its tax authorities on the other hand. Taxpayers are more inclined to pay their taxes honestly if they get valuable public services in exchange. However, taxpayers are honest even in cases when the benefit principle of taxation does not hold, i.e. for redistributive policies, if such political decisions follow fair procedures. The treatment of taxpayers by the tax authority also plays a role. If taxpayers are treated like partners in a (tax) contract instead of subordinates in a hierarchical relationship, taxpayers will stick to the obligations of the psychological tax contract more easily. Hence, (better) tax morale and (stronger) social norms may reduce the probability of individuals working in the shadow economy.	E.g. Feld and Frey (2007), Kirchler (2007), Torgler and Schneider (2009), Feld and Larsen (2005, 2009), Feld and Schneider (2010)
(6) Deterrence	Despite the strong focus on deterrence in policies fighting the shadow economy and the unambiguous insights of the traditional economic theory of tax non-compliance, surprisingly little is known from empirical studies about the effects of deterrence. This is because data on the legal background and the frequency of audits are not available on an international basis; such data are difficult to collect even for OECD countries. Either the legal background is quite complicated, differentiating fines and punishment according to the severity of the offense and the true income of the non-complier, or tax authorities do not reveal how intensively auditing is taking place. The little empirical survey evidence available demonstrates that fines and punishment do not exert a negative influence on the shadow economy, while the subjectively perceived risk of detection does. However, results are often weak and Granger causality tests show that the size of the shadow economy can affect deterrence, instead of deterrence reducing the shadow economy.	E.g. Andreoni, Erard and Feinstein (1998), Pedersen (2003), Feld and Larsen (2005, 2009), Feld and Schneider (2010)
(7) Development of the official economy	The development of the official economy is another key factor in the shadow economy. The higher (lower) the unemployment quota (GDP growth), the higher the incentive to work in the shadow economy, ceteris paribus.	Schneider and Williams (2013), Feld and Schneider (2010)
(8) Self-employment	The higher the rate of self-employment, the more activities can be performed in the shadow economy, ceteris paribus.	Schneider and Williams (2013), Feld and Schneider (2010)
(9) Unemployment	The higher the rate of unemployment, the higher the probability to work in the shadow economy, ceteris paribus.	Schneider and Williams (2013), Williams and Schneider (2016)
(10) Size of the agricultural sector	The larger the agricultural sector, the more possibilities to work in the shadow economy, ceteris paribus.	Hassan and Schneider (2016)

(11) Use of cash	The larger the shadow economy, the more cash will be used, ceteris paribus. Mostly measured as M0/M1, or M1/M2, or cash per capita outside the banking sector.	Hassan and Schneider (2016) Williams and Schneider (2016)
(12) Share of labor force	The higher the shadow economy, the lower the official labor force participation rate, ceteris paribus.	Schneider and Williams (2013) Feld and Schneider (2010)
(13) GDP per capita (economic growth)³²	A larger shadow economy is associated with more economic activities moving out of the formal economy, hence, it shows a decrease in economic growth, ceteris paribus.	

Source: Schneider (2017).

³² Additionally, and to address criticism of the use of official GDP, in section 4 this study relies on data on light intensity from outer space as a proxy for the “true” economic growth achieved by countries. This approach has been also successfully used by Medina, Jonelis, and Cangul (2017) in the context of Sub-Saharan African countries.

Table 2. NOE adjustments by informality type – percent of GDP (share of adjustment type within total NOE); 2011–2012

	Underground N1 + N6	Illegal N2	Informal sector N3 + N4 + N5	Statistical deficiencies N7	Total NOE
Austria	2.4 (31.7)	0.2 (2.1)	1.5 (19.4)	3.5 (46.8)	7.5 (100)
Belgium	3.8 (83.8)	-	-	0.7 (16.2)	4.6 (100)
Canada	1.9 (88.2)	0.2 (8.2)	-	0.1 (3.6)	2.2 (100)
Czech Rep.	6.3 (77.6)	0.4 (4.5)	1.3 (15.6)	0.2 (2.3)	8.1 (100)
France	3.7 (54.7)	-	2.9 (42.7)	0.2 (2.7)	6.7 (100)
Hungary	3.1 (27.9)	0.8 (7.5)	3.1 (28.6)	3.9 (36)	10.9 (100)
Israel	2.2 (32.6)	-	1.4 (21.8)	3 (45.6)	6.6 (100)
Italy	16.2 (92.8)	-	-	1.2 (7.2)	17.5 (100)
Mexico	5.5 (34.7)	-	10.4 (65.3)	-	15.9 (100)
Netherlands	0.8 (36.6)	0.5 (20.1)	0.5 (20)	0.5 (23.2)	2.3 (100)
Norway	0.5 (51.5)	0 (0.3)	0.5 (43.8)	0 (4.4)	1 (100)
Poland	12.7 (82.6)	0.9 (6)	0 (0)	1.8 (11.4)	15.4 (100)
Slovak Rep.	12.1 (77.3)	0.5 (3)	2.9 (18.7)	0.2 (1)	15.6 (100)
Slovenia	3.9 (38.2)	0.3 (3.2)	2.8 (27.7)	3.1 (30.9)	10.2 (100)
Sweden	3 (100)	-	-	-	3 (100)
UK	1.5 (65.6)	-	0.5 (22.9)	0.3 (11.4)	2.3 (100)

Source: Gyomai and van de Ven (2014, p. 6).

Table 3. Undeclared working hours as a proportion of normal working hours; year 2015

Country	Friends/ relatives in shadow labor market (percent)	Average weekly undeclared hours worked by respondents with shadow experience	Average weekly undeclared hours worked for the whole population	Normal average weekly working hours	Undeclared hours as a share of normal hours (percent)
	1	2	3=1x2	4	5=3/4
	Proportion	Hours per week	Hours per week	Hours per week	Proportion
Belarus	29	23.5	6.82	39.8	17.1
Estonia	26	22.4	5.82	38.9	15.0
Latvia	36	20.3	7.31	39.1	18.7
Lithuania	29	16.8	4.87	38.1	12.8
Poland	33	25.5	8.42	40.7	20.7
Sweden	8	18.9	1.51	36.3	4.2

Note: Figures for the experience of friends or relatives in the shadow labor market and average weekly undeclared hours are taken from the survey, while normal average weekly working hours come from the Eurostat Database for the year 2014. In the absence of such data for Belarus, it was estimated as an average of normal working hours for Central and Eastern European countries that belong to the European Union.

Source: Zukauskas and Schneider (2016, p. 128).

Table 4. Extent of aggregated shadow wages as a proportion of GDP; year 2015

Country	Undeclared hours worked per year	Average undeclared hourly wage	Extent of shadow market	GDP	Extent of shadow employment of GDP
	1	2	3=1x2	4	5=3/4
	Million hours	Euro	Million Euros	Million Euros	Proportion (percent)
Belarus	2,504	7.51	18,816	57,300	32.8
Estonia	289	10.37	2,993	19,963	15.0
Latvia	549	5.03	2,760	23,581	11.7
Lithuania	540	6.62	3,570	36,444	9.8
Poland	11,954	8.24	98,554	410,845	24.0
Sweden	541	13.32	7,212	430,635	1.7

Note. Undeclared hours worked per year are calculated as shadow frequency/100 x average weekly undeclared hours worked by persons who carried out shadow activities x 52 x total population aged 18–74. Figures for shadow frequency, average undeclared weekly hours, and average undeclared hourly wage are taken from the survey, while the population aged 18–74 and GDP at current prices are taken from the Eurostat Database for the year 2014.

Source: Zukauskas and Schneider, 2016.

Table 5. A comparison of the size of the shadow economy (in percent of GDP) in the Baltic countries 2009 – 2015 by Putnins and Sauka with Schneider

Year	Estonia	Latvia	Lithuania
2009	20.2	36.6	17.7
2010	19.4	38.1	18.8
2011	18.9	30.2	17.1
2012	19.2	21.1	18.2
2013	15.7	23.8	15.3
2014	13.2	23.5	12.5
2015	14.9	21.3	15.0
Average 2009–2015	17.4	27.8	16.4

Source: Putnins and Sauka (2015, Table 1, p. 12).

Table 6. Comparison of the shadow economy estimates of statistical offices and from the currency demand models of Dybka et al. (2017)

Country	Ref. Year	Size of the shadow economy (percent of official GDP)					
		Statistical offices	FGLS	FGLS44	FGLS44-AR	MIMIC-M.	MIMIC-Adj.
Bulgaria	2014	9.90	14.40	15.40	9.50	21.60	14.04
Denmark	2012	1.50	7.50	5.60	3.90	15.48	10.06
Israel	2014	5.20	8.90	9.00	6.00	19.39	12.60
Macedonia	2012	19.20	13.70	16.00	8.70	-	-
Moldova	2015	23.70	9.90	11.50	7.30	39.68	25.79
Mongolia	2015	15.90	NA	12.60	7.80	13.20	8.58
Norway	2009	1.00	5.20	4.10	3.20	17.37	11.29
Poland	2014	13.30	9.80	9.90	6.40	18.09	11.76
Switzerland	2012	1.30	4.00	4.60	3.40	6.66	4.33
Czech Rep.	2015	10.10	8.40	8.00	5.50	10.47	6.81
Hungary	2009	10.90	11.40	10.90	7.00	23.18	15.07
Sweden	2009	3.00	7.10	5.30	3.70	15.71	10.21
UK	2009	2.30	5.60	5.60	3.90	11.00	7.15
Croatia	2015	6.90	13.30	13.70	8.20	22.96	14.92

Source: Goymai and van de Ven (2014) for the data of statistical offices; Dybka et al. (2017, p.22, Table 7) for FGLS, FGLS44 and FGLS44-AR; and our own estimations (macro and adjusted).

Table 7. Decomposition of shadow economy activities in Estonia and Germany

No.	Kinds of shadow economy activities (rough estimates!)	Estonia		Germany	
		Size in percent of official GDP average 2009–2015	Proportion of total shadow economy (percent)	Size in percent of official GDP average 2009–2015	Proportion of total shadow economy (percent)
1	Total shadow economy (estimated by the MIMIC and calibrated by the currency demand procedures)	24.94	100	9.37	100
2	Legally bought material for shadow economy and DIY activities	5.24	21	1.79	19.1
3	Illegal activities (smuggling etc.)	1.75	7	0.69	7.4
4	Do-it-yourself activities and neighbors' help ¹⁾	1.75	7	0.86	9.2
5	Sum (2), (3) and (4)	8.73	35	3.35	35.7
6	“Corrected” shadow economy, but legal activities (position (1) minus position (5))	16.21	65	6.02	64.2
	¹⁾ Without legally bought material which is included in (2)				

Source: Own calculations based on the work of Enste and Schneider (2006) and Buehn and Schneider (2013), p.12.

Table 8. MIMIC Model Estimation Results: 1991-2015, All Countries

	1	2	3	4	5	6
Causes						
Trade Openess	-0.086***	-0.085***	-0.137***	-0.086***	-0.086***	-0.113***
GDP per capita	-0.332***	-0.335***	-0.37***	-0.298***	-0.302***	-0.334***
Unemployment Rate	0.051**	0.054***	0.069***	0.053**	0.057***	0.069***
Size of Government	0.102***	0.102***	0.111***			
Fiscal Freedom				-0.131***	-0.134***	-0.147***
Rule of Law	-0.049***			-0.06***		
Control of Corruption		-0.042***			-0.046**	
Government Stability			-0.054***			-0.015
Indicators						
Currency	1	1	1	1	1	1
Labor Force Participation Rate	-0.521***	-0.532***	-0.31***	-0.452***	-0.468***	-0.249***
Growth of GDP per capita	-0.208**	-0.245***	-0.386***	-0.113	-0.144*	-0.157***
Statistical Tests						
RMSEA	0.073	0.073	0.067	0.078	0.078	0.055
Chi-square	513.407	506.43	649.062	508.189	500.667	535.332
Observations	1897	1892	2350	1758	1757	1998
Countries	151	151	122	144	144	120

Source: Own calculations.

Note: *** p<0.01, ** p<0.05, * p<0.1

Table 9. MIMIC Model Estimation Results: 1991-2015, Developing Countries

	1	2	3	4	5	6
Causes						
Trade Openess	-0.114***	-0.111***	-0.134***	-0.117***	-0.116***	-0.131***
GDP per capita	-0.282***	-0.287***	-0.337***	-0.244***	-0.245***	-0.291***
Unemployment Rate	0.062***	0.059***	0.074***	0.085***	0.085***	0.084***
Size of Government	0.111***	0.112***	0.107***			
Fiscal Freedom				-0.12***	-0.123***	-0.121***
Rule of Law	-0.026			-0.046**		
Control of Corruption		-0.029			-0.039*	
Government Stability			-0.059***			-0.015
Indicators						
Currency	1	1	1	1	1	1
Labor Force Participation Rate	-0.499***	-0.511***	-0.464***	-0.421***	-0.441***	-0.446***
Growth of GDP per capita	-0.442***	-0.434***	-0.545***	-0.113	-0.462***	-0.433***
Statistical Tests						
RMSEA	0.084	0.087	0.068	0.087	0.086	0.062
Chi-square	309.936	306.792	471.032	302.157	297.42	387.446
Observations	1309	1304	1687	1206	1205	1406
Countries	105	105	84	98	98	82

Source: Own calculations.

