



Prof. Dr. Andreas Bühn

Professor für Volkswirtschaftslehre, Studiengangleiter Public Management an der Berufsakademie Sachsen (Staatliche Studienakademie Bautzen).

Arbeits- und Forschungsschwerpunkte: Informelle ökonomische Aktivitäten (Schattenwirtschaft, Schwarzarbeit, Steuerhinterziehung, illegale Migration, Schmuggel), Steuerpolitik und Fiskalföderalismus, Regionalökonomie, Einkommens- und Vermögens(un)gleichheit.

Kontakt: andreas.buehn@ba-sachsen.de

The Shadow Economy: Estimation, Problems and Open Questions*

Andreas Bühn

Der vorliegende Artikel stellt die verschiedenen Methoden zur Schätzung des Umfangs der Schattenwirtschaft sowie ihre Stärken und Schwächen vor. Der Beitrag verfolgt zwei Ziele. Zum einen soll der Begriff „Schattenwirtschaft“ definiert und die dafür verantwortlichen Faktoren erläutert werden. Zum anderen wird aufgezeigt, dass es keine ideale Methode zur Schätzung des Umfangs und der Entwicklung der Schattenwirtschaft gibt. Aufgrund ihrer Flexibilität wird die MIMIC-Methode, die häufig zur Ermittlung von Makro-Schätzungen des Umfangs der Schattenwirtschaft herangezogen wird, ausführlicher dargestellt. Schließlich wird ein Überblick über die Schätzungen der Schattenwirtschaft für Deutschland gegeben und mit Schätzungen für Polen und die Tschechische Republik verglichen. Die Folgen der COVID 19-Pandemie werden ebenfalls kurz angesprochen.

This article presents the various methods to estimate the size of the shadow economy, their strengths and weaknesses. The purpose of the article is twofold. Firstly, the article focuses on the definition and causal factors of the shadow economy. Secondly, it demonstrates that no ideal method to estimate the size and development of the shadow economy exists. Because of its flexibility, the MIMIC method used to get macro-estimates of the size of the shadow economy is presented in more detail. Finally, I present an overview about shadow economy estimates for Germany comparing them to estimates for Poland and the Czech Republic. The consequences of the Corona COVID 19 pandemic are also briefly discussed.

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1. INTRODUCTION

Empirical research about the size and development of the shadow economy is still – although so many studies already exist – an interesting topic. Because authors use different methods and estimation procedures to estimate the size and development of the shadow economy, it is quite difficult to judge the reliability of various methods. Hence, the goal of this overview is to review the various methods estimating the size of the shadow economy briefly and to discuss their strengths and weaknesses. This shall enable an interested reader to realize what advantages and disadvantages different methods have.

The article is structured as follows: The next section presents some theoretical considerations, starting with a definition of the shadow economy and a brief discussion of its main determinants typically used in empirical research. Section 3 reviews the various measurement methods as well as their strengths and weaknesses. This section also presents estimates of the size of the shadow economy in Germany using different estimation methods. Finally, macroeconomic estimates for Germany, Poland and the Czech Republic are shown and some remarks on future developments in the light of the SARS-CoV-2 pandemic made. Section 4 summarizes and concludes.

2. THEORETICAL CONSIDERATIONS

A useful starting point for a theoretical discussion of the shadow economy is the path-breaking study by Allingham and Sandmo (1972) on income tax evasion. While the shadow economy and tax evasion are not congruent, in most cases activities in the shadow economy imply the evasion of direct or indirect taxes, the factors determining tax evasion will most certainly also affect the shadow economy. According to Allingham and Sandmo, tax compliance depends on its expected costs and benefits. The benefits of tax non-compliance result from the individual marginal tax rate and the true individual income. In the case of the shadow economy the individual marginal tax rate is often roughly calculated using the overall tax burden from indirect and direct taxes including social security contributions. The expected costs of non-compliance derive from deterrence enacted by the state, i.e., the state's auditing activities raising the probability of detection and the fines individuals face when they are caught. Individual morality also plays a role for compliance and additional costs could pertain beyond the tax administration's pure punishment in the form of psychic costs like shame or regret, but also additional pecuniary costs if, for example, a reputation loss results. Individuals are rational calculators who weight the costs and benefits a legal status entails. Their decision to partially or completely participate in the shadow economy is a choice under uncertainty facing a trade-off between the gains if their activities are not discovered and a loss if 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 labour costs W – the individual income generated in the shadow economy is usually categorized as labor income rather than capital income – due to labour market regulations. Hence, the higher the tax burden and labor costs, the more incentives individuals have to avoid those 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 detection of shadow economic activities. This discussion suggests the following equation:

$$SE = SE \left[p \left(A, F \right); f; B \left(T, W \right) \right]. \quad (1)$$

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 transaction of legal nature, hence all productive economic activities that would generally be taxable were they reported to the state (tax) authorities. Those activities are deliberately concealed from public authorities to avoid payment of income, value added or other taxes and social security

contributions, to avoid 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 the national accounts, but which remain underground due to tax or regulatory burdens.¹⁾ Although such legal activities would contribute to the country's value added, they are not captured in the 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 in the analysis of the shadow economy.²⁾

To summarize, shadow economic activities include all market-based legal production of goods and services, deliberately concealed from public authorities:

- (1) to avoid payment of taxes, e.g. income taxes or value added taxes,
- (2) to avoid payment of social security contributions,
- (3) to avoid certain legal labor market standards, such as minimum wages, maximum working hours, safety standards, etc., and
- (4) to avoid compliance with certain administrative procedures, such as completing statistical questionnaires or other administrative forms.

