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Implausible Large Differences in the Sizes of Underground Economies in Highly Developed European Countries? A Comparison of Different Estimation Methods

by

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Abstract

In this paper, first, the MIMIC estimation method is described and criticized and due to a double counting problem a correction is suggested. Second, the measurement methods used for National Accounts Statistics – the discrepancy method and two new micro survey methods – are described and a third, a micro method, using a combination of company manager surveys and their knowledge to calibrate the size of the shadow economy in firms, is presented, too. Third, a detailed comparison of the four micro estimation methods with the MIMIC and the corrected MIMIC method are presented. One major result is that the corrected MIMIC method, especially, comes quite close to various types of lately developed micro survey methods.

Keywords: MIMIC estimation methods, macro and adjusted, micro survey method asking company managers, micro survey method using households' data, using the consumption-income-gap, comparison of results of size of shadow economy of European countries, shadow economies.

JEL-classifications: E26, E01, H 26, H32, K42, P 24, O17

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1) Introduction

The estimation of the size and development of shadow economies all over the world is a hot and controversial scientific topic. There are numerous review articles which tackle this problem and there is ongoing debate about the plausibility of the size of the shadow economy under the various methods[1]. At the same time, some new and promising micro approaches have been developed, widening the survey methods. The goal of this paper is twofold, first to present the results of four micro methods, and second to compare these micro-based results with MIMIC-macro and MIMIC-macro-adjusted results, as from them we see the, by far, the biggest differences in the size of various countries' shadow economies.

In chapter 2 four micro approaches (surveys and related techniques) are presented and also the MIMIC and the adjusted MIMIC approach. In chapter 3 a detailed comparison of the results for the size of the shadow economy of mostly highly developed European countries is undertaken to see how large the difference is between these macro (MIMIC) and micro approaches and what we can learn when making these comparisons. Chapter 4 provides a summary and draws some conclusions.

2) Micro approaches and a modified macro MIMIC approach to estimate a shadow economy

In this chapter the following five methods of measuring the shadow economy[2] are briefly presented[3] and critically evaluated.

(i) Measurement by the system of National Accounts Statistics – Discrepancy method;

(ii) Micro approach (survey technique);

(iii) Micro method: use of surveys of company managers;

(iv) Micro method: estimation of the consumption-income-gap of households; and

(v) MIMIC method (macro and adjusted).

[1] For recent surveys compare Feld and Schneider (2010), Schneider (2017), Williams and Schneider (2016). For debates and controversies compare Kirchgaessner (2016) and Feld and Schneider (2016), Breusch (2016), Feige (2016a,b), Schneider (2016) and Hashimzade and Heady (2016).

[2] 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).

[3] 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).

2.1. 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 productive and legal, but deliberately concealed from public authorities.
(ii) Illegal production: Productive activities that generate goods and services forbidden by law or they 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.

Goymai and van de Ven (2014) provide a quite precise definition in order to reach the goal of exhaustive estimates which is the following:

(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, value added or other payments;
(ii) to avoid the payment of social security contributions;
(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 posession 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:

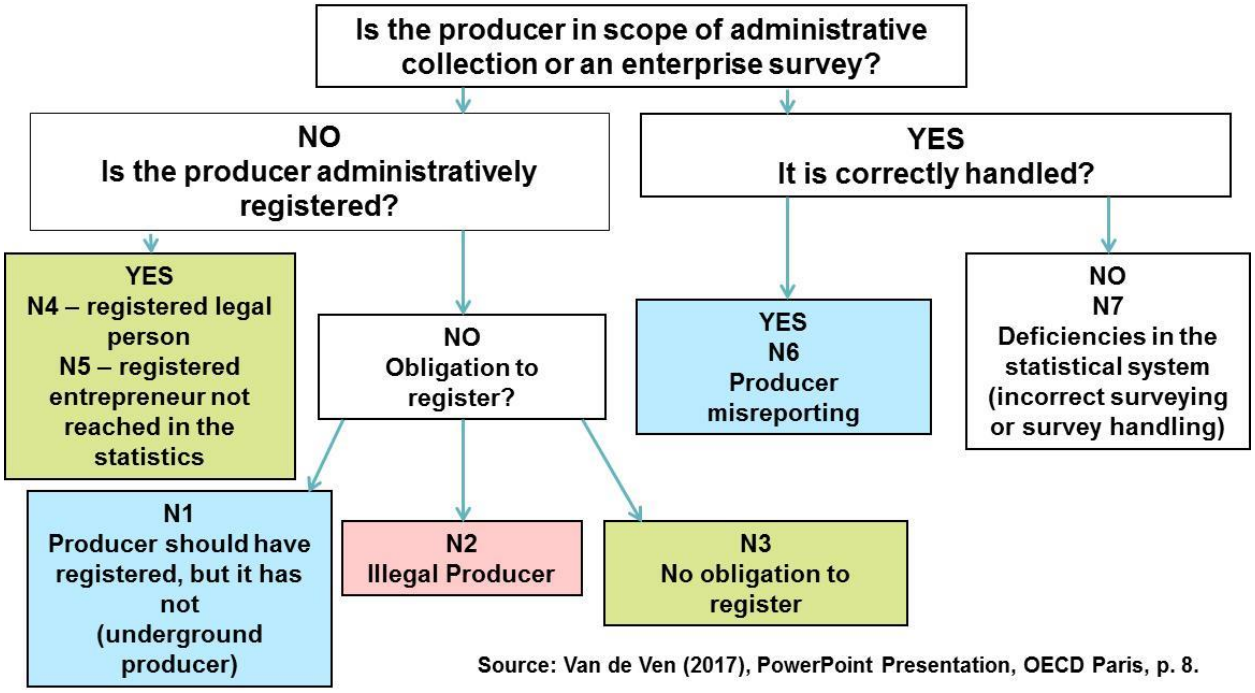
First, data sources with identifying biases on reporting on scope are corrected via imputations.

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 2.1 the classification of the NOE (non-observed economy) in order to reach estimates with the national accounts‘ method (NAM) is shown.

Figure 2.1: Classification of NOE (Non-Observed Economy)



We clearly see that this is a careful procedure which takes all possible situations so that one finally should get an exhaustive estimation. The concept of the national account 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, in European Union nowadays increased interest in illegal activities, 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 the various countries. Table 2.1 presents NOE adjustments by informality type of 16 developed OECD countries over the years 2011 to 2012. It shows that the total non-observed economy varies considerably between the countries[4]. 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%, followed by Slovak Republic with 15.6% and Poland with 15.4% of official GDP. The smallest one here is Norway with 1%.

Table 2.1: NOE adjustments by informality type – percentage 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%)**
U.K.	**1.5 (65.6%)**	**-**	**0.5 (22.9%)**	**0.3 (11.4%)**	**2.3 (100%)**

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

2.2. Micro-Approach: Representative surveys

Representative surveys[5] 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 from May 22 until June 15, 2015. The target audience included local residents aged 18–75. The total sample size comprised 6,000 respondents across the six countries. Approximately two thirds of the survey participants were 36 years old or older. Some

[4] A comparison to other methods will be done in chapter 3.

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

results of the surveys are presented in Tables 2.2 and 2.3[6]. Table 2.2 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% in Sweden and 20.7% 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. In Table 2.3 the extent of aggregated shadow wages as a proportion of GDP is shown. Obviously Sweden has by far the lowest with 1.7% of GDP as shadow employment, Belarus the largest with 32.8%, followed by Poland with 24%. One also sees a quite considerable variance here.

Table 2.2: Undeclared working hours as a proportion of normal working hours; year 2015

Country	Friends/ relatives in shadow labor market	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
	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).

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

Table 2.3 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
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.

2.3. Micro method: Measuring the shadow economy with the use of surveys of company managers

Putnins and Sauka (2015) 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. They have developed first results for Estonia, Latvia and Lithuania. Results are shown in Table 2.4. For all countries, there is a decline over the period 2009 to 2015 and the highest shadow economy is Latvia with 27.8% average over 2009 to 2015, followed by Estonia with 17.4% and Lithuania with 16.4%.

Table 2.4: A comparison of the size of the shadow economy (in % 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).