Note: *** p<0.01, ** p<0.05, * p<0.1

Table 10. MIMIC Model Estimation Results: 1991-2015, Advanced Countries

	1	2	3	4	5	6
Causes						
Trade Openess	0.022	0.031	-0.16139***	0.013	0.025	-0.084
GDP per capita	-0.6***	-0.641***	-0.559***	-0.494***	-0.534***	-0.474***
Unemployment Rate	0.099**	0.089*	0.104**	0.056	0.043	0.049
Size of Government	-0.151***	-0.158***	-0.122**			
Fiscal Freedom				-0.138***	-0.166***	-0.168***
Rule of Law	-0.026			-0.084*		
Control of Corruption		-0.0972094**			-0.126***	
Government Stability			-0.0182766			-0.015
Indicators						
Currency	1	1	1	1	1	1
Labor Force Participation Rate	-0.618***	-0.606***	-0.319***	-0.582***	-0.571***	-0.259***
Growth of GDP per capita	0.279*	0.252*	0.104	-0.113	0.114	0.189*
Statistical Tests						
RMSEA	0.103	0.102	0.117	0.079	0.081	0.083
Chi-square	159.688	164.678	197.819	144.259	152.109	147.31
Observations	274	274	416	265	265	359
Countries	26	26	25	25	25	22

Source: Own calculations.

Note: *** p<0.01, ** p<0.05, * p<0.1

Table 11. MIMIC Model Estimation Results (night lights instead of GDP): All Countries

	1	2	3	4	5	6
Causes						
Trade Openess	-0.172***	-0.167***	-0.106***	-0.178***	-0.175***	-0.161***
Unemployment Rate	0.062**	0.061**	0.008	0.067**	0.068**	0.056**
Size of Government	0.106***	0.101***	0.036*			
Fiscal Freedom				-0.15***	-0.153***	-0.162***
Rule of Law	-0.065**			-0.068**		
Control of Corruption		-0.026			-0.035	
Government Stability			-0.183***			-0.132***
Indicators						
Currency	1	1	1	1	1	1
Labor Force Participation Rate	-0.457***	-0.503***	-0.478***	-0.226*	-0.244*	-0.23**
Lights (GDP)	-0.346***	-0.372***	-1.838***	-0.275***	-0.289***	-0.661***
Statistical Tests						
RMSEA	0.023	0.027	0.079	0.052	0.053	0.082
Chi-square	125.015	116.891	548.593	158.781	151.93	307.091
Observations	1341	1336	1767	1211	1210	1498
Countries	148	148	120	139	139	116

Source: Own calculations.

Note: *** p<0.01, ** p<0.05, * p<0.1

Table 12. MIMIC Model Estimation Results (night lights instead of GDP): Developing Countries

	1	2	3	4	5	6
Causes						
Trade Openess	-0.159***	-0.155***	-0.076***	-0.139***	-0.136***	-0.08***
Unemployment Rate	0.029	0.029	-0.007	0.047	0.047	0.006
Size of Government	0.094**	0.092**	0.026*			
Fiscal Freedom				-0.129***	-0.128***	-0.104***
Rule of Law	-0.021			-0.009		
Control of Corruption		-0.004			-0.009	
Government Stability			-0.192***			-0.164***
Indicators						
Currency	1	1	1	1	1	1
Labor Force Participation Rate	-0.419**	-0.427**	-0.518***	-0.311*	-0.313*	-0.323**
Lights (GDP)	-0.636***	-0.657***	-2.389***	-0.694***	-0.704***	-1.426***
Statistical Tests						
RMSEA	0.01	0.014	0.072	0.04	0.04	0.073
Chi-square	89.64	87.74	527	113.669	110.397	290.032
Observations	957	952	1304	850	849	1088
Countries	103	103	83	96	96	80

Source: Own calculations.

Note: *** p<0.01, ** p<0.05, * p<0.1

Table 13. MIMIC Model Estimation Results (night lights instead of GDP): Advanced Countries

	1	2	3	4	5	6
Causes						
Trade Openess	0.132	0.204**	0.229***	0.075	0.108	0.174**
Unemployment Rate	-0.352***	-0.36***	-0.41***	-0.3***	-0.295***	-0.34***
Size of Government	-0.098	-0.158*	-0.165**			
Fiscal Freedom				-0.247***	-0.293***	-0.23***
Rule of Law	-0.24***			-0.186**		
Control of Corruption		-0.117*			-0.092	
Government Stability			-0.064			0.024
Indicators						
Currency	1	1	1	1	1	1
Labor Force Participation Rate	-0.329*	-0.363*	-0.462***	-0.308*	-0.329**	-0.316**
Lights (GDP)	0.467**	0.366*	-0.0661817	0.553***	0.51***	0.381**
Statistical Tests						
RMSEA	0.068	0.067	0.122	0.052	0.056	0.086
Chi-square	76.456	64.922	136.547	89.16	82.642	113.695
Observations	189	189	302	189	189	263
Countries	24	24	24	24	24	24

Source: Own calculations.

Note: *** p<0.01, ** p<0.05, * p<0.1

Table 14. Size of the shadow economy using the Predictive Mean Matching Method

Less than 20 percent				Between 20 percent and 30 percent				More than 30 percent			
Rank	Country	Size of the Shadow economy in percent of GDP		Rank	Country	Size of the Shadow economy in percent of GDP		Rank	Country	Size of the Shadow economy in percent of GDP	
		PMM ₁₎	MIMI C ²⁾			PMM ¹⁾	MIMI C ²⁾			PMM ¹⁾	MIMIC ₂₎
1	Norway	1	17.1	32	Kazakhstan	20	38.9	60	Lebanon	30	31.6
2	Canada	2.2	13.9	33	Jamaica	20.4	34.1	61	Bangladesh	30.3	33.6
3	Netherlands	2.3	10.8	34	Mozambique	20.7	37.2	62	Iran, Islamic Rep.	31.1	17.9
4	United Kingdom	2.3	11.1	35	Colombia	21.3	33.3	63	Côte d'Ivoire	31.1	43.4
5	Sweden	3	16.3	36	Kenya	22.1	33.2	64	Zambia	32.7	45.3
6	Belgium	4.6	20.6	37	South Africa	22.7	25.9	65	Burkina Faso	33.1	38.4
7	Israel	6.6	22	38	Bulgaria	23.3	29.2	66	Cabo Verde	33.2	35.8
8	France	6.7	14.1	39	Brazil	24.2	37.6	67	Tanzania	33.4	52.2
9	Austria	7.5	8.9	40	Mexico	24.8	31.7	68	Belarus	33.7	44.5
10	Czech Republic	8.1	14.8	41	Azerbaijan	24.8	52.2	69	Angola	33.9	44
11	Qatar	8.1	15.9	42	Oman	25.1	19.9	70	Guatemala	34	54.7
12	Denmark	8.6	18.6	43	Ecuador	25.2	33.6	71	Gabon	36.3	52.4
13	Japan	8.9	10.4	44	Turkey	25.4	31.4	72	Argentina	36.3	24.1
14	Chile	9.4	16.7	45	Romania	26	30.1	73	Chad	37	40.1
15	Iceland	9.5	14.2	46	Uganda	26.3	38.7	74	Pakistan	37.3	33.1
16	Lithuania	9.8	25.2	47	Indonesia	26.6	24.1	75	Sierra Leone	37.4	41.5
17	Slovenia	10.2	24.1	48	Bosnia and Herzegovina	27.1	34.2	76	Tunisia	38	35.3
18	Hungary	10.9	25.2	49	Kyrgyz Republic	27.5	37.9	77	Cameroon	38.4	32.5
19	Estonia	12.1	28.8	50	Gambia, The	27.5	46.9	78	Swaziland	38.5	40

Table 14. Size of the shadow economy using the Predictive Mean Matching Method

Less than 20 percent				Between 20 percent and 30 percent				More than 30 percent			
Rank	Country	Size of the Shadow economy in percent of GDP		Rank	Country	Size of the Shadow economy in percent of GDP		Rank	Country	Size of the Shadow economy in percent of GDP	
		PMM ₁₎	MIMI C ²⁾			PMM ¹⁾	MIMI C ²⁾			PMM ¹⁾	MIMIC ₂₎
20	Uruguay	12.3	42.9	51	Bhutan	27.7	26.9	79	Congo, Rep.	39.9	45.1
21	Ukraine	12.9	44.8	52	Algeria	27.9	30.9	80	Togo	40.9	37.3
22	Australia	13.1	12.1	53	Ghana	28.1	42.9	81	Guinea	40.9	39.9
23	Poland	15.4	25.1	54	Albania	28.5	32.7	82	Nigeria	41.4	56.7
24	Slovak Republic	15.6	15.3	55	Kuwait	29.3	19.3	83	Senegal	41.6	43.3
25	Egypt, Arab Rep.	16.9	34.2	56	Cambodia	29.7	46	84	Congo, Dem. Rep.	42	46.4
26	Tajikistan	18.3	43	57	Nepal	29.8	37.5	85	Zimbabwe	44	60.6
27	Croatia	18.7	28.8	58	Mongolia	29.9	17.3	86	India	46.3	23.9
28	Peru	19	52.4	59	Moldova	30	43.4	87	Comoros	47.6	39.1
29	Armenia	19.5	42.6					88	Central African Republic	49.6	41.9
30	Namibia	19.6	28.1					89	Benin	50	53.7
31	Botswana	19.9	30.3					90	Niger	51.5	39.7
								91	Burundi	64.8	36.7

1) Average over 1991-2015

2) Average over 1991-2015; results from this paper's MIMIC estimations.

Source: Own calculations.

Table 15. MIMIC Model Estimation Results (Excluding GDP and GDP per capita), All Countries

	1	2	3	4	5	6
Causes						
Trade Openess	-0.138***	-0.133***	-0.237***	-0.133***	-0.133***	-0.19***
Unemployment Rate	0.113***	0.115***	0.12***	0.099***	0.104***	0.125***
Size of Government	0.073***	0.067**	0.086***			
Fiscal Freedom				-0.199***	-0.209***	-0.228***
Rule of Law	-0.095***			-0.095***		
Control of Corruption		-0.041*			-0.048*	
Government Stability			-0.024			0.028
Indicators						
Currency	1	1	1	1	1	1
Labor Force Participation Rate	-0.642***	-0.746***	-0.48***	-0.391***	-0.416***	-0.323***
Statistical Tests						
RMSEA	0.032	0.019	0.018	0.062	0.061	0.047
Chi-square	183.492	153.806	250.361	263.345	243.527	331.241
Observations	1901	1896	2329	1761	1760	1963
Countries	151	151	122	144	144	120

Source: Own calculations.

Note: *** p<0.01, ** p<0.05, * p<0.1

Table 16. MIMIC Model Estimation Results: (Excluding GDP and GDP per capita), Developing Countries

	1	2	3	4	5	6
Causes						
Trade Openess	-0.125***	-0.123***	-0.189***	-0.117***	-0.116***	-0.17***
Unemployment Rate	0.099***	0.098***	0.092***	0.098***	0.099***	0.108***
Size of Government	0.094***	0.091***	0.082**			
Fiscal Freedom				-0.174***	-0.173***	-0.196***
Rule of Law	-0.028			-0.041		
Control of Corruption		0.001			-0.012	
Government Stability			-0.068**			0.0026759
Indicators						
Currency	1	1	1	1	1	1
Labor Force Participation Rate	-0.587***	-0.61***	-0.568***	-0.41***	-0.44***	-0.393***
Statistical Tests						
RMSEA	0.018	0.009	0.054	0.039	0.032	0.054
Chi-square	87.747	81.821	155.224	121.97	115.142	180.803
Observations	1309	1304	1670	1206	1205	1384
Countries	105	105	84	98	98	82

Source: Own calculations.

Note: *** p<0.01, ** p<0.05, * p<0.1

**Table 17. MIMIC Model Estimation Results: (Excluding GDP and GDP per capita),
Advanced Countries**

	1	2	3	4	5	6
Causes						
Trade Openess	-0.211***	-0.231***	-0.401***	-0.151**	-0.153**	-0.251***
Unemployment Rate	0.212***	0.222***	0.192***	0.145**	0.141**	0.174***
Size of Government	-0.105	-0.132*	-0.12*			
Fiscal Freedom				-0.231***	-0.287***	-0.258***
Rule of Law	-0.18***			-0.161**		
Control of Corruption		-0.145**			-0.169***	
Government Stability			-0.008			0.036
Indicators						
Currency	1	1	1	1	1	1
Labor Force Participation Rate	-0.63***	-0.683***	-0.558***	-0.596***	-0.632***	-0.528***
Statistical Tests						
RMSEA	0.07	0.072	0.095	0.064	0.067	0.116
Chi-square	78.546	75.321	150.647	93.674	98.075	134.892
Observations	274	274	408	265	265	351
Countries	26	26	25	25	25	25

Source: Own calculations.