Kanniainen, Pääkönen and Schneider (2004) incorporate many of these insights in their model of the shadow economy. They hypothesize that tax hikes unambiguously increase the shadow economy, while the availability of public goods financed by taxes moderates participation in the shadow economy. The latter effect however depends on the ability to access those public goods. A shortcoming of this analysis is the neglected endogeneity of tax morale and good governance, which is addressed by Feld and Frey (2007) who argue that tax compliance is the result of a complicated interaction between tax morale and deterrence measures. However, it must be clear to taxpayers what the rules of the game are and as deterrence measures serve as signals for the level of tax morale a society wants to elicit (Posner, 2000), deterrence may also crowd out the intrinsic motivation to pay taxes. Tax morale does not only increase if taxpayers perceive the public goods received in exchange for their tax payments. It may also decrease if individuals perceive political decisions for public activities or the treatment of taxpayers by the tax authorities to be unfair. Tax morale is thus not exogenously given, but influenced by deterrence and the quality of state institutions. Table 1 gives an overview of the most important determinants influencing the shadow economy.

¹ 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 typically not distinguish legal from illegal underground activities; rather they represent the whole informal economy spectrum.

² From a social perspective, may even from an economic one, soft forms of illicit employment, such as moon-lighting (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).

Determinant	Theoretical reasoning
Tax and social security contribution burdens	The distortion of the overall tax burden affects labor-leisure choices and stimulates labor supply in the shadow economy. The bigger the difference between the total labor cost in the official economy and after-tax earnings, the greater is the incentive to reduce the tax wedge and to work in the shadow economy. This tax wedge is one of the key determinants for the existence of the shadow economy.
Quality of institutions	The quality of public institutions is another key factor for the development of the informal sector. In particular, a bureaucracy with highly corrupt government officials seems to be associated with larger unofficial activity, while a good rule of law by securing property rights and contract enforceability increases the benefits of being formal. In fact, the production in the formal sector benefits from a higher provision of productive public services. An informal sector develops in consequence of the failure of political institutions in promoting an efficient market economy, and entrepreneurs going underground, as there is an inefficient public goods provision that reduces if institutions can be strengthened and fiscal policy gets closer to the median voter's preferences.
Regulations	Regulations, for example labor market regulations or trade barriers, are another important factor that reduces the freedom (of choice) for individuals in the official economy. They lead to a substantial increase in labor costs 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 regulations – mostly not enforced – is the key factor for the burden levied on firms and individuals.
Public sector services	An increase of the shadow economy may lead to fewer state revenues, which in turn reduce the quality and quantity of publicly provided goods and services. Ultimately, this may lead to increasing tax rates for firms and individuals, although the deterioration in the quality of the public goods (such as the 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.
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 of taxpayers and citizens on the one hand, but also by the state and its tax authorities on the other hand. Taxpayers are more heavily 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 their obligations of the psychological tax contract more easily. Hence, (better) tax morale and (stronger) social norms may reduce the probability of individuals to work underground.
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 about the effects of deterrence from empirical studies. The reason is that data on the legal background and the frequency of audits is not comprehensively available on an international basis. Either is the legal background 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 actually is. The little empirical 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, the results are often weak and Granger causality tests show that the size of the shadow economy can impact deterrence instead of deterrence reducing the shadow economy.
Development of the official economy	The development of the official economy is another key factor of the shadow economy. The higher (lower) the unemployment quota (GDP-growth), the higher is the incentive to work in the shadow economy for obvious reasons, ceteris paribus.

Table 1: The main causes determining the shadow economy; Source: Schneider and Buehn (2017)

3. METHODS ESTIMATING THE SIZE OF THE SHADOW ECONOMY

Estimating the size of a shadow economy is a difficult and challenging task. This article gives a short but comprehensive overview on the various procedures for estimating the size of a shadow economy. Three different categories of measurement methods are most widely used and each is briefly discussed.

3.1. Direct approaches

These microeconomic approaches typically employ either well designed surveys and samples based on voluntary replies or tax auditing and other compliance methods. Their main disadvantages are the flaws of all surveys, e.g., the average precision and that results greatly depend on the respondent's willingness to cooperate. It is difficult to assess the amount of undeclared work from a direct questionnaire, as most interviewees hesitate to confess to fraudulent behavior and responses are of uncertain reliability. This makes it difficult to calculate a true estimate (in monetary terms) of the extent of undeclared work. The main advantage of this method lies in the detailed information about the structure of the shadow economy, although it is very sensitive to the way the questionnaire is formulated.³⁾ Again, estimates based on tax audits reflect only that portion of the shadow economy income authorities discover, and this is likely to be only a fraction of all hidden income. Capturing shadow economic activities only partially, these estimates may be seen as lower bounds of the „true“ size of the shadow economy. However, they have one considerable advantage: they provide detailed information about the structure and composition of these activities as well as the socio-economic characteristics and motives of those who work in the shadow economy (at least partially).

3.2. Indirect approaches

These approaches are also called indicator approaches and are mostly macroeconomic. They use various economic and other indicators that contain information about the development of the shadow economy and often provide value added figures. In most cases, the quite often legally bought material is included; hence, they provide upper bound estimates with the danger of double counting due to the inclusion of the legally bought material.

3.2.1 Discrepancy methods

This approach is based on discrepancies between income and expenditure statistics. In national accounting the income measure of GNP should be equal to the expenditure measure of GNP. Thus, if an independent estimate for the expenditure side of the national accounts is available, the gap between the expenditure measure and the income measure can be used as an indicator for the extent of the shadow

economy.⁴⁾ Unfortunately, discrepancies reflect all omissions and errors of national accounts statistics and do not only indicate shadow economic activities. These estimates may therefore be crude and of questionable reliability.⁵⁾ Alternatively, the discrepancy between the official and actual labor force may be used. The weakness of this method is that differences in the rate of participation may also have other causes. Hence, such estimates are often seen of questionable reliability.