2.4. Micro method using household data based on the consumption-income-gap

The size of the shadow economy of the Czech and Slovak Republic is estimated by Lichard, Hanousek and Filer (2014, 2016) based on microeconomic data without making the unrealistic assumption which leads to underestimating the size of the shadow economy by excluding underreporting among those who unjustifiably are assumed to have fully reported their income. Their explanation is that employees being paid under the table or having a secondary undeclared source of income while not being officially classified as self-employed constitute a major source of unreported income; this is included in their approach. Lichard, Hanousek and Filer correctly criticize that most approaches continue to rely on the basic and critical assumption that researchers must specify in advance a sub-set of the population who always fully report their incomes and another group of self-employed individuals who may underreport. These simplifying assumptions are, however, weak, both theoretically and empirically. Hence, their goal is to avoid the problem of arbitrary a priori assignment of individuals to evading and non-evading groups by using an endogenous switching regression with an unknown sample separation rule, to estimate the probability of underreporting and its potential extent. Such a technique is, to the authors' knowledge, first used by them and they apply a new method for the year 2008 for the Czech and Slovak Republics. The size of the shadow economy for 2008 for the Czech Republic was 17.6% and for the Slovak Republic 22.9%. These are quite high values for the shadow economies for these two countries, higher than the shadow economy calculated from normal micro methods and other methods[7].

[7] Compare chapter 3 for detailed results.

2.5. The Model or Macro MIMIC approach

2.5.1. The Method

Using this macro approach the size of the shadow economy is based on a combination of the cash (currency/demand) approach and of the Multiple Indicators Multiple Causes (MIMIC) method. The basic idea behind the currency demand approach is that goods and services performed in the shadow economy are paid for in cash and that, using a cash demand function, it is possible to estimate such goods and services performed in return for cash and thus to calculate the volume (value added) of the shadow economy. The MIMIC approach is based on the idea that the shadow economy is not a directly observable figure, but that it is possible to approximate it using quantitatively measurable causes of working in the underground economy (such as the tax burden and amount of regulation), and using indicators (such as cash, official labor force participation rate, etc.), in which shadow economic activities are reflected. As the MIMIC method only enables relative orders of magnitude of the underground economy of individual countries to be calculated, some values calculated with the help of the cash approach are necessary to convert the shadow economy quantities into absolute values (in percentage of official GDP or in billions of Euros).

In the following, we will briefly explain the MIMIC estimation procedure (compare also Figure 2.2):

(1) Modelling the shadow economy as an unobservable (latent) variable;

(2) Description of the relationships between the latent variable and its causes in a structural model: $\boxed{\eta = \Gamma x + \zeta}$; and

(3) The link between the latent variable and its indicators is represented in the measurement model: $\boxed{y = \Lambda_y \eta + \varepsilon}$.

where

η: latent variable (shadow economy);

X: (q×1) vector of causes in the structural model;

Y: (p×1) vector of indicators in the measurement model;

Γ: (1×q) coefficient matrix of the causes in the structural equation;

Λy: (p×1) coefficient matrix in the measurement model;

ζ: error term in the structural model and ε is a (p×1) vector of measurement error in y.

The specification of the structural equation is:

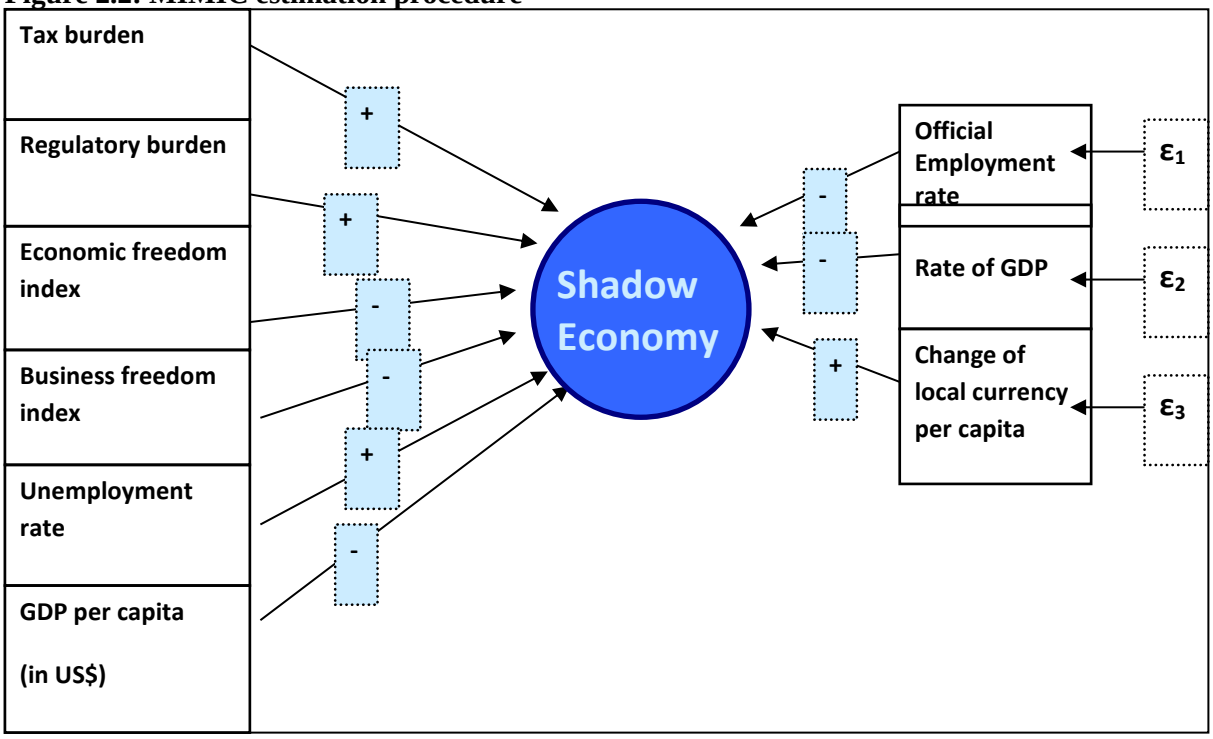
$$[\text{shadow economy}] = [\gamma 1, \gamma 2, \gamma 3, \gamma 4, \gamma 5, \gamma 6, \gamma 7, \gamma 8] \times \begin{matrix} [\text{Share of direct taxation}] \\ [\text{Share of indirect taxation}] \\ [\text{Share of social security burden}] \\ [\text{Burden of state regulation}] \\ [\text{Quality of state institutions}] \\ [\text{Tax morale}] \\ [\text{Unemployment quota}] \\ [\text{GDP per capita}] \end{matrix} + [\zeta]$$

The specification of the measurement equation is:

$$\begin{matrix} \text{Employment Quota} \\ \text{Change of local currency} \\ \text{Average working time} \end{matrix} = \begin{matrix} \lambda 1 \\ \lambda 2 \\ \lambda 3 \end{matrix} \times \textbf{Shadow Economy} + \begin{matrix} \varepsilon 1 \\ \varepsilon 2 \\ \varepsilon 3 \end{matrix}$$

where γi and λi are coefficients to be estimated.

Figure 2.2: 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 two or three absolute values of the absolute size of the shadow economy.

2.5.2. The Problem of "double counting"

One big problem with macro approaches such as the MIMIC or Currency Demand approaches 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 neighbours to do things, hence, do-it-yourself activities, neighbours' or friends help, legally bought material for shadow economy, but also illegal activities are included in these macro approaches. Hence, in these macro approaches (including the electricity approach, too) a "total" shadow economy is estimated which includes do-it-yourself activities and neighbours help which certainly is an upper bound estimate.

In Table 2.5 a decomposition of the shadow economy activities for the countries Estonia and Germany is undertaken. Table 2.5 starts with line (1) of the macro MIMIC estimates of 28% in Estonia as an average value for 2009 to 2015 and 16.2% 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 neighbours' 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% for Estonia and 64.2% 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 2.3. The shadow economy appears considerably smaller and this might be a more realistic value of the actual true size of the shadow economy using a macro method.

Table 2.5: Decomposition of shadow economy activities in Estonia and Germany