Note: *** p<0.01, ** p<0.05, * p<0.1

Table 18. Summary statistics of the shadow economy of 158 countries over the period 1991 to 2015

Country	ISO	Average	Stand. Dev.	Median	Min.	Max.
Albania	ALB	32.72	5.64	32.64	25.41	40.07
Algeria	DZA	30.86	5.47	29.62	23.98	38.88
Angola	AGO	43.96	6.51	46.30	34.53	52.47
Argentina	ARG	24.14	1.91	24.41	20.80	27.18
Armenia	ARM	42.59	4.68	43.57	34.56	47.61
Australia	AUS	12.06	2.51	12.25	8.10	15.18
Austria	AUT	8.93	0.60	8.86	7.69	9.85
Azerbaijan	AZE	52.19	7.29	53.67	42.15	64.66
Bahamas, The	BHS	33.52	4.95	35.56	26.20	39.51
Bahrain	BHR	19.34	1.33	19.21	16.63	21.11
Bangladesh	BGD	33.59	3.17	35.12	27.42	36.71
Belarus	BLR	44.52	6.92	47.83	32.29	53.57
Belgium	BEL	20.57	1.95	20.93	17.71	23.49
Belize	BLZ	46.83	4.17	45.38	40.67	53.69
Benin	BEN	53.66	3.37	53.52	46.33	56.88
Bhutan	BTN	26.93	3.19	27.82	20.28	31.00
Bolivia	BOL	62.28	8.27	66.74	45.98	70.57
Bosnia and Herzegovina	BIH	34.21	3.46	33.18	29.88	44.45
Botswana	BWA	30.30	4.39	31.43	22.10	35.89
Brazil	BRA	37.63	2.75	38.47	32.56	41.69
Brunei Darussalam	BRN	29.76	1.14	29.84	26.98	31.83
Bulgaria	BGR	29.17	5.37	30.72	20.83	35.30
Burkina Faso	BFA	38.39	4.78	38.81	29.63	44.75
Burundi	BDI	36.74	3.40	37.99	26.87	40.02
Cabo Verde	CPV	35.84	5.70	36.02	29.16	43.88
Cambodia	KHM	46.04	6.63	45.40	33.85	56.69
Cameroon	CMR	32.45	2.25	32.51	28.14	35.60
Canada	CAN	13.92	2.80	13.57	9.42	17.61
Central African Republic	CAF	41.90	4.61	41.43	36.94	55.96
Chad	TCD	40.09	5.92	40.32	28.76	46.60
Chile	CHL	16.69	2.60	17.80	12.64	19.74
China	CHN	14.67	1.88	15.12	11.74	16.52
Colombia	COL	33.31	4.17	34.95	25.25	39.10
Comoros	COM	39.11	1.89	39.11	35.79	43.22

Table 18. Summary statistics of the shadow economy of 158 countries over the period 1991 to 2015

Country	ISO	Average	Stand. Dev.	Median	Min.	Max.
Congo, Dem. Rep.	COD	46.42	1.73	46.53	41.07	48.00
Congo, Rep.	COG	45.10	6.14	47.33	33.18	52.86
Costa Rica	CRI	24.46	2.01	24.11	19.24	26.95
Côte d'Ivoire	CIV	43.43	2.39	43.63	38.88	46.49
Croatia	HRV	28.81	4.82	27.13	21.56	37.33
Cyprus	CYP	31.30	2.35	30.77	27.91	34.66
Czech Republic	CZE	14.83	2.63	15.80	10.47	18.22
Denmark	DNK	15.19	1.36	15.17	12.51	16.69
Dominican Republic	DOM	32.37	2.19	32.34	27.60	34.73
Ecuador	ECU	33.56	2.75	34.40	28.45	37.02
Egypt, Arab Rep.	EGY	34.24	2.12	35.10	28.88	36.85
El Salvador	SLV	45.59	3.84	44.69	40.05	50.78
Equatorial Guinea	GNQ	31.84	3.26	31.38	27.16	37.27
Eritrea	ERI	39.29	4.07	38.65	31.42	46.36
Estonia	EST	23.80	4.23	24.60	27.52	30.51
Ethiopia	ETH	34.31	4.89	36.39	24.47	40.30
Fiji	FJI	32.47	3.36	32.33	25.37	35.77
Finland	FIN	13.49	1.84	13.00	10.95	16.32
France	FRA	14.08	1.60	13.96	11.61	16.60
Gabon	GAB	52.43	5.94	53.48	41.60	63.47
Gambia, The	GMB	46.88	5.36	47.90	35.17	56.73
Georgia	GEO	64.87	4.97	65.31	53.07	71.95
Germany	DEU	11.97	2.07	12.80	7.75	14.62
Ghana	GHA	42.91	2.56	42.62	38.50	46.97
Greece	GRC	27.06	1.66	27.08	23.20	29.76
Guatemala	GTM	54.74	4.76	53.47	46.88	60.86
Guinea	GIN	39.95	1.74	39.70	37.41	43.89
Guinea-Bissau	GNB	36.42	5.11	38.61	21.98	42.76
Guyana	GUY	31.78	3.27	32.07	26.03	36.27
Haiti	HTI	53.28	3.96	54.15	42.14	59.12
Honduras	HND	46.31	4.19	47.36	37.68	50.45
Hong Kong SAR, China	HKG	14.69	1.73	15.36	11.89	16.99
Hungary	HUN	25.23	4.11	24.14	20.49	32.03
Iceland	ISL	14.20	1.05	14.16	12.45	15.73
India	IND	23.91	3.47	24.84	17.89	27.83

Table 18. Summary statistics of the shadow economy of 158 countries over the period 1991 to 2015

Country	ISO	Average	Stand. Dev.	Median	Min.	Max.
Indonesia	IDN	24.11	1.56	24.29	21.05	25.90
Iran, Islamic Rep.	IRN	17.88	2.16	18.38	14.52	21.06
Ireland	IRL	13.89	2.48	13.36	9.58	17.67
Israel	ISR	22.01	1.66	22.26	19.18	23.42
Italy	ITA	24.95	1.79	24.49	22.43	27.31
Jamaica	JAM	33.02	3.30	33.89	24.97	36.92
Japan	JPN	10.41	0.86	10.61	8.19	11.79
Jordan	JOR	17.38	2.61	18.26	13.44	20.58
Kazakhstan	KAZ	38.88	5.64	39.58	30.06	47.35
Kenya	KEN	33.18	2.01	33.43	28.68	36.24
Korea, Rep.	KOR	25.70	3.08	26.76	19.83	30.04
Kuwait	KWT	19.31	1.72	19.75	15.71	22.07
Kyrgyz Republic	KGZ	37.92	4.46	38.04	29.95	45.93
Lao PDR	LAO	30.25	3.71	30.60	24.10	35.02
Latvia	LVA	22.23	4.10	22.05	15.92	28.65
Lebanon	LBN	31.58	3.47	33.03	24.63	34.79
Lesotho	LSO	31.28	2.83	31.30	24.56	35.17
Liberia	LBR	43.24	1.61	43.02	39.95	46.67
Libya	LBY	33.62	3.84	34.94	25.86	38.76
Lithuania	LTU	25.15	4.75	24.29	17.62	32.49
Luxembourg	LUX	10.67	0.60	10.67	9.37	11.97
Madagascar	MDG	42.56	2.32	41.67	38.70	47.41
Malawi	MWI	38.51	2.29	38.76	33.56	43.66
Malaysia	MYS	31.49	2.79	31.10	26.07	35.04
Maldives	MDV	27.44	2.70	27.82	20.65	31.50
Mali	MLI	38.70	4.81	39.63	29.45	44.71
Malta	MLT	29.80	1.74	30.55	26.96	33.12
Mauritania	MRT	32.29	4.70	33.39	24.38	38.57
Mauritius	MUS	22.57	2.31	22.66	19.23	26.19
Mexico	MEX	31.74	2.63	30.99	28.07	38.25
Moldova	MDA	43.43	3.00	43.84	37.35	49.08
Mongolia	MNG	17.28	2.46	17.68	12.02	21.12
Morocco	MAR	34.01	3.93	34.72	27.13	40.42
Mozambique	MOZ	37.20	4.98	36.57	30.13	46.87
Myanmar	MM R	51.39	6.75	49.30	39.86	60.53
Namibia	NAM	28.07	3.77	28.82	21.78	32.09

Table 18. Summary statistics of the shadow economy of 158 countries over the period 1991 to 2015

Country	ISO	Average	Stand. Dev.	Median	Min.	Max.
Nepal	NPL	37.50	2.66	37.35	30.22	40.59
Netherlands	NLD	10.77	1.78	10.94	7.83	13.26
New Zealand	NZL	11.70	1.47	11.53	8.97	12.93
Nicaragua	NIC	42.63	1.89	42.99	38.47	45.20
Niger	NER	39.70	2.61	40.25	34.12	42.76
Nigeria	NGA	56.67	4.10	56.95	50.64	66.61
Norway	NOR	14.07	1.73	13.77	10.47	16.35
Oman	OMN	19.93	2.07	19.90	15.52	23.91
Pakistan	PAK	33.10	2.17	33.58	30.28	36.80
Papua New Guinea	PNG	34.01	4.12	35.14	23.25	37.81
Paraguay	PRY	34.47	2.94	34.54	29.42	40.32
Peru	PER	52.40	7.62	56.43	39.53	59.94
Philippines	PHL	39.31	5.35	41.39	28.04	45.40
Poland	POL	25.10	4.56	26.14	16.67	30.21
Portugal	PRT	21.88	1.51	22.02	17.82	24.18
Qatar	QAT	15.93	2.01	16.65	12.15	19.00
Romania	ROM	30.14	4.10	31.12	22.73	34.99
Russian Federation	RUS	38.42	5.46	37.68	31.04	48.73
Rwanda	RWA	36.25	4.90	38.69	26.68	41.65
Saudi Arabia	SAU	16.65	1.97	17.86	13.34	19.15
Senegal	SEN	43.35	6.29	41.48	33.68	52.60
Sierra Leone	SLE	41.50	6.28	43.17	25.69	50.14
Singapore	SGP	11.90	1.36	12.17	9.20	13.76
Slovak Republic	SVK	15.33	2.79	16.57	11.18	18.45
Slovenia	SVN	24.09	3.10	24.40	17.58	28.17
Solomon Islands	SLB	30.41	4.00	30.15	24.90	37.42
South Africa	ZAF	25.94	3.52	27.64	20.35	29.84
Spain	ESP	24.52	1.98	24.04	21.53	27.98
Sri Lanka	LKA	45.58	4.67	46.30	35.49	50.22
Suriname	SUR	32.22	6.26	35.31	22.46	39.80
Swaziland	SWZ	40.04	2.63	39.55	34.73	43.70
Sweden	SWE	13.28	2.15	12.60	10.12	16.66
Switzerland	CHE	7.24	0.61	7.27	6.16	8.23
Syrian Arab Republic	SYR	19.58	2.00	19.21	15.65	22.79

Table 18. Summary statistics of the shadow economy of 158 countries over the period 1991 to 2015

Country	ISO	Average	Stand. Dev.	Median	Min.	Max.
Taiwan	TWN	32.50	3.33	33.49	26.88	35.89
Tajikistan	TJK	42.99	3.26	43.37	35.42	47.23
Tanzania	TZA	52.22	6.18	54.32	38.91	58.43
Thailand	THA	50.63	3.30	50.51	43.12	56.64
Togo	TGO	37.31	3.72	37.27	31.49	42.68
Trinidad and Tobago	TTO	34.37	5.83	33.09	26.15	43.02
Tunisia	TUN	35.31	4.28	36.35	27.16	40.20
Turkey	TUR	31.38	2.62	32.03	27.33	34.51
Uganda	UGA	38.74	3.93	40.72	31.88	43.25
Ukraine	UKR	44.80	5.59	42.90	36.65	57.00
United Arab Emirates	ARE	26.54	1.92	27.36	22.02	28.81
United Kingdom	GBR	11.08	1.35	11.00	8.32	12.80
United States	USA	8.34	0.82	8.23	7.00	9.23
Uruguay	URY	37.91	9.65	42.20	20.38	48.69
Venezuela, RB	VEN	33.81	2.73	32.65	29.64	40.03
Vietnam	VNM	18.70	2.27	18.92	14.78	21.75
Yemen, Rep.	YEM	28.34	3.89	28.35	22.94	34.35
Zambia	ZMB	45.32	7.37	48.52	30.72	52.41
Zimbabwe	ZWE	60.64	4.21	60.58	52.09	69.08

Source: Own calculations.