3.2.2 The transaction and currency demand approaches

This approach has been fully developed by Feige (1996). It is based on the assumption that there is a constant relation between the volume of transaction and official GNP over time, as summarized by the well-known Fisher quantity equation. Making assumptions on the velocity of money and about the relationships between the value of total transactions and total (official + unofficial) nominal GNP. Relating total nominal GNP to total transactions, the GNP of the shadow economy can be calculated by subtracting the official GNP from total nominal GNP.

However, to derive figures for the shadow economy, one must assume a base year with given shadow economic activities and a “normal” and constant ratio between the value of total transactions and total nominal (official = total) GNP in that base year. A further assumption is that all variations in the ratio between the total value of transaction and the officially measured GNP are due to the shadow economy. This means that a considerable amount of data is required in order to eliminate for example financial transactions from „pure“ cross payments, which are legal and have nothing to do with the shadow economy. In general, although this approach is theoretically attractive, the empirical requirements necessary to obtain reliable estimates are so difficult to fulfill that its application can lead to doubtful results.

3.2.3 The currency demand approach

The currency demand approach was first used by Cagan (1958), who considered the correlation between currency demand and tax pressure (as one cause of the shadow economy) for the United States over the period 1919 to 1955. 20 years later, Gutmann (1977) used the same approach but without any statistical procedures. Cagan's approach was further developed by Tanzi (1980, 1983), who estimated a currency demand function for the United States for the period 1929 to 1980 in order to calculate the size of the shadow economy. His approach assumes that shadow (or hidden) transactions are undertaken in the form of cash payments to blur otherwise observable traces for authorities. An increase in the size of the shadow econo-

3 The advantages and disadvantages of this method are extensively dealt by Pedersen (2003) and Mogensen et. al (1995) in their excellent and very carefully done investigations.

4 See, e.g., MacAfee (1980) O'Higgins (1989) and Smith (1985), for Great Britain; Petersen (1982) and Del Boca (1981) for Germany; Park (1979) for the United States. For a critical survey, see Thomas (1992).

5 A related approach is pursued by Pissarides and Weber (1989), who use micro data from household budget surveys to estimate the extent of income understatement by self-employed.

my will therefore increase the demand for currency. To isolate the resulting excess demand for currency, a currency demand equation is estimated over time. All conventional possible factors, such as the development of income, payment habits, interest rates, credit and other debt cards as a substitute for cash and so on, are controlled for. Additionally, such variables as the direct and indirect tax burden, government regulation, state institutions and tax morale, which are assumed to be the major factors causing people to work in the shadow economy, are included in the estimation equation.

This is one of the most commonly used approaches. It has been applied to many countries but has nevertheless been criticized on various grounds. The most commonly raised objections to this method are:

(1) Not all transactions in the shadow economy are paid in cash. Isachsen and Strom (1985) used the survey method to find out that in Norway, in 1980, roughly 80 percent of all transactions in the hidden sector were paid in cash. The size of the total shadow economy (including barter) may thus be even larger than estimated.

(2) Most studies consider only one particular factor, the tax burden, as a cause of the shadow economy. But others (such as the impact of regulation, taxpayers' attitudes toward the state, tax morality and so on) are not considered. If, as seems likely, these other factors also have an impact on the extent of the hidden economy, it might again be higher than reported in most studies.⁶

(3) As discussed by Garcia (1978), Park (1979), and Feige (1996), increases in currency demand deposits are largely due to a slowdown in demand deposits rather than to an increase in currency caused by activities in the shadow economy, at least in the case of the US.

(4) Feige (1986, 1996) criticizes Tanzi's studies on the grounds that the US dollar is used as an international currency. He argues that Tanzi should have considered (and controlled for) the presence of US dollars, which are used as an international currency and held in cash abroad.⁷ Frey and Pommerehne (1984) and Thomas (1986, 1992, 1999) claim that Tanzi's parameter estimates are not very stable.⁸

6 One (weak) justification for using the tax variable only is that this variable has by far the strongest impact on the size of the shadow economy in the studies known to the author. The only exception is the study by Frey and Weck-Hannemann (1984) where the variable "tax immorality" has a quantitatively larger and statistically stronger influence than the direct tax ratio. In the study of Pommerehne and Schneider (1985), for the US, besides various tax measures, data for regulation, tax immorality, minimum wage rates are available, the tax variable has a dominating influence and contributes roughly 60-70% to the size of the shadow economy.

7 Tanzi (1982, esp. pp. 110-113) explicitly deals with this criticism. A very careful investigation of the amount of US dollars used abroad and US currency used in the shadow economy and for "classical" crime activities has been undertaken by Rogoff (1998), who concludes that large denomination bills are major driving force for the growth of the shadow economy and classical crime activities, as they reduce transactions costs significantly.

8 In studies for European countries Kirchgässner (1983, 1984) and Schneider (1986) conclude that the estimation results for Germany, Denmark, Norway and Sweden are quite robust using the currency demand method. Hill and Kabir (1996) find for Canada that the rise of the shadow economy varies with respect to the tax variable used.

(5) Most studies assume the same velocity of money in official and shadow economies. As argued by Hill and Kabir (1996) for Canada and by Klovland (1984) for the Scandinavian countries, there is considerable uncertainty about the velocity of money in the official economy, and the velocity of money in the hidden sector is even more difficult to estimate. Without knowledge about the velocity of currency in the shadow economy, one has to accept the assumption of an equal velocity of money in both sectors.

(6) Ahumada et al. (2004) show that the currency demand approach together with the assumption of equal income velocity of money concerning reported and hidden transactions is only correct if the income elasticity is 1.

(7) Finally, the assumption of no shadow economy in a base year is open to criticism. Relaxing this assumption would again imply an upward adjustment for its size.