Table 19. Comparison of the MIMIC (macro and adjusted) results with National Accounts Method; 16 OECD Countries, year 2011/2012 (av.)

No.	Country	NOE ¹ (1)	MIMIC		Difference (MIMIC-NOE)	
		percent of GDP	Macro (2)	Adj. (3)	(2)-(1)	(3)-(1)
2	<i>Norway</i>	1	16.48	10.7	15.48	9.7
5	<i>Mexico</i>	15.9	29.89	19.4	13.99	3.5
4	<i>Belgium</i>	4.6	18.00	11.7	13.40	7.1
3	<i>Israel</i>	6.6	19.63	12.8	13.03	6.2
1	Slovenia	10.2	22.53	14.6	12.33	4.4
7	Sweden	3	14.49	9.4	11.49	6.4
6	Hungary	10.9	22.07	14.3	11.17	3.4
8	Canada	2.2	10.87	7.1	8.67	4.9
11	UK	2.3	9.99	6.5	7.69	4.2
14	Italy	17.5	25.0	16.3	7.54	-1.2
12	Netherlands	2.3	8.10	5.3	5.80	3.0
13	France	6.7	11.95	7.8	5.25	1.1
9	Poland	15.4	19.19	12.5	3.79	-2.9
10	<i>Czech Rep.</i>	8.1	11.59	7.5	3.49	-0.6
16	<i>Austria</i>	7.5	8.4	5.5	0.94	-2.0
15	<i>Slovak Rep.</i>	15.6	11.9	7.7	-3.72	-7.9

Source: Gyomai and van de Ven (2014, p. 6) and own calculations.

Table 20. Comparison between National Accounts Statistics and MIMIC results for eight Sub-Saharan African countries over 2010–2014

Country	Methods (averages over 2010–2014)			Differences	
	(1) National Accounts Statistics ¹⁾	(2) MIMIC	(3) MIMIC Adjusted	(2)–(1)	(3)–(1)
Mali	55	32.3	21.0	-22.7	-34.0
Guinea-Bissau	53.4	37.6	24.4	-15.8	-29.0
Burkina Faso	43.1	31.6	20.5	-11.5	-22.6
Senegal	47.5	37.9	24.6	-9.6	-22.9
Guinea	48.1	39.5	25.7	-8.6	-22.4
Togo	40.1	34.8	22.6	-5.3	-17.5
Benin	55.6	52.1	33.9	-3.5	-21.7
Côte d’Ivoire	34	41.9	27.2	7.9	-6.8
Correlation: 0.73 Spearman’s Rank Correlation: 0.857***					

1) Mostly the Discrepancy method is used.

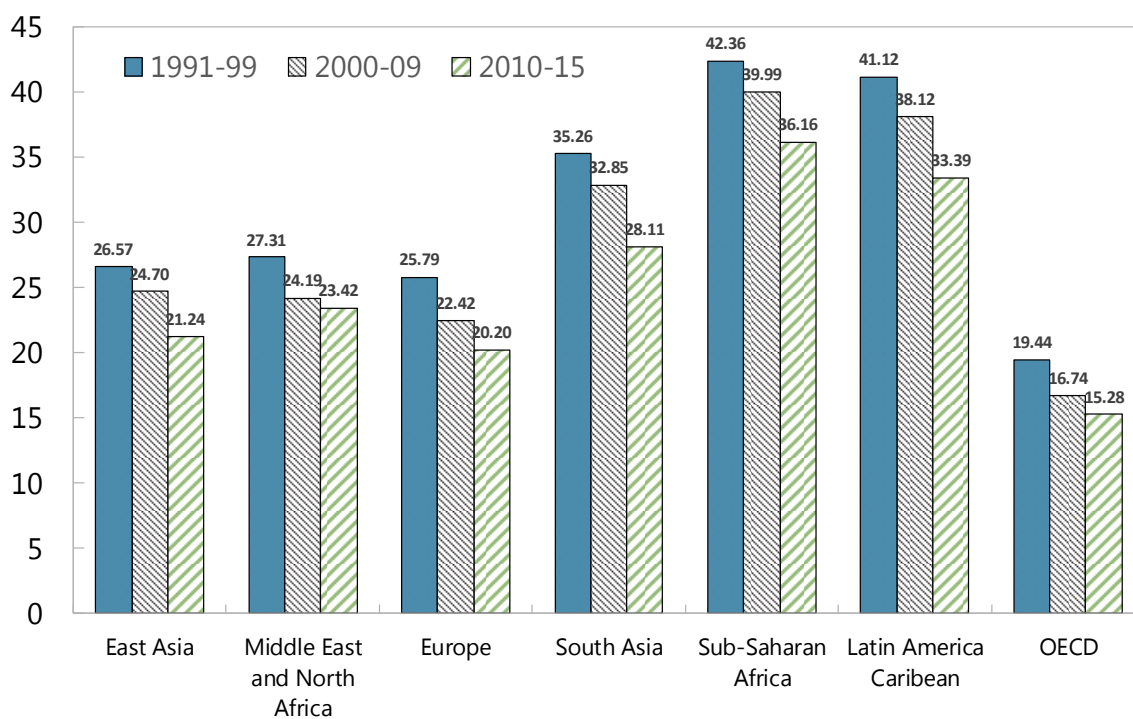
Source: Medina et al. (2017), p. 28 and own calculations.

Table 21. Alternative estimates of the shadow economy as percent of GDP for Czech and Slovak Republics

Estimation method	Source	Year	Czech Rep.	Slovak Rep.
<i>Currency Demand Deposit Ratio (panel GMM difference)</i>	<i>Alm and Embaye (2013)</i>	<i>2006</i>	<i>23.2</i>	<i>25.1</i>
<i>Consumption-Income Gap Method (switching reg.)</i>	<i>Lichard et al. (2014)</i>	<i>2008</i>	<i>17.6</i>	<i>22.9</i>
<i>Deterministic Dynamic General Equilibrium Model</i>	<i>Elgin and Öztunali (2012)</i>	<i>2008</i>	<i>16.8</i>	<i>16.6</i>
MIMIC	Buehn and Schneider (2013)	2008	15.2	16.0
Hybrid-Model of CD-method	Dybka et al. (2017)	2008	12.2	-
Statistical Office: Discrepancy Method	Calculated from Quintano and Mazzocchi (2010)	2008	5.4	13.6
Currency Deposit Ratio	Embaye (2007)	2000–2005	8.0	12.6
Structural Model (calibrated to M1)	Ruge (2010)	2001	8.2	8.1
Food Engel Curves (self-employed excl.)	Lichard (2012)	2008	4.0	6.8
Structural Model (calibrated to M2)	Ruge (2010)	2001	3.3	3.3

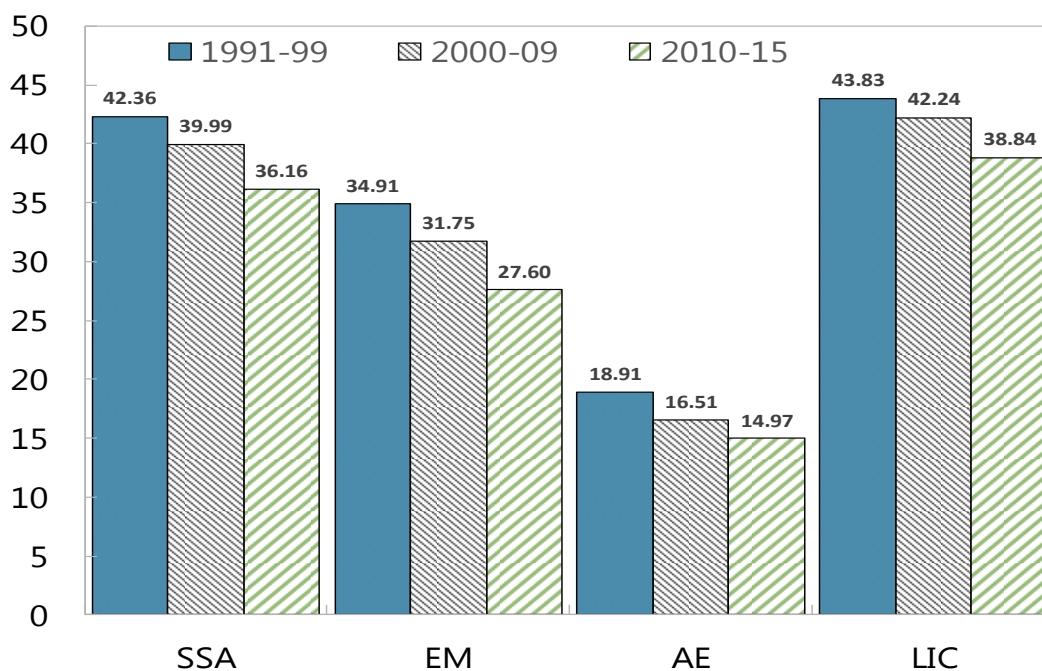
Source: Lichard et al. (2014, p. 23).

Figure 3.4 Shadow Economy by Region (average, percent of GDP)



Source: Own calculations.

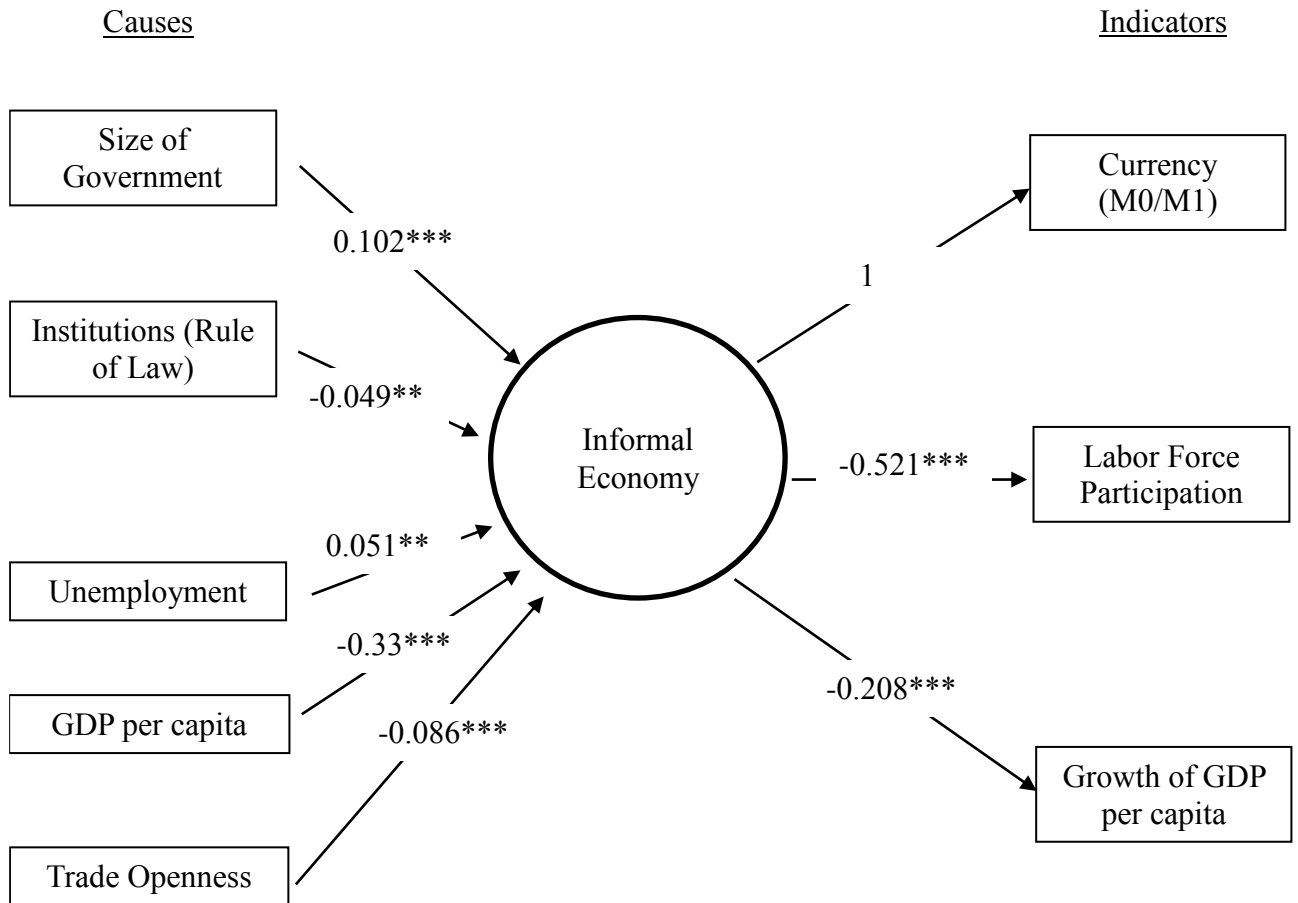
Figure 3.5 Shadow Economy by Income Level (average, percent of GDP)



Source: Own calculations.