3.2.4 The physical input (electricity consumption) method

To measure overall (official and unofficial) economic activity in an economy, Kaufmann and Kaliberda (1996) assume that electricity consumption is regarded as the single best physical indicator of overall (or official plus unofficial) economic activity.⁹ Overall economic activity and electricity consumption have been empirically observed throughout the world to move in lockstep with an electricity to GDP elasticity usually close to one. This means that the growth of total electricity consumption is an indicator for growth of overall (official and unofficial) GDP. By having this proxy for the overall economy and then subtracting this overall measure from the estimates of official GDP, Kaufmann and Kaliberda (1996) derive an estimate of unofficial GDP.

This method is very simple and appealing. However, it can also be criticized on various grounds:

(1) Not all shadow economy activities require a considerable amount of electricity (e.g. personal services), and other energy sources can be used (gas, oil, coal, etc.). Hence, only a part of the shadow economy will be indicated.

(2) Over time, there has been considerable technical progress so that both the production and use of electricity are more efficient than in the past, and this will apply in both official and unofficial uses.

(3) There may be considerable differences or changes in the elasticity of electricity/GDP across countries and over time.¹⁰

9 This method was used earlier by Lizzeri (1979), Del Boca and Forte (1982), and much later by Kaufmann and Kaliberda (1996) and Johnson et al. (1997). For a critique see Lackó (1998).

10 Johnson et al. (1997) make an attempt to adjust for changes in the elasticity of electricity to GDP.

Lackó (1998, 1999, 2000a,b) assumes that a certain part of the shadow economy is associated with the household consumption of electricity. This part comprises the so-called household production, do-it-yourself activities, and other non-registered production and services. Lackó further assumes that in countries where the portion of the shadow economy associated with the household electricity consumption is high, the rest of the hidden economy (or the part Lackó cannot measure) will also be high. Lackó (1996, pp.19 ff.) assumes that in each country a part of the household consumption of electricity is used in the shadow economy. This approach is subject to similar caveats like the method developed by Kaufmann and Kaliberda (1996) and shadow economic activities do not take place in the household sector only.

3.2.5 The model approach

All methods described so far consider just one indicator to capture the shadow economy. However, shadow economy effects show up simultaneously in production/consumption and the labor market. An even more important critique is that the causes that determine the size of the shadow economy are taken into account only in some of the monetary approach studies that usually consider one cause, the burden of taxation. The model approach explicitly considers multiple causes of the existence and growth of the shadow economy, as well as the multiple effects of the shadow economy over time. The empirical method used is quite different from those described so far. It is based on the statistical theory of unobserved variables, which considers multiple causes and multiple indicators of the phenomenon to be measured.

As the size of the shadow economy is by definition unknown (not officially measured such as the GDP), applying a latent estimator approach such as the MIMIC (i.e. multiple indicators, multiple causes estimation) procedure may be plausible. This method uses the statistical theory of unobservable variables. The statistical idea behind such a model is to compare a sample covariance matrix, that is, a covariance matrix of observable variables, with the parametric structure imposed on this matrix by a hypothesized model.¹¹) Using covariance information among the observable variables, the unobservable variable is in the first step linked to observable variables in a factor analytical model also called measurement model. Second, the relationships between the unobservable variable and observable variables are specified through a structural model. Therefore, a MIMIC model is the simultaneous specification of a factor and a structural model as Figure 1 demonstrates. The general idea behind the application of this model is to estimate the relationships between a set of observable variables, divided into causes and indicators,

and the shadow economy (unobservable variable), and to test if the researcher's theory or the derived hypotheses as a whole fit the data. The key advantage of the MIMIC approach is the ability to take the multiple determinants (causes) and multiple effects (indicators) of the shadow economy into account.

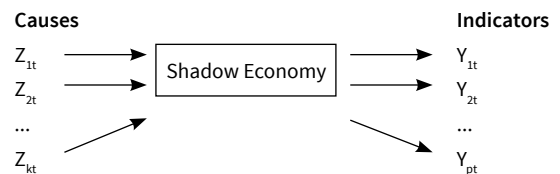


Figure 1: The MIMIC model

Source: Buehn and Schneider (2013), p. 177.

The details of this approach, its advantages and disadvantages, the application to single country, cross-country and time series studies as well as the criticism raised against its application is comprehensively discussed in Schneider and Buehn (2017). Of course this method has its limitations, too, which are identified and discussed in the literature. The criticism mostly focuses on the following points:

- (1) One often made objection is the meaning of the latent variable (e.g. Helberger and Knepel 1988; Dell'Anno 2003). The confirmatory rather than exploratory nature of this approach means that one is more likely to determine whether a certain model is valid than to 'find' a suitable model. This criticism is probably the most common in the literature being difficult to overcome as it goes back to the theoretical assumptions behind the choice of variables and the empirical limitations of data availability.
- (2) Helberger and Knepel (1988) argue that SEM/MIMIC models lead to unstable coefficients w.r.t. changes of the sample size and alternative model specifications. Dell'Anno (2003) shows, however, that the instability disappears asymptotically as the sample size increases.
- (3) The criticism also focuses on the benchmarking procedure used to derive figures of shadow economic activities (Breusch 2005). Often, the application of the 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 (Dell'Anno and Schneider (2009).

The economic literature using such models is well aware of these limitations. Consequently, it acknowledges that it is not an easy task to apply this methodology to an economic dataset, but also argues that this does not mean one should abandon this approach. On the

¹¹ Estimation of a MIMIC model with a latent variable can be done by means of a computer program for the analysis of covariance structures, such as LISREL (Linear Structural Relations). A useful overview of the LISREL software package in an economics journal is Cziraky (2004).

contrary, following an interdisciplinary approach to economics, SEMs are valuable tools for economic analysis, particularly when studying the shadow economy. Moreover, the mentioned objections should provide incentives for further research in this field.