1. APPENDIX

Figure A.1: Shadow economy Estimation: The MIMIC Model



RMSEA: 0.073

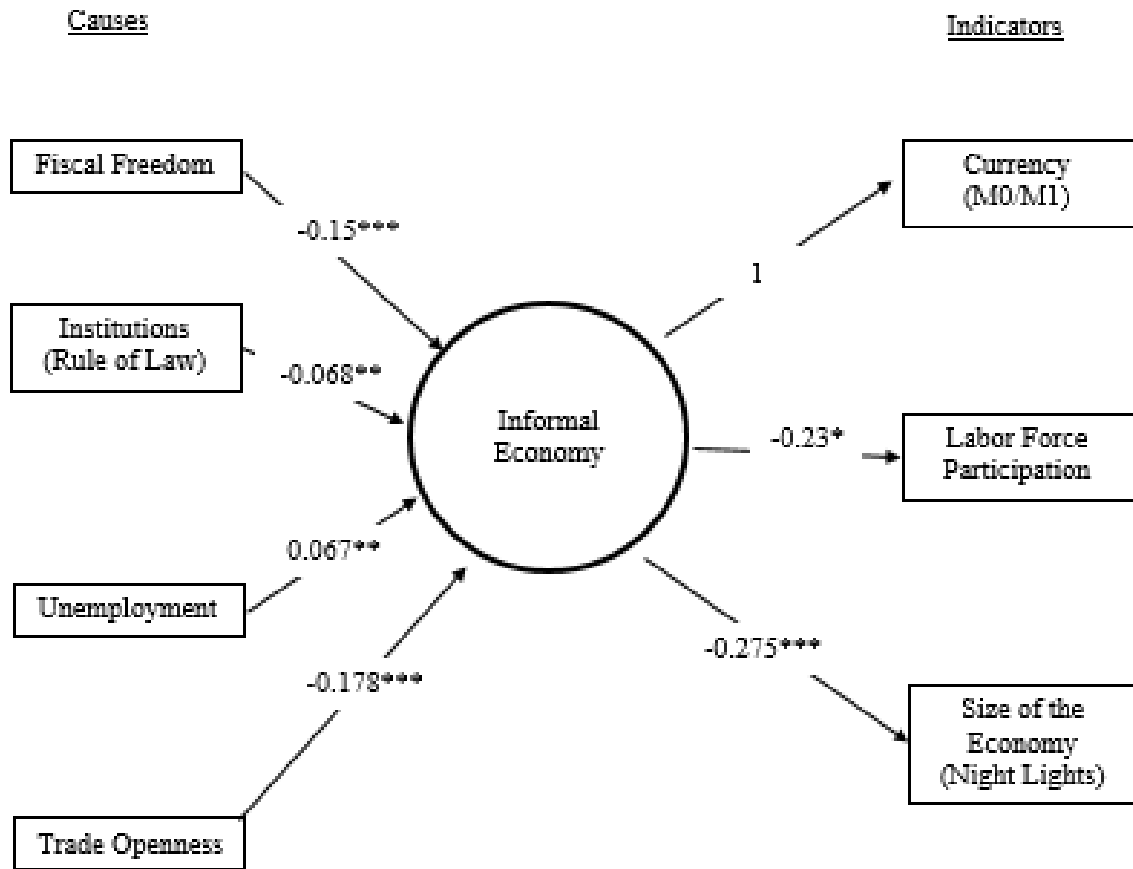
Chi-Square: 513.407

Observations: 1897

Countries: 151

Source: Own calculations.

Figure A.2: Shadow Economy Estimation: The MIMIC Model Using Night Lights



Source: Own calculations.

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part I (1991–2003)

No.	Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	Albania	43.18	40.18	39.45	40.07	39.18	37.07	37.59	38.16	36.04	35.30	36.04	33.67	32.64
2	Algeria	34.96	36.14	38.16	38.88	37.64	37.68	37.18	38.28	36.11	34.20	33.58	31.90	29.62
3	Angola	50.17	47.80	55.43	50.48	52.47	46.30	50.48	49.21	48.64	48.80	46.14	48.40	48.86
4	Argentina	25.22	24.41	26.59	26.22	27.18	25.32	25.20	24.00	25.83	25.40	26.94	26.19	25.37
5	Armenia	46.65	49.50	48.63	44.66	47.14	47.48	46.41	45.81	46.85	46.60	47.61	44.11	42.08
6	Australia	15.69	16.63	16.15	15.18	14.42	14.55	13.72	13.29	13.40	13.10	12.50	12.43	12.08
7	Austria	9.03	9.27	9.95	9.65	9.66	9.85	9.57	9.47	9.24	8.80	8.50	8.53	8.70
8	Azerbaijan	54.69	53.67	60.46	64.66	59.95	59.22	58.85	61.13	59.52	60.60	58.29	55.95	54.18
9	Bahamas, The	35.61	38.96	38.60	39.31	36.81	35.56	34.08	31.13	28.28	26.20	26.86	26.43	28.76
10	Bahrain	22.49	21.83	19.65	19.80	19.64	19.72	19.18	19.37	18.84	18.40	18.76	18.67	18.35
11	Bangladesh	36.34	36.48	37.12	36.71	35.27	35.70	35.78	35.87	35.60	35.60	34.48	35.12	36.65
12	Belarus	52.78	47.83	47.95	49.54	53.57	52.24	51.11	49.32	50.14	48.10	49.39	49.73	48.64
13	Belgium	22.10	22.07	23.31	23.49	23.19	23.41	22.19	22.92	21.63	19.90	19.78	20.93	21.65
14	Belize	50.98	51.65	51.78	52.39	53.69	53.09	52.69	52.60	49.01	43.80	44.59	45.03	42.98
15	Benin	58.78	60.80	58.66	56.88	54.86	52.65	53.47	51.49	51.24	50.20	50.34	49.72	53.24
16	Bhutan	31.24	30.66	30.20	29.64	27.82	31.00	29.94	28.75	27.98	29.40	29.21	29.28	28.18
17	Bolivia	68.09	71.34	71.08	70.39	69.40	66.78	67.31	63.69	68.67	67.10	70.57	68.82	69.01
18	Bosnia and Herzegovina	31.38	32.18	33.43	43.30	44.45	38.53	36.66	33.25	32.87	34.10	33.99	37.34	35.94
19	Botswana	33.57	35.44	36.37	35.89	35.52	35.20	32.98	34.18	32.95	33.40	33.05	32.08	31.43
20	Brazil	40.64	39.67	39.25	38.25	39.61	40.83	40.50	41.69	40.79	39.80	38.65	38.50	38.89
21	Brunei Darussalam	29.84	29.20	29.60	30.73	28.26	26.98	28.48	30.84	31.83	31.10	30.42	29.78	29.52

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part I (1991–2003)

No.	Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
22	Bulgaria	35.13	34.99	36.05	34.57	32.93	31.45	30.72	32.83	34.60	35.30	34.91	33.45	32.97
23	Burkina Faso	43.42	44.06	44.89	44.75	43.59	43.91	41.76	41.26	38.81	41.40	41.20	41.22	39.34
24	Burundi	26.87	28.78	31.52	32.17	34.62	39.84	38.61	37.99	38.88	39.50	39.36	39.05	40.02
25	Cabo Verde	44.03	44.69	47.21	43.88	43.76	39.60	41.17	38.48	38.25	36.10	35.30	36.05	37.16
26	Cambodia	44.12	45.40	54.06	56.69	54.55	55.11	53.95	53.24	51.95	50.10	49.80	49.35	49.66
27	Cameroon	35.14	35.48	37.91	34.86	33.00	35.60	34.03	33.37	33.58	32.80	33.06	32.94	31.96
28	Canada	19.31	19.52	18.92	17.61	16.59	16.59	15.15	14.65	13.79	13.40	13.52	14.15	14.25
29	Central African Republic	39.80	43.28	43.64	41.94	39.84	42.26	39.11	38.70	41.43	42.60	41.84	40.28	43.12
30	Chad	45.92	45.75	48.86	46.23	46.18	46.31	46.04	44.36	46.60	46.20	45.23	40.32	42.04
31	Chile	19.83	19.62	19.82	19.51	18.61	19.06	18.03	18.77	19.74	18.90	18.53	18.34	17.80
32	China	17.47	17.03	16.86	16.43	15.86	16.07	16.07	16.13	16.52	16.50	16.33	15.82	15.12
33	Colombia	35.69	34.53	34.95	35.41	35.24	37.30	36.19	37.46	38.98	39.10	37.26	37.97	35.87
34	Comoros	39.97	35.79	35.89	40.15	39.87	41.56	40.77	43.22	42.93	39.60	39.11	39.31	37.86
35	Congo, Dem. Rep.	48.08	49.10	49.27	46.08	45.76	46.36	47.56	47.85	46.97	48.00	47.71	47.74	46.28
36	Congo, Rep.	50.40	50.74	52.82	52.08	49.00	47.53	51.09	52.86	52.17	48.20	48.41	48.24	47.33
37	Costa Rica	28.63	26.72	26.47	26.71	26.72	26.95	26.18	23.82	23.99	23.90	25.70	25.09	24.11
38	Côte d'Ivoire	46.29	48.39	48.25	44.53	41.05	38.88	42.53	40.37	41.53	43.20	43.64	43.68	46.49
39	Croatia	30.70	32.85	34.93	35.91	37.33	35.64	32.64	34.22	34.60	32.00	30.91	29.06	27.13
40	Cyprus	36.22	34.72	35.29	34.09	27.91	28.94	28.96	30.51	30.13	28.70	28.40	29.31	31.62

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part I (1991–2003)

No.	Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
41	Czech Republic	18.42	17.77	18.18	18.22	16.81	16.05	16.70	16.31	17.15	16.80	15.80	16.75	17.08
42	Denmark	17.08	17.03	18.06	16.69	16.15	16.50	15.17	15.54	15.16	14.60	14.23	14.77	14.94
43	Dominican Republic	35.84	35.85	35.62	34.73	34.41	33.57	34.07	32.24	32.49	32.10	33.59	33.68	31.94
44	Ecuador	35.84	35.47	36.03	36.98	35.69	34.54	36.58	34.75	37.02	34.40	36.05	35.81	36.42
45	Egypt, Arab. Rep.	36.02	35.57	36.51	36.82	36.85	35.28	35.99	35.47	35.83	35.10	35.49	35.70	35.16
46	El Salvador	52.74	52.96	52.82	49.56	48.33	50.78	47.93	47.80	46.88	46.30	46.03	44.19	43.53
47	Equatorial Guinea	37.64	37.54	38.10	37.27	35.97	32.71	33.10	33.47	32.69	32.80	30.75	32.06	30.82
48	Eritrea	37.57	48.92	44.07	36.69	38.65	33.54	31.42	34.25	38.16	40.30	36.28	35.68	39.56
49	Estonia	23.54	26.04	29.13	29.79	30.51	30.22	27.01	26.79	27.59	27.70	26.16	25.39	24.77
50	Ethiopia	38.29	37.77	36.71	37.55	38.05	36.39	36.22	37.83	39.82	40.30	37.98	38.79	39.30
51	Fiji	38.88	38.44	38.40	35.64	34.81	32.50	35.63	35.77	32.90	33.60	32.84	31.17	31.74
52	Finland	16.52	17.11	17.00	16.32	15.74	15.91	14.51	13.77	13.39	12.50	12.46	13.00	12.71
53	France	14.96	15.58	16.76	16.60	16.20	16.28	16.01	15.34	14.92	13.80	13.31	14.72	14.58
54	Gabon	48.72	50.91	48.21	43.95	43.84	44.23	41.60	43.10	49.15	48.00	56.07	55.82	57.40
55	Gambia, The	50.65	49.38	49.46	53.55	56.73	55.31	54.35	51.61	48.35	45.10	42.36	51.76	42.85
56	Georgia	61.47	65.31	65.01	63.70	71.95	71.33	69.35	71.27	70.10	67.30	66.86	67.53	64.90
57	Germany	13.26	13.78	14.28	14.18	14.06	14.62	13.97	13.72	13.32	12.90	12.48	13.01	13.18
58	Ghana	46.07	46.12	47.71	46.18	44.98	46.97	44.65	45.70	44.58	41.90	42.62	42.66	42.60
59	Greece	28.79	28.46	29.35	28.92	29.76	28.63	28.91	28.23	27.82	26.10	26.46	27.01	26.17
60	Guatemala	63.95	63.38	61.90	60.18	59.76	60.86	58.75	57.45	54.66	51.50	54.44	55.29	56.06

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part I (1991–2003)