3.3. Estimates of the German shadow economy using different methods

Finally, I will show a few empirical figures for the size and development of the shadow economy in Germany, the Czech Republic and Poland. While the literature presents plenty of estimations about the size and development of the German shadow economy, much less is known about it concerning the Czech Republic and Poland. Empirical results for Germany are shown in great detail in Table 2, both with respect to different estimation procedures as discussed above and to the development over time from the 1970s to the beginning of the 21st century. The oldest estimate uses the survey method of the Institut für Demoskopie (IfD) in Allensbach (Germany) and shows that the shadow economy was 3.6% of official GDP in 1974. In a much later study Feld and Larsen (2005, 2009) undertook an extensive research project using the survey method to estimate shadow economy activities in the years 2001 to 2006. Using the officially paid wage rate, they concluded that shadow economic activities reached 4.1% in 2001, 3.1% in 2004, 3.6% in 2005 and 2.5% in 2006. Using the much lower shadow economy wage rate, these estimates shrink, however, to 1.3% in 2001 and 1.0% in 2004, respectively.

As discussed, it is likely that the survey method underestimates the size of the shadow economy. Using the discrepancy method and applying national income statistics, Lippert and Walker (1997) estimate a size of the German shadow economy from 1970 to 1980 between 11.0% and 13.4% of official GDP. Using the discrepancy method applying official and actual employment, Langfeldt (1983) gets much higher estimates for 1970 to 1980, ranging from 23.0% to 34.0%. Applying the physical input method (electricity approach), Feld and Larsen (2005) get results of 14.5% for the year 1985 and 14.6% for 1990. The monetary transaction method developed by Feige calculates the shadow economy to be of about 30% between 1980 and 1985. These are the highest estimates for the case of Germany. Applying the currency demand approach, Kirchgässner (1983, 1984) presents values of 3.1% in 1970 and 10.3% in 1980. His estimates are quite similar to those obtained by Schneider and Enste (2000, 2002), who also use the currency demand approach to estimate the size of the shadow economy, which are 4.5% in 1970 and 14.7% in 2000. For the first time, Frey and Weck (1983) use the MIMIC model and present results quite similar to those from the currency demand approach.¹² They calculated a shadow economy in Germany in 1970 of 5.8%, which increases to 8.2% in 1980. Pickardt and Sarda (2006) presented an estimate of 9.4% for 1980, which increased to 16.3% in the year 2000. The different empirical results are due to the sample

starting a bit later. These are quite similar values to Schneider (2005, 2007). Finally, using the soft modeling variant of the MIMIC approach, Weck-Hannemann (1983) gets a value of 8.3% of GDP in 1975.

Table 2 also shows the very different results different estimation procedures produce. It is safe to say that the figures of the transactions and discrepancy approaches are unrealistically large. A size of the shadow economy of almost one third of official GDP in the mid-eighties is most likely an exaggeration. The figures obtained using the currency demand and the hidden (latent, MIMIC) approaches are, on the other hand, relatively close together and much lower than those produced by the discrepancy or transactions approach. The estimates from the MIMIC approach may be regarded as the most reasonable estimates of the size of the shadow economy and the survey model is likely to produce too low estimates for the reasons already discussed.

Table 3 presents yearly estimates for the size and development in the Czech Republic, Germany, and Poland over the period 2000 to 2010. It can be seen that in all three countries the shadow economies had decreased during the period shown. However, the continuous decline had stopped in 2009/2010 due to the world financial and economic crisis in 2009. Worldwide, economic growth came to an abrupt ending and jobs were cut. People therefore potentially looked for alternative income sources in the shadow economy. Table 3 also shows that shadow economic activities are much more common in Poland compared to Germany and the Czech Republic. In the latter countries, the shadow economy averaged to about 16% of official GDP while it was about 26% of official GDP in Poland.

Finally, I will briefly address the question how the shadow economy may be responded to the Coronavirus COVID-19 pandemic. Empirical and theoretical research regarding the effect of such a long and severe health, economic, and societal crisis on the shadow economy is still very limited. My remarks are therefore notional to some extent. As discussed above, the shadow economy – if seen as problematic at all – cannot easily and simply be handled through higher fines and the stricter enforcement of controls. It is a too complex phenomenon. Because of different attitudes of people, the level of development, and the severity of the Coronavirus COVID-19 pandemic as well as government measures responding to it, a country-specific analysis of causes and consequences concerning the development of the shadow economy during the pandemic is necessary.

Looking briefly at the determinants of the shadow economy – taxes, unemployment as well as rules and regulations and their enforcement – it seems likely that the shadow economy has grown during the last two years in many countries around the world. Due to shutdowns and the worldwide decrease of demand for goods and services economies have shrunk. The subsequent lower demand for labor

¹² This is not astonishing as quite often the starting values of the calibration procedure are taken from the currency demand approach in order to transform the relative estimates of the MIMIC model into actual values of the shadow economy.

Method/Source	Shadow economy (in percentage of official GDP) in:							
	1970	1975	1980	1985	1990	1995	2000	2005
Survey (IfD Allensbach 1975) (Feld and Larsen 2005)	-	3.6 ¹⁾	-	-	-	-	-	-
	-	-	-	-	-	-	4.1 ²⁾	3.1 ²⁾
	-	-	-	-	-	-	1.3 ³⁾	1.0 ³⁾
Discrepancy between expenditure and income (Lippert and Walker 1997)	11.0	10.2	13.4	-	-	-	-	-
Discrepancy between official and actual employment (Langfeldt 1983)	23.0	38.5	34.0	-	-	-	-	-
Physical input method (Feld and Larsen 2005)	-	-	-	14.5	14.6	-	-	-
Transactions approach	17.2	22.3	29.3	31.4	-	-	-	-
Currency demand approach (Kirchgässner 1983) (Langfeldt 1983, 1984) (Schneider and Enste 2000)	3.1	6.0	10.3	-	-	-	-	-
	12.1	11.8	12.6	-	-	-	-	-
	4.5	7.8	9.2	11.3	11.8	12.5	14.7	-
Latent ((DY)MIMIC) approach (Frey and Weck 1983) (Pickardt and Sarda 2006) (Schneider 2005, 2007)	5.8	6.1	8.2	-	-	-	-	-
	-	-	9.4	10.1	11.4	15.1	16.3	-
	4.2	5.8	10.8	11.2	12.2	13.9	16.0	15.4
Soft modelling (Weck-Hannemann 1983)	-	8.3	-	-	-	-	-	-

Table 2: The size of the shadow economy in Germany according to different methods (in percentage of official GDP)

Source: Feld and Schneider (2010), p. 132, Table 12; Schneider and Enste (2000), pp. 106-107, Table 8 (Germany only).