No.	Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
61	Guinea	41.22	41.34	41.16	41.88	41.75	42.03	41.32	39.73	40.14	39.70	39.12	38.09	39.01
62	Guinea-Bissau	30.64	30.50	32.41	30.82	30.73	27.98	21.98	42.76	37.78	39.60	39.88	41.71	42.40
62	Guyana	36.55	35.01	34.54	34.18	33.53	31.45	32.07	31.70	32.40	33.60	33.86	34.17	35.83
64	Haiti	42.14	46.75	44.87	55.79	50.18	52.83	50.89	57.19	54.69	55.40	56.61	59.12	56.05
65	Honduras	53.74	51.79	49.64	49.83	48.89	49.12	46.96	48.10	50.41	49.60	50.45	49.28	49.36
66	Hong Kong SAR, China	15.75	15.69	15.48	15.31	15.56	16.13	15.36	16.84	16.93	16.60	16.54	16.99	16.61
67	Hungary	31.89	32.26	33.69	32.03	30.18	29.18	28.35	27.11	26.57	25.10	24.70	24.14	24.19
68	Iceland	15.03	15.81	16.01	15.72	15.73	15.54	14.92	14.64	14.41	14.30	14.05	14.64	14.57
69	India	28.43	27.96	28.02	26.50	26.67	25.69	27.07	26.96	27.83	26.70	26.62	26.48	24.84
70	Indonesia	26.99	26.18	26.38	25.59	24.62	23.64	23.49	21.78	24.33	23.70	24.05	25.43	25.90
71	Iran, Islam Rep.	19.13	19.54	20.42	20.85	21.06	20.65	20.07	20.35	19.88	18.90	19.89	18.39	17.02
72	Ireland	18.36	18.30	18.11	17.67	16.75	16.69	15.51	14.76	13.82	13.40	12.92	13.23	13.76
73	Israel	25.02	24.83	24.05	23.18	23.42	22.26	23.38	23.18	22.91	21.90	22.82	22.81	23.32
74	Italy	29.14	28.52	28.31	27.15	24.80	24.18	25.13	24.14	24.54	22.70	23.55	23.46	24.28
75	Jamaica	36.02	32.72	32.76	31.25	31.18	33.89	36.11	34.82	35.76	36.40	35.23	35.76	34.57
76	Japan	10.35	10.46	10.67	10.80	10.85	10.72	10.61	10.91	11.22	11.20	11.31	11.79	11.57
77	Jordan	21.12	19.75	20.27	20.58	19.81	19.91	19.92	19.93	19.76	19.40	19.29	19.34	18.26
78	Kazakhstan	43.62	43.41	44.49	42.63	46.08	47.35	45.99	45.66	44.61	43.20	42.73	40.89	39.58
79	Kenya	34.75	35.01	31.63	32.21	31.68	34.08	34.68	36.24	35.46	34.30	34.45	35.34	35.92
80	Korea, Rep.	29.13	29.23	29.14	28.35	27.48	28.03	26.97	30.04	28.49	27.50	27.37	26.76	27.41
81	Kuwait	18.55	21.40	20.35	19.83	19.39	19.03	19.18	19.22	20.66	20.10	20.67	20.91	18.79

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part I (1991–2003)

No.	Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
82	Kyrgyz Republic	35.75	38.76	41.83	44.44	45.93	43.02	41.83	41.65	41.94	41.20	40.35	43.00	39.05
83	Laos	36.16	35.88	35.62	35.02	35.00	33.96	33.70	32.10	32.04	30.60	30.66	30.80	31.33
84	Latvia	20.07	24.44	25.29	24.79	28.65	28.07	26.96	27.44	27.07	26.70	25.18	25.12	23.71
85	Lebanon	36.68	35.85	34.93	33.96	33.03	32.23	33.07	33.27	34.54	34.10	34.47	34.23	34.79
86	Lesotho	35.12	35.37	35.76	34.37	35.17	32.57	34.58	32.02	32.97	31.30	31.51	29.85	30.58
87	Liberia	42.08	43.89	44.70	45.25	45.55	46.67	45.12	45.95	44.64	43.20	42.23	41.84	43.02
88	Libya	34.24	36.22	35.75	35.07	34.68	36.26	36.26	38.21	36.20	35.10	36.24	34.94	31.83
89	Lithuania	21.15	23.78	26.36	28.76	32.49	32.22	30.90	31.27	30.88	31.10	29.31	28.45	27.01
90	Luxembourg	11.07	11.43	11.37	11.24	11.40	11.97	11.38	10.90	10.37	9.80	10.18	10.32	10.71
91	Madagascar	40.40	41.06	41.06	41.22	40.90	44.34	41.95	41.67	40.21	39.60	41.16	47.41	45.47
92	Malawi	39.40	40.32	40.19	43.66	39.25	39.91	40.17	38.55	37.52	40.30	40.34	41.99	39.41
93	Malaysia	37.47	37.30	36.79	35.04	33.22	30.58	30.37	32.10	31.63	31.10	32.27	32.65	32.03
94	Maldives	28.11	28.29	27.35	26.75	31.50	30.21	30.98	30.22	30.60	30.30	29.39	28.93	27.73
95	Mali	44.15	45.15	45.28	42.78	43.40	43.36	41.10	44.71	42.22	42.30	39.63	39.70	38.10
96	Malta	31.54	30.61	31.40	31.03	30.88	33.12	31.65	30.61	29.72	27.10	30.66	30.15	30.99
97	Mauritania	36.00	36.59	35.26	36.38	33.39	31.80	35.57	36.45	36.09	36.10	37.39	38.57	38.27
98	Mauritius	25.83	25.61	25.94	26.19	25.86	25.43	24.12	22.90	24.01	23.10	21.67	22.14	22.66
99	Mexico	33.06	33.53	36.34	35.81	38.25	36.63	33.70	32.62	31.44	30.10	31.20	30.99	30.84
100	Moldova	38.89	43.96	44.53	48.96	49.08	47.10	44.20	42.98	46.30	45.10	45.23	46.53	45.50
101	Mongolia	18.83	20.65	19.53	21.12	20.12	19.54	19.15	18.81	18.87	18.40	18.88	18.01	17.68
102	Morocco	36.59	38.18	40.33	38.96	40.42	35.91	38.68	35.70	37.28	36.40	36.48	35.25	34.72
103	Mozambique	43.14	44.97	44.79	46.87	42.39	41.06	40.67	41.11	40.14	40.30	39.03	36.57	36.60

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part I (1991–2003)

No.	Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
104	Myanmar	63.83	61.85	61.55	60.53	59.12	58.63	57.67	57.77	53.59	52.60	49.77	47.66	43.64
105	Namibia	31.84	31.86	32.12	31.96	32.09	31.57	31.89	31.45	31.88	31.40	31.32	29.14	28.82
106	Nepal	43.39	40.59	40.88	39.15	39.97	40.59	39.59	38.68	38.04	36.80	37.20	37.71	37.35
107	Netherlands, The	13.21	13.13	13.38	13.26	13.00	12.80	11.79	11.51	10.92	10.50	10.40	11.33	11.75
108	New Zealand	14.97	14.62	13.85	12.92	12.70	12.75	12.78	12.93	12.13	11.50	10.85	11.36	11.36
109	Nicaragua	44.54	44.75	44.82	44.71	44.74	42.70	42.99	43.01	43.23	45.20	43.76	43.50	43.68
110	Niger	38.66	43.09	42.70	41.65	40.80	40.23	41.28	39.04	42.00	41.90	40.06	40.25	41.63
111	Nigeria	56.95	58.17	58.82	66.61	62.21	61.09	60.69	62.33	59.87	57.90	57.64	59.93	57.19
112	Norway	16.25	17.30	17.17	16.35	15.77	14.84	13.44	13.77	14.04	12.70	12.73	15.20	15.42
113	Oman	23.41	22.56	22.42	22.42	21.99	20.72	20.11	19.88	20.04	18.90	18.82	19.82	20.17
114	Pakistan	37.55	34.92	34.40	34.90	34.48	32.81	34.58	34.63	35.35	36.80	35.12	34.97	33.58
115	Papua New Guinea	41.96	38.86	34.34	32.09	33.64	30.63	35.36	34.44	34.63	36.10	36.43	37.08	37.34
116	Paraguay	34.63	35.39	33.95	32.29	30.67	32.67	34.54	34.87	37.79	39.80	39.65	40.32	37.60
117	Peru	59.87	59.25	61.00	58.50	58.52	59.63	57.08	58.23	59.94	59.90	58.47	56.43	56.65
118	Philippines	45.43	45.39	45.53	45.40	45.04	42.21	43.50	43.79	44.43	43.30	43.02	42.16	41.39
119	Poland	33.10	32.70	31.96	30.21	29.54	28.40	27.60	26.14	26.70	26.20	26.90	26.69	26.42
120	Portugal	23.28	23.66	24.40	24.18	23.62	23.01	22.81	21.88	22.02	21.40	21.79	21.70	22.36
121	Qatar	16.41	15.40	15.80	17.65	16.68	18.21	17.02	16.65	17.21	19.00	18.32	17.74	18.31
122	Romania	36.03	35.13	34.80	34.99	33.40	31.12	31.65	32.18	34.45	34.40	32.33	32.51	33.03
123	Russian Federation	39.73	31.49	41.53	45.04	45.65	46.83	48.73	47.72	42.05	41.91	40.81	40.78	40.08

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part I (1991–2003)

No.	Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
124	Rwanda	39.72	39.59	39.61	39.91	41.09	41.65	38.69	40.25	41.23	40.30	41.14	39.01	38.52
125	Saudi Arabia	18.90	17.93	18.07	17.86	18.03	17.98	18.62	19.15	18.22	18.40	18.33	18.79	17.96
126	Senegal	52.64	52.30	53.39	51.60	50.08	52.60	51.87	47.48	45.97	45.10	44.05	41.48	41.95
127	Sierra Leone	38.20	41.77	43.17	43.67	44.51	46.36	46.60	45.96	48.49	48.60	50.14	47.76	45.34
128	Singapore	13.69	13.38	13.13	12.56	12.17	12.76	12.26	13.56	12.86	13.10	13.40	13.76	13.00
129	Slovak Republic	17.19	19.45	19.27	18.28	17.92	18.45	17.17	17.85	17.41	17.60	17.23	17.15	16.57
130	Slovenia	27.41	28.59	29.47	28.16	28.17	27.02	26.54	25.01	25.88	25.20	25.00	24.50	24.40
131	Solomon Islands	30.60	29.61	29.41	25.84	25.71	24.90	25.79	24.97	27.51	33.40	36.36	37.42	36.16
132	South Africa	29.87	31.12	31.25	29.84	27.66	29.05	28.68	28.62	29.19	28.40	27.78	27.64	28.15
133	Spain	27.49	28.04	28.69	27.98	27.37	26.13	25.96	24.78	24.47	22.70	23.02	23.13	23.05
134	Sri Lanka	52.94	51.87	50.43	49.94	50.22	48.67	48.28	47.07	46.30	44.60	46.29	46.85	46.19
135	Suriname	36.49	38.08	39.36	38.26	37.60	39.11	37.28	37.94	38.13	39.80	36.42	36.36	35.31
136	Swaziland	43.99	42.74	44.13	43.61	41.48	41.42	43.70	42.81	42.55	41.40	39.55	38.44	37.55
137	Sweden	15.54	17.01	17.85	16.66	15.40	16.40	15.07	14.87	13.74	12.60	12.10	12.93	12.91
138	Switzerland	7.56	8.08	8.23	8.23	8.08	8.05	7.83	7.33	7.27	6.80	7.07	7.34	7.78
139	Syrian Arab. Rep.	24.23	21.90	20.58	19.13	18.80	18.35	18.72	17.27	18.88	19.30	19.47	18.83	19.16
140	Taiwan	38.43	37.66	36.72	35.65	35.24	35.89	34.97	35.31	33.62	33.61	34.32	34.17	33.49
141	Tajikistan	35.42	47.43	46.64	46.53	45.92	47.23	45.21	46.97	45.51	43.20	44.02	43.98	42.62
142	Tanzania	60.32	59.95	58.11	57.47	54.69	55.35	56.10	57.87	58.43	58.30	57.09	55.25	53.90
143	Thailand	55.72	54.05	54.34	53.11	51.84	50.05	51.98	55.43	56.64	52.60	54.17	51.36	50.51

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part I (1991–2003)

No.	Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
144	Togo	38.45	40.70	50.52	42.68	40.48	36.69	32.17	34.52	35.24	35.10	37.73	37.75	36.86
145	Trinidad and Tobago	43.72	44.75	44.26	43.02	41.56	40.18	38.91	37.03	37.98	34.40	35.73	34.27	33.09
146	Tunisia	42.00	40.08	39.60	39.42	38.85	38.92	39.42	40.20	38.46	38.40	36.35	37.74	37.24
147	Turkey	35.99	35.89	35.30	34.51	32.84	32.95	31.01	32.03	33.26	32.10	32.75	33.74	32.07
148	Uganda	41.79	41.88	42.66	43.25	41.36	40.93	41.69	42.35	40.72	43.10	41.56	43.23	41.67
149	Ukraine	38.96	41.79	44.06	48.12	48.92	51.76	56.31	57.00	51.91	52.20	49.06	47.06	45.29
150	United Arab Emirates	27.74	28.05	28.50	27.47	27.00	26.76	26.98	27.72	28.54	26.40	28.15	27.81	27.46
151	United Kingdom	13.65	13.93	13.37	12.80	12.13	11.95	11.29	10.98	11.11	10.80	10.66	11.19	11.23
152	United States	10.12	10.00	9.69	9.23	8.91	8.90	8.23	8.00	7.82	7.60	8.01	8.54	8.40
153	Uruguay	47.99	46.04	46.91	44.92	47.52	48.69	42.96	42.20	45.21	46.10	46.57	46.33	43.18
154	Venezuela, RB	32.02	31.12	31.12	31.69	32.21	29.64	35.08	35.57	38.18	36.00	38.26	38.70	40.03
155	Vietnam	22.24	21.39	22.17	21.75	21.23	20.59	21.31	20.18	19.98	19.20	19.73	19.22	18.92
156	Yemen, Rep.	35.03	34.24	34.02	34.35	30.83	29.39	29.80	30.17	28.35	27.40	26.48	27.20	25.42
157	Zambia	54.17	50.68	50.91	51.39	51.33	52.41	51.74	51.61	49.86	48.90	48.85	47.71	48.40
158	Zimbabwe	57.35	62.24	59.35	56.29	57.27	54.05	56.16	52.09	56.43	59.40	56.12	58.32	61.83
	<i>Av. over countries</i>	<i>34.51</i>	<i>34.82</i>	<i>35.22</i>	<i>34.89</i>	<i>34.50</i>	<i>34.14</i>	<i>33.81</i>	<i>33.83</i>	<i>33.78</i>	<i>33.26</i>	<i>33.16</i>	<i>33.14</i>	<i>32.73</i>

Source: Own calculations.

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part II (2004–2015)

No.	Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	<i>Av. over years</i>
1	Albania	31.72	30.89	29.58	28.53	27.12	26.91	26.10	25.41	25.52	25.68	25.78	26.21	32.72
2	Algeria	27.76	24.93	24.44	24.21	24.07	25.90	25.89	27.37	26.94	25.98	25.74	23.98	30.86
3	Angola	46.81	43.84	41.23	37.13	35.26	36.25	36.54	36.49	36.60	35.92	34.53	35.25	43.96
4	Argentina	24.32	23.21	22.63	21.93	21.87	22.97	21.64	20.80	21.62	21.57	22.02	24.99	24.14
5	Armenia	43.57	41.03	41.38	39.47	35.39	41.04	40.14	38.46	35.52	34.56	34.78	35.96	42.59
6	Australia	12.11	12.25	11.66	9.32	8.96	9.39	9.14	8.87	9.83	9.95	8.89	8.10	12.06
7	Austria	8.72	8.86	8.34	7.69	7.78	9.65	9.07	8.47	8.40	8.68	8.39	9.01	8.93
8	Azerbaijan	52.45	50.01	48.02	45.32	43.70	44.82	44.20	43.71	43.30	42.26	42.15	43.66	52.19
9	Bahamas, The	29.23	27.92	27.50	27.37	30.82	37.73	37.77	38.57	37.62	39.51	38.92	38.55	33.52
10	Bahrain	17.64	17.54	18.12	18.79	18.16	20.33	20.30	21.01	21.11	20.03	19.21	16.63	19.34
11	Bangladesh	36.50	34.95	34.13	32.93	31.32	31.47	30.78	28.79	28.97	28.22	27.42	27.60	33.59
12	Belarus	46.72	46.77	44.64	42.10	38.69	39.70	38.17	33.03	32.29	34.07	34.12	32.37	44.52
13	Belgium	21.12	21.11	20.74	18.27	18.28	18.74	18.8	17.71	18.28	18.81	18.06	17.8	20.57
14	Belize	44.56	43.74	41.18	41.87	40.67	47.13	45.51	45.45	45.38	44.08	44.69	42.29	46.83
15	Benin	55.49	56.38	55.79	52.75	53.52	56.63	54.49	55.12	53.64	50.71	46.33	48.28	53.66
16	Bhutan	27.26	27.15	25.91	25.87	24.63	26.04	24.19	23.40	22.26	21.81	21.06	20.28	26.93
17	Bolivia	66.74	65.64	61.77	59.97	54.65	58.40	55.06	51.82	49.64	48.18	46.93	45.98	62.28
18	Bosnia and Herzegovina	33.57	32.72	33.48	33.11	30.97	33.13	33.18	32.60	32.59	31.38	31.19	29.88	34.21
19	Botswana	30.57	30.12	27.85	26.52	27.06	28.46	26.44	25.03	24.44	22.85	22.10	23.99	30.30
20	Brazil	37.29	38.47	37.62	37.05	35.16	36.9	34.55	33.06	32.71	32.56	33.01	35.22	37.63
21	Brunei Darussalam	29.96	30.39	29.94	30.55	29.04	29.80	28.88	28.34	28.16	30.00	31.81	30.44	29.76
22	Bulgaria	30.58	28.63	26.78	23.70	22.77	24.08	23.42	22.39	22.12	22.37	21.60	20.83	29.17

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part II (2004–2015)

No.	Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	<i>Av. over years</i>
23	Burkina Faso	38.69	37.25	36.21	38.30	36.40	35.64	33.29	32.06	31.12	31.12	30.53	29.63	38.39
24	Burundi	39.75	38.08	35.96	38.89	38.23	37.95	38.64	37.86	37.04	36.93	36.25	35.68	36.74
25	Cabo Verde	36.02	34.86	30.32	29.94	29.16	31.48	30.83	29.59	29.52	29.20	29.26	30.23	35.84
26	Cambodia	46.74	43.69	40.92	41.76	41.02	42.88	42.31	40.30	38.08	36.56	34.92	33.85	46.04
27	Cameroon	32.06	31.37	30.44	30.43	30.26	32.51	31.93	31.20	30.52	29.63	28.14	28.93	32.45
28	Canada	13.77	13.57	12.92	12.87	12.02	12.26	10.71	10.46	11.28	11.21	10.05	9.42	13.92
29	Central African Republic	42.12	41.58	39.12	38.15	38.88	38.23	37.54	36.94	37.85	52.64	55.96	50.71	41.90
30	Chad	35.03	34.26	35.01	36.35	37.11	37.11	34.11	35.14	33.90	34.30	31.20	28.76	40.09
31	Chile	16.86	16.16	15.67	15.10	14.09	14.47	14.06	12.96	12.64	12.79	12.72	13.16	16.69
32	China	14.31	14.14	13.84	13.82	12.79	12.83	12.13	12.03	12.41	12.25	11.74	12.11	14.67
33	Colombia	35.30	33.98	31.79	30.89	29.82	31.24	30.71	27.6	27.34	26.77	25.99	25.25	33.31
34	Comoros	38.78	37.92	37.45	38.08	39.21	40.02	39.05	38.63	38.61	36.63	36.44	40.92	39.11
35	Congo, Dem. Rep.	46.64	46.53	47.09	44.51	44.06	46.36	44.19	44.81	45.98	45.65	41.07	46.95	46.42
36	Congo, Rep.	46.31	44.52	41.81	45.64	43.27	40.65	36.40	36.43	37.13	36.28	33.18	35.05	45.10
37	Costa Rica	24.00	23.06	22.12	22.20	21.3	24.33	24.6	24.72	23.76	23.81	23.41	19.24	24.46
38	Côte d'Ivoire	45.62	44.55	43.84	44.39	43.94	42.81	42.15	43.63	43.47	41.06	38.94	42.40	43.43
39	Croatia	26.10	24.96	23.80	22.50	21.56	25.27	25.6	24.64	25.26	25.28	24.48	22.96	28.81
40	Cyprus	30.74	30.77	29.90	29.03	28.77	31.64	31.39	32.71	33.32	34.66	32.69	32.20	31.30
41	Czech Republic	15.75	14.46	13.14	11.53	11.18	13.52	12.97	11.68	11.5	11.79	10.76	10.47	14.83
42	Denmark	14.55	13.75	12.66	12.51	13.01	16.33	16.17	15.26	15.48	15.24	14.13	14.70	15.19

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part II (2004–2015)

No.	Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	<i>Av. over years</i>
43	Dominican Republic	32.34	32.95	30.78	32.24	31.26	33.1	30.71	30.48	30.58	29.02	27.6	27.97	32.37
44	Ecuador	33.84	32.67	32.14	31.40	31.04	34.32	32.07	29.71	29.19	28.45	28.50	30.18	33.56
45	Egypt, Arab. Rep.	33.92	33.47	33.07	30.80	28.88	30.3	30.5	32.91	33.64	34.37	34.96	33.32	34.24
46	El Salvador	42.21	42.74	42.34	40.93	40.05	45.73	44.69	42.77	42.72	41.78	41.30	42.60	45.59
47	Equatorial Guinea	29.77	30.15	29.27	27.70	27.16	27.87	28.76	28.37	28.55	29.92	32.20	31.38	31.84
48	Eritrea	39.42	39.86	41.13	41.61	46.36	44.45	44.88	41.38	37.33	38.18	36.09	36.53	39.29
49	Estonia	23.15	21.26	19.00	17.84	19.42	24.60	22.99	19.67	18.34	17.97	17.52	18.49	23.80
50	Ethiopia	36.97	36.13	33.87	32.41	31.68	31.41	30.10	27.65	26.84	26.21	24.47	25.10	34.31
51	Fiji	27.94	28.57	30.42	32.33	29.84	33.48	32.06	29.64	29.48	31.19	28.97	25.37	32.47
52	Finland	12.29	11.97	11.26	10.98	10.95	13.11	12.54	12.19	12.59	13.08	12.12	13.30	13.49
53	France	14.00	13.96	13.31	12.88	11.61	13.89	13.11	11.81	12.08	12.41	12.12	11.65	14.08
54	Gabon	58.13	55.41	59.63	58.68	60.07	63.47	58.02	54.75	53.50	52.52	53.48	52.01	52.43
55	Gambia, The	38.90	45.77	48.19	47.90	45.28	39.78	35.17	48.57	42.64	40.95	43.81	43.64	46.88
56	Georgia	66.10	66.91	63.79	64.55	67.93	68.46	64.73	60.86	58.67	56.57	54.10	53.07	64.87
57	Germany	12.80	12.61	11.41	10.56	9.59	11.69	10.88	9.05	8.85	9.22	8.17	7.75	11.97
58	Ghana	42.90	43.16	41.68	41.51	41.41	40.61	40.03	40.64	40.99	39.25	38.50	39.37	42.91
59	Greece	25.29	25.99	24.90	24.23	23.2	25.32	26.15	27.08	28.39	27.78	27.11	26.45	27.06
60	Guatemala	53.47	53.12	50.46	49.68	50.47	53.26	52.23	51.76	50.62	50.48	47.82	46.88	54.74
61	Guinea	38.77	37.54	37.41	38.30	38.94	42.16	43.89	39.60	37.51	38.32	38.18	41.58	39.95
62	Guinea-Bissau	41.51	40.07	40.40	39.20	38.51	38.61	37.54	34.13	39.01	38.69	38.75	34.94	36.42
62	Guyana	34.65	36.27	31.85	29.65	31.58	30.65	28.73	27.52	26.35	26.16	26.03	26.09	31.78

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part II (2004–2015)

No.	Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Av. over years
64	Haiti	54.67	55.02	56.53	58.25	54.15	53.72	52.93	52.30	52.49	51.84	51.21	56.38	53.28
65	Honduras	47.36	44.37	42.68	41.14	40.97	45.48	44.90	41.96	42.12	42.37	39.51	37.68	46.31
66	Hong Kong SAR, China	15.52	14.45	13.74	13.11	13.01	13.81	12.79	12.22	12.29	12.15	11.89	12.39	14.69
67	Hungary	22.88	22.52	21.05	21.40	20.58	23.18	22.82	21.87	22.26	21.63	20.78	20.49	25.23
68	Iceland	13.78	13.26	13.14	12.69	12.56	14.12	14.16	13.74	13.38	13.31	13.07	12.45	14.20
69	India	23.87	23.44	22.06	21.03	21.68	22.27	20.65	19.71	18.99	18.11	18.33	17.89	23.91
70	Indonesia	25.18	24.82	24.87	25.13	23.4	24.29	23.44	22.65	22.22	21.92	21.05	21.76	24.11
71	Iran, Islam Rep.	16.01	16.63	16.34	14.52	14.60	15.73	15.60	14.93	15.79	16.17	16.14	18.38	17.88
72	Ireland	13.52	13.08	12.59	12.55	12.45	13.36	11.78	12.49	11.4	11.14	9.93	9.58	13.89
73	Israel	22.43	21.84	21.11	21.80	20.37	21.5	20.48	19.4	19.85	19.9	19.39	19.18	22.01
74	Italy	24.17	24.62	23.81	22.43	23.51	27.31	26.13	24.54	25.53	24.49	24.33	22.97	24.95
75	Jamaica	32.20	33.19	30.71	30.61	30.42	35.55	36.92	35.43	36.28	26.49	26.33	24.97	33.02
76	Japan	11.09	10.91	10.35	10.14	9.21	10.39	9.93	9.89	9.73	9.28	8.69	8.19	10.41
77	Jordan	16.09	14.91	14.71	13.66	13.44	14.91	14.96	15.38	15.00	14.64	14.20	15.16	17.38
78	Kazakhstan	38.41	36.39	35.12	34.21	32.66	34.65	33.03	31.61	31.92	30.77	30.06	32.82	38.88
79	Kenya	34.64	33.32	32.27	33.35	32.93	33.62	31.54	29.92	30.11	29.99	28.68	33.43	33.18
80	Korea, Rep.	26.23	26.03	26.37	24.89	23.86	23.13	22.97	20.81	20.96	21.27	20.36	19.83	25.70
81	Kuwait	17.63	16.33	15.85	15.71	16.45	18.98	19.75	19.81	19.86	20.55	22.07	21.72	19.31
82	Kyrgyz Republic	37.73	38.04	37.52	34.72	33.34	34.10	34.32	33.06	34.26	31.35	29.95	30.78	37.92
83	Laos	30.35	29.31	28.08	27.52	27.37	28.33	26.53	25.78	25.29	25.73	24.10	25.00	30.25
84	Latvia	22.05	19.93	18.13	17.04	18.27	21.16	20.41	18.67	17.32	16.68	15.92	16.62	22.23
85	Lebanon	31.71	32.10	33.05	31.39	28.09	26.02	24.63	25.51	25.67	27.96	29.06	29.16	31.58