¹⁾ 1974. ²⁾ 2001 and 2004; calculated using wages in the official economy. ³⁾ 2001 and 2004; calculated using actual "black" hourly wages paid.

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg.
Czech Rep.	19.1	18.9	18.8	18.7	18.4	17.8	17.3	16.3	15.2	15.7	15.5	17.6
Germany	16.0	15.9	16.1	16.3	16.1	16.0	15.6	15.3	14.8	14.6	15.1	15.7
Poland	27.6	27.7	27.7	27.5	27.3	26.9	26.4	25.4	24.7	24.6	23.8	26.4

Table 3: Size of the shadow economy in the Czech Republic, Germany, and Poland

Source: Schneider and Buehn (2017)

has resulted in a cutback of jobs and consequently to income losses for quite some people. This should have made participation in the shadow economy more attractive as people wanted to compensate their income losses and have thus probably supplied more labor informally. Demand for goods and services produced in a cheaper, i.e. untaxed way, in the shadow economy may have also increased matching the higher supply of production (factors) in the black market. Looking at the long run developments, taxes and the price level/inflation – due to the lack or shortage of preliminary and/or intermediate products and potential adjustments economies need to deal with addressing the climate crises – will very likely increase. These are another two important reasons for growing shadow economies during and in the aftermath of the Coronavirus COVID-19 pandemic. The strong correlation between corruption and the size of the shadow economy is a key problem in times of crisis too (Buehn and Schneider 2012). Corrupt officials increase distrust in official institutions, i.e. when politicians are much earlier vaccinated against Covid-19 than the general public, facing a higher risk of severe health problems from the disease. Buehn and Schneider (2012) have shown that countries with higher trust in official institutions and the society (i.e. more social capital) have smaller shadow economies, *ceteris paribus*. Hence, these countries should also have suffered less in economic terms from the Covid-19 pandemic and face fewer consequences concerning the size and development of their shadow economies.

4. SUMMARY AND CONCLUDING REMARKS

This article has discussed some recent developments in research about the measurement of the shadow economy and presented some estimations for especially Germany as well as Poland and the Czech Republic. It shows that a wide range of measurement methods exists which produce quite different results with huge variances. Summarizing the findings about the methods to estimate the size and development of the shadow economy, one has to acknowledge that each method has its caveats: The survey method has the disadvantages that quite often only households are questioned and firms are – at least partly – left out. In addition, surveys typically do obtain results of the financial volume of “black” hours worked and do not calculate value added figures (Feld and Larsen 2005, 2008, 2009, and Kazemier 2006). The discrepancy method has the difficulty that quite often a combination of “rough” estimations and unclear assumptions is used, and the reader is often left with some uncertainty about the calculation method. The monetary and/or electricity methods result in very (unrealistic) high estimates and great differences converting millions of kWh into a value added figure. The MIMIC (latent) method has a number of critical points as well. The most prominent are that estimations are quite often highly sensitive with respect to changes in the data and specifications, and the intricacy to differentiate between causes and indicators of the shadow economy. The literature also discusses the application of the calibration (benchmarking) procedure used to convert the relative coefficients estimated into a value added figure of the shadow economy.

I will conclude by trying to answer the question what we have learnt in the last 35 years of shadow economy research:

1. There is no ideal or dominating method to estimate the size and development of the shadow economy. All methods have their own methodological problems and weaknesses. Combining the results of several methods may allow getting somewhat closer to the “true” value for the size of the shadow economy.
2. Much more research is needed with respect to the estimation methodology and the empirical results for different countries and periods.
3. Future research should may be focus on shadow economy research at the micro level, even combined with the application of experimental methods in order to reach a better micro-foundation and to develop a better understanding about people’s incentives and earnings working in the shadow economy.

What questions do remain open? A common and internationally accepted definition of the shadow economy is still missing. Such a definition or convention is needed to make the comparisons between shadow economy estimates of different countries more reliable. The link between theory and empirical results of shadow economy estimations is still unsatisfactory. At the moment, theory mostly provides us with the expected signs of the causal factors, but which are the “core” causal factors and indicators is still open and the selection in empirical research is often altered. A satisfactory validation of the empirical results is thus necessary and has to be established so that it is easier to judge the empirical results with respect to their plausibility.

REFERENCES

- Ahumada, H., Facundo, A., Canavese A. and P. Canavese (2004), The demand for currency approach and the size of the shadow economy: a critical assessment, Discussion Paper, Delta Ecole Normale Supérieure, Paris.
- Allingham, M.G. and A. Sandmo (1972), Income Tax Evasion: A Theoretical Analysis, *Journal of Public Economics*, 1/3, pp. 323–338.
- Breusch, T. (2005a), The Canadian underground economy: An examination of Giles and Tedds, *Canadian Tax Journal*, 53, pp. 367–391.
- Buehn, A. and F. Schneider (2012), „Corruption and the shadow economy: like oil and vinegar, like water and fire?, *International Tax and Public Finance*, 19(1), pp. 172–194.
- Shadow Economies around the World: Novel Insights, Accepted Knowledge, and New Estimates, *International Tax and Public Finance*, 19, pp. 139–171.