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part II (2004–2015)

No.	Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	<i>Av. over years</i>
86	Lesotho	31.05	31.86	30.89	30.07	28.68	29.85	28.81	28.20	27.79	26.71	24.56	32.32	31.28
87	Liberia	41.31	42.47	39.95	42.71	43.09	43.45	41.57	41.52	42.23	42.37	42.45	43.67	43.24
88	Libya	31.29	29.51	28.30	27.02	25.86	27.88	27.05	38.76	32.79	34.75	37.91	38.27	33.62
89	Lithuania	25.69	23.88	22.38	20.58	20.28	24.29	23.13	20.86	19.32	18.30	17.62	18.65	25.15
90	Luxembourg	10.67	10.72	10.33	9.37	9.65	11.01	10.37	10.34	10.80	10.65	10.39	10.38	10.67
91	Madagascar	39.87	40.98	41.34	42.68	38.70	43.33	44.98	45.02	44.30	46.27	44.84	45.29	42.56
92	Malawi	38.76	38.76	39.40	37.34	36.75	38.01	36.39	37.29	36.05	35.09	34.28	33.56	38.51
93	Malaysia	30.59	29.77	29.21	31.23	30.03	31.71	30.17	29.82	29.78	29.84	26.41	26.07	31.49
94	Maldives	26.83	27.82	30.09	27.92	24.85	25.80	25.28	24.39	24.49	24.21	23.41	20.65	27.44
95	Mali	41.00	39.04	36.21	36.86	35.08	36.67	33.28	34.22	31.49	31.40	30.88	29.45	38.70
96	Malta	31.92	30.84	28.69	26.96	27.30	30.55	29.19	28.06	27.25	27.15	28.08	29.43	29.80
97	Mauritania	36.50	33.26	27.78	27.81	28.67	29.90	28.39	27.03	25.42	24.45	24.38	25.75	32.29
98	Mauritius	23.06	23.05	22.49	20.85	19.24	21.18	20.83	19.67	19.24	20.28	19.62	19.23	22.57
99	Mexico	29.81	29.47	28.53	30.65	29.82	32.65	31.15	30.25	29.52	30.05	29.14	28.07	31.74
100	Moldova	42.90	41.60	43.84	41.50	40.89	45.06	43.52	41.05	40.84	39.26	37.35	39.68	43.43
101	Mongolia	17.31	17.22	16.77	16.89	15.90	16.37	16.35	13.69	13.69	13.04	12.02	13.20	17.28
102	Morocco	33.92	34.30	32.27	30.94	28.68	30.93	29.37	28.98	29.83	29.79	29.18	27.13	34.01
103	Mozambique	36.36	35.16	34.26	33.53	33.16	32.84	31.50	31.37	30.13	31.46	31.71	30.98	37.20
104	Myanmar	43.91	39.86	48.41	46.38	48.89	49.30	48.60	47.56	45.49	43.93	43.30	50.99	51.39
105	Namibia	28.68	28.21	26.00	25.11	23.96	24.54	24.79	23.46	22.85	22.85	22.23	21.78	28.07
106	Nepal	36.86	37.60	36.24	36.59	37.09	38.02	36.48	35.70	35.98	33.46	33.42	30.22	37.50
107	Netherlands, The	11.36	11.12	10.94	10.55	9.58	8.9	8.6	8.09	8.11	8.44	8.75	7.83	10.77
108	New Zealand	11.07	11.53	11.72	10.57	10.76	11.66	11.62	10.19	10.33	10.09	9.33	8.97	11.70

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part II (2004–2015)

No.	Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	<i>Av. over years</i>
109	Nicaragua	43.72	41.78	42.11	41.40	41.79	42.91	42.76	40.90	40.12	38.47	38.58	39.51	42.63
110	Niger	42.76	42.33	40.95	41.45	39.27	38.94	35.85	36.51	35.77	35.48	35.74	34.12	39.70
111	Nigeria	56.72	55.84	51.95	54.96	53.06	53.98	52.8	51.51	51.56	51.7	50.64	52.49	56.67
112	Norway	13.52	12.90	11.29	11.03	10.47	14.37	14.05	13.63	13.32	13.64	13.35	15.07	14.07
113	Oman	19.90	20.38	19.55	18.18	15.52	16.83	16.76	17.65	18.25	19.07	21.07	23.91	19.93
114	Pakistan	33.87	31.19	30.94	30.84	30.49	31.28	30.28	30.91	31.12	30.62	30.29	31.62	33.10
115	Papua New Guinea	35.67	37.81	37.24	35.29	35.14	33.83	32.20	28.49	27.07	26.32	23.25	35.16	34.01
116	Paraguay	36.34	35.42	35.19	33.96	32.34	36.18	31.72	30.65	33.87	30.78	29.42	31.66	34.47
117	Peru	53.50	54.68	51.36	48.83	46.08	47.7	43.04	40.42	39.73	39.53	40.18	41.53	52.40
118	Philippines	39.87	36.50	36.18	36.37	35.08	37.02	34.63	33.9	33.61	31.71	29.3	28.04	39.31
119	Poland	25.84	25.32	24.18	23.51	21.65	21.56	20.93	19.33	19.04	18.86	18.09	16.67	25.10
120	Portugal	22.26	22.68	22.69	22.05	20.74	21.67	20.79	20.37	20.24	20.38	19.29	17.82	21.88
121	Qatar	16.67	17.25	15.33	15.36	15.39	16.69	14.56	12.72	12.28	12.15	12.31	13.08	15.93
122	Romania	30.57	30.49	28.88	27.03	25.44	28.23	26.76	25.41	25.14	23.97	22.73	22.94	30.14
123	Russian Federation	37.68	36.41	35.47	34.59	32.6	36.79	33.7	32.03	31.88	32.21	31.04	33.72	38.42
124	Rwanda	36.16	39.23	37.79	35.44	32.73	32.48	31.50	29.53	28.47	27.56	26.68	28.05	36.25
125	Saudi Arabia	17.38	16.63	16.27	15.03	13.76	15.07	14.37	13.97	13.34	13.6	13.88	14.7	16.65
126	Senegal	40.00	37.74	39.84	37.16	36.06	39.37	38.36	40.20	37.59	37.21	35.91	33.68	43.35
127	Sierra Leone	43.88	43.45	42.96	40.92	40.87	40.60	39.34	36.12	32.36	25.69	26.47	34.18	41.50
128	Singapore	11.74	11.13	10.88	11.51	10.72	11.87	10.72	10.13	9.9	10.15	9.9	9.2	11.90
129	Slovak Republic	15.37	14.50	13.52	12.15	11.52	13.47	12.84	11.96	11.81	11.75	11.64	11.18	15.33
130	Slovenia	23.25	22.70	20.94	17.96	17.58	22.24	22.54	22.18	22.89	23.02	21.49	20.21	24.09

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part II (2004–2015)

No.	Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	<i>Av. over years</i>
131	Solomon Islands	36.03	36.04	35.32	32.52	30.25	32.56	30.15	27.38	27.08	26.88	27.44	30.89	30.41
132	South Africa	26.58	25.44	21.33	21.81	20.35	23.41	23.23	22.08	22.2	21.47	21.33	21.99	25.94
133	Spain	23.47	23.32	22.96	22.67	21.53	24.24	23.91	23.65	24.08	24.35	24.04	22.01	24.52
134	Sri Lanka	45.63	45.93	46.17	47.55	46.35	48.85	41.88	39.33	37.53	38.14	37.02	35.49	45.58
135	Suriname	33.21	31.42	29.60	27.57	26.38	26.89	25.18	23.00	23.14	22.46	22.65	23.80	32.22
136	Swaziland	39.19	38.69	38.02	38.27	38.48	38.17	38.97	40.28	36.44	35.57	34.73	40.94	40.04
137	Sweden	12.06	12.32	11.14	10.12	10.3	12.71	11.45	11.08	11.89	12.31	11.88	11.74	13.28
138	Switzerland	7.54	7.30	6.96	6.34	6.16	7.06	6.76	6.62	6.66	6.56	6.39	6.94	7.24
139	Syrian Arab. Rep.	17.98	17.15	16.53	15.65	20.81	19.21	19.39	21.50	22.18	22.79	22.24	19.53	19.58
140	Taiwan	32.04	31.43	31.45	31.32	30.12	28.89	28.22	28	28.02	28.01	26.88	28.97	32.50
141	Tajikistan	43.52	44.48	43.37	42.19	41.20	42.80	42.13	41.59	38.80	39.63	36.54	37.73	42.99
142	Tanzania	53.00	51.40	54.32	48.78	47.18	49.49	46.73	44.08	44.29	44.04	40.45	38.91	52.22
143	Thailand	49.45	48.70	48.24	48.11	47.84	51.22	48.65	47.88	46.67	46.74	47.25	43.12	50.63
144	Togo	38.24	38.93	38.14	37.27	38.40	37.53	35.90	35.12	35.09	34.16	33.52	31.49	37.31
145	Trinidad and Tobago	31.56	30.23	27.41	27.43	26.15	30.04	29.85	28.11	28.92	29.36	29.90	31.40	34.37
146	Tunisia	34.43	33.98	31.49	29.27	27.16	29.12	27.83	33.85	31.97	32.94	33.08	30.90	35.31
147	Turkey	30.80	29.77	29.47	30.38	29.14	32.33	30.21	27.65	28.03	27.33	27.45	27.43	31.38
148	Uganda	40.34	39.18	38.25	36.41	34.46	34.88	34.87	34.63	32.28	32.46	32.75	31.88	38.74
149	Ukraine	41.96	42.08	40.89	38.71	36.65	43.53	42.15	39.19	39.65	39.99	39.95	42.9	44.80
150	United Arab Emirates	27.53	27.99	28.81	27.36	26.77	25.54	25.09	23.92	23.11	22.44	22.02	24.26	26.54

Table A.1: Size and development of the shadow economy of 158 countries over the period 1991 to 2015 – Part II (2004–2015)

No.	Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	<i>Av. over years</i>
151	United Kingdom	11.43	11.39	10.44	10.78	9.83	11	10.33	10.06	9.91	9.57	8.81	8.32	11.08
152	United States	8.43	7.86	7.47	8.00	7.76	9.18	8.71	8.23	7.83	7.66	7.04	7	8.34
153	Uruguay	40.74	39.93	39.92	31.94	30.2	30.72	27.32	25.68	23.25	22.49	20.59	20.38	37.91
154	Venezuela, RB	36.21	33.05	32.16	31.55	31.13	35.15	33.50	32.65	32.12	31.74	32.65	33.63	33.81
155	Vietnam	18.40	17.18	17.64	17.13	16.99	17.4	17.18	16.09	15.79	15.82	15.06	14.78	18.70
156	Yemen, Rep.	24.38	23.46	23.18	23.29	23.31	22.94	23.57	32.07	31.98	31.07	27.61	28.81	28.34
157	Zambia	47.60	49.01	48.52	45.54	43.22	42.17	34.47	36.61	33.38	30.83	30.72	32.99	45.32
158	Zimbabwe	63.50	63.16	60.58	60.42	61.66	69.08	65.62	63.89	63.69	64.55	65.85	67.00	60.64
	<i>Av. over countries</i>	31.79	31.24	30.41	29.69	28.98	30.56	29.42	28.77	28.33	28.05	27.44	27.78	31.77

Source: Own calculations.