- Buehn, A. and F. Schneider (2013), A preliminary attempt to estimate the financial flows of transnational crime using the MIMIC method, in: B. Unger and D. van der Linde (eds.), *Research Handbook on Money Laundering*, Edward Elgar Publishing, Cheltenham, UK, pp. 172-189.
- Buehn, A., Karmann, A. and F. Schneider (2009), Shadow economy and do-it-yourself activities: the German case, *Journal of Institutional and Theoretical Economics*, 165/4, pp.701-722.
- Cagan, P. (1958), The demand for currency relative to the total money supply, *Journal of Political Economy*, 66, pp. 302-328.
- Dell'Anno, R. (2003), Estimating the shadow economy in Italy: A structural equation approach, Working Paper 2003-7, Department of Economics, University of Aarhus, Aarhus, Denmark.
- Dell'Anno, R. and F. Schneider (2009), A complex approach to estimate shadow economy: the structural equation modelling, in M. Fagnini and T. Looks (eds), *Coping with the Complexity of Economics*, Springer, Berlin, pp. 110-30.
- Del Boca, D. (1981), Parallel economy and allocation of time, *Micros (Quarterly Journal of Microeconomics)*, 4, pp. 13-18.
- Del Boca, D. and F. Forte (1982), Recent empirical surveys and theoretical interpretations of the parallel economy in Italy, in: V. Tanzi (ed.), *The Underground Economy in the United States and Abroad*, Lexington Books, Lexington, MA, pp. 160-178.
- Feige, E.L. (1986), A re-examination of the underground economy in the United States, *IMF Staff Papers*, 33, pp. 768-781.
- Feige, E.L. (1996), Overseas holdings of U.S. currency and the underground economy. In: Pozo, S. (Ed.), *Exploring the Underground Economy*. W.E. Upjohn Institute for Employment Research, Kalamazoo, MI, pp. 5-62.
- Feld, L.P. and B.S. Frey (2007), Tax Compliance as the Result of a Psychological Tax Contract: The Role of Incentives and Responsive Regulation, *Law and Policy*, 29/1, pp. 102-120.
- Feld, L. P. and C. Larsen (2005), Black Activities in Germany in 2001 and 2004: A Comparison Based on Survey Data, Study no.12, Copenhagen: Rockwool Foundation Research Unit.
- Feld, L. P. and C. Larsen (2008), „Black“ activities low in Germany in 2006, News from the Rockwool Foundation Research Unit, March, pp. 1-12.
- Feld, L. P. and C. Larsen (2009), Undeclared Work in Germany 2001-2007 – Impact of Deterrence, Tax Policy, and Social Norms: An Analysis Based on Survey Data, Springer, Berlin.
- Feld, L. P. and F. Schneider (2010), Survey on the shadow economy and undeclared earnings in OECD countries, *German Economic Review*, 11/2, pp. 109-49.
- Frey, B. S. and W. Pommerehne (1984), The hidden economy: State and prospect for measurement, *Review of Income and Wealth*, 30/1, pp. 1-23.
- Frey, B.S. and H. Weck (1983), Estimating the shadow economy: a “naïve” approach, *Oxford Economic Papers*, 35, pp. 23-44.
- Frey, B.S. and H. Weck-Hannemann (1984), The hidden economy as an “unobserved” variable, *European Economic Review*, 26, pp. 33-53.
- Garcia, G. (1978), The currency ratio and the subterranean economy, *Financial Analysts Journal*, 69, pp. 64-66.
- Gutmann, P.M. (1977), The subterranean economy, *Financial Analysts Journal*, 34/1, pp. 24- 27.
- Helberger, C. and H. Knepel (1988), How big is the shadow economy? A re-analysis of the unobserved-variable approach of B.S. Frey and H.Weck-Hannemann, *European Economic Review*, 32/4, pp. 965-976.
- Hill, R. and M. Kabir (1996), Tax rates, the tax mix, and the growth of the underground economy in Canada: what can we infer?, *Canadian Tax Journal/Revue Fiscale Canadienne*, 44, pp. 1552-1583.
- IfD Allensbach (1975), Studie im Auftrag der Kommission für Wirtschaftlichen und Sozialen Wandel, Bodensee: Allensbach.
- Isachsen, A.J. and S. Strøm (1985), The Size and Growth of the Hidden Economy in Norway, *Review of Income and Wealth*, 31/1, pp. 21-38.
- Johnson, S., Kaufmann, D. and A. Shleifer (1997), The unofficial economy in transition, *Brookings Papers on Economic Activity*, Fall, Washington D.C.
- Kanniainen, V., Pääkönen J. and F. Schneider (2004), Fiscal and Ethical Determinants of Shadow Economy: Theory and Evidence, Discussion Paper, Department of Economics, Johannes Kepler University of Linz, Linz, Austria.

- Kaufmann, D. and A. Kaliberda (1996), Integrating the unofficial economy into the dynamics of post socialist economies: a framework of analyses and evidence, in: Kaminski, B. (ed.), *Economic Transition in Russia and the New States of Eurasia*. M.E. Sharpe, London, pp. 81–120.
- Kirchgässner, G. (1983), Size and development of the West German shadow economy, 1955–1980, *Zeitschrift für die Gesamte Staatswissenschaft*, 139, pp. 197–214.
- Kirchgässner, G. (1984), Verfahren zur Erfassung des in der Schattenwirtschaft erarbeiteten Sozialprodukts, *Allgemeines Statistisches Archiv*, 68, pp. 378–405.
- Klovland, J. (1984), Tax evasion and the demand for currency in Norway and Sweden: is there a hidden relationship?, *Scandinavian Journal of Economics*, 86, pp. 423–439.
- Lackó, M. (1996), Hidden economy in East-European countries in international comparison, Working paper, International Institute for Applied Systems Analysis (IIASA), Laxenburg.
- Lackó, M. (1998), The Hidden Economies of Visegrad Countries in International Comparison: A Household Electricity Approach, in: Halpern, L. and Ch. Wyplosz (eds.), *Hungary: Towards a Market Economy*, Cambridge (Mass.), Cambridge University Press.
- Lackó, M. (1999), Electricity Intensity and the Unrecorded Economy in Post-Socialist Countries, in: Feige, E. and K. Ott (eds.), *Underground Economies in Transition*, Ashgate Publishing Company.
- Lackó, M. (2000a), Do Power Consumption Data Tell the Story? Electricity Intensity and Hidden Economy in Post-Socialist Countries, in: Maskin, E. and A. Simonovits (eds.), *Planning, Shortage and Transformation: Essays in Honor of Janos Kornai*, Cambridge (Mass.), The MIT Press.
- Lackó, M. (2000b), Hidden Economy – an Unknown Quantity? Comparative Analysis of Hidden Economies in Transition Economies, 1989-95, *Economics of Transition*, 8/1, pp. 117-149.
- Langfeldt, E. (1983), The unobserved economy in the Federal Republic of Germany, in: Feige, E.L. (ed.), *The Unobserved Economy*, Cambridge University Press, Cambridge, UK, pp. 236–260.
- Lippert, O. and M. Walker (eds.) (1997), *The Underground Economy: Global Evidences of its Size and Impact*, The Frazer Institute, Vancouver, B.C.
- MacAfee, K. (1980), A glimpse of the hidden economy in the national accounts, *Economic Trends*, 136, pp. 81–87.
- Mogensen, G.V., Kvist, H.K., Kfirmendi, E. and S. Pedersen (1995), *The Shadow Economy in Denmark 1994: Measurement and Results*, Study no. 3, The Rockwool Foundation Research Unit, Copenhagen.
- O’Higgins, M. (1989), Assessing the underground economy in the United Kingdom, in: Feige, E.L. (ed.), *The Underground Economies: Tax Evasion and Information Distortion*, Cambridge University Press, Cambridge, UK, pp. 175–195.
- Park, T. (1979), *Reconciliation Between Personal Income and Taxable Income*, Bureau of Economic Analysis, Washington, DC, pp. 1947–1977.
- Pedersen, S. (2003), *The Shadow Economy in Germany, Great Britain and Scandinavia: A Measurement Based on Questionnaire Service*, Study No. 10, The Rockwool Foundation Research Unit, Copenhagen.
- Petersen, H.G. (1982), Size of the public sector, economic growth and the informal economy: development trends in the Federal Republic of Germany, *Review of Income and Wealth*, 28, pp. 191–215.
- Pissarides, C. and G. Weber (1989), An expenditure-based estimate of Britain’s black economy, *Journal of Public Economics*, 39, pp. 17-32.
- Pommerehne, W.W. and F. Schneider (1985), The decline of productivity growth and the rise of the shadow economy in the U.S., Working Paper 85-9, University of Aarhus.
- Posner, E.A. (2000), *Law and Social Norms*, Harvard University Press, Cambridge.
- Rogoff, K. (1998), Blessing or curse? Foreign and underground demand for euro notes, *Economic Policy: The European Forum*, 26, pp. 261–304.
- Schneider, F. (1986), Estimating the size of the Danish shadow economy using the currency demand approach: an attempt, *The Scandinavian Journal of Economics*, 88, pp. 643–668.
- Schneider, F. (2005), Shadow economies around the world: what do we really know?, *European Journal of Political Economy*, 21(4), pp. 598–642.
- Schneider, F. (2007), *Shadow Economies and Corruption All Over the World: New Estimates for 145 Countries*, *Economics*, 2007-9, July.
- Schneider, F. (2015), *Schattenwirtschaft und Schattenarbeitsmarkt: Die Entwicklungen der vergangenen 20 Jahre, Perspektiven der Wirtschaftspolitik*, 16/1, pp. 3-25.

Schneider, F. and A. Buehn (2013), Shadow Economies in Highly Developed OECD-Countries: What are the Driving Forces?, Discussion Paper, Department of Economics, University of Linz, Linz, Austria, June 2013.

Schneider F. and A. Buehn (2017), Shadow Economy: Estimation Methods, Problems, Results and Open questions,“ Open Economics, De Gruyter, vol. 1(1), March, pp. 1-29.

Schneider, F. and D. Enste (2000), Shadow economies: Size, causes, and consequences, The Journal of Economic Literature, 38/1, pp. 77-114.

Schneider, F. and D. Enste (2002), The Shadow Economy: Theoretical Approaches, Empirical Studies, and Political Implications, Cambridge University Press, Cambridge (UK).

Schneider, F. and C.C. Williams (2013), The Shadow Economy, IEA, London.

Smith, J.D. (1985), Market motives in the informal economy, in: Gaertner, W. and A. Wenig (eds.), The Economics of the Shadow Economy, Springer, Heidelberg, pp. 161-177.

Tanzi, V. (1980), The underground economy in the United States: estimates and implications, Banca Nazionale del Lavoro, 135, pp. 427-453.

Tanzi, V. (1982), A second (and more skeptical) look at the underground economy in the United States, in: Tanzi, V. (ed.), The Underground Economy in the United States and Abroad, Lexington Books, Lexington, MA, pp. 38-56.

Tanzi, V. (1983), The underground economy in the United States: annual estimates, 1930-1980, IMF Staff Papers, 30, pp. 283-305.

Thomas, J.J. (1986), The underground economy in the United States: comment on Tanzi, IMF Staff Papers, 33, pp. 782-789.

Thomas, J. J. (1992), Informal Economic Activity, LSE, Handbooks in Economics, Harvester Wheatsheaf, London.

Thomas, J.J. (1999), Quantifying the Black Economy: „Measurement Without Theory‘ Yet Again?, Economic Journal, 109, pp. 381-389.

Weck-Hannemann, H. (1983), Schattenwirtschaft: Eine Möglichkeit zur Einschränkung der öffentlichen Verwaltung? Eine ökonomische Analyse, Bern-Frankfurt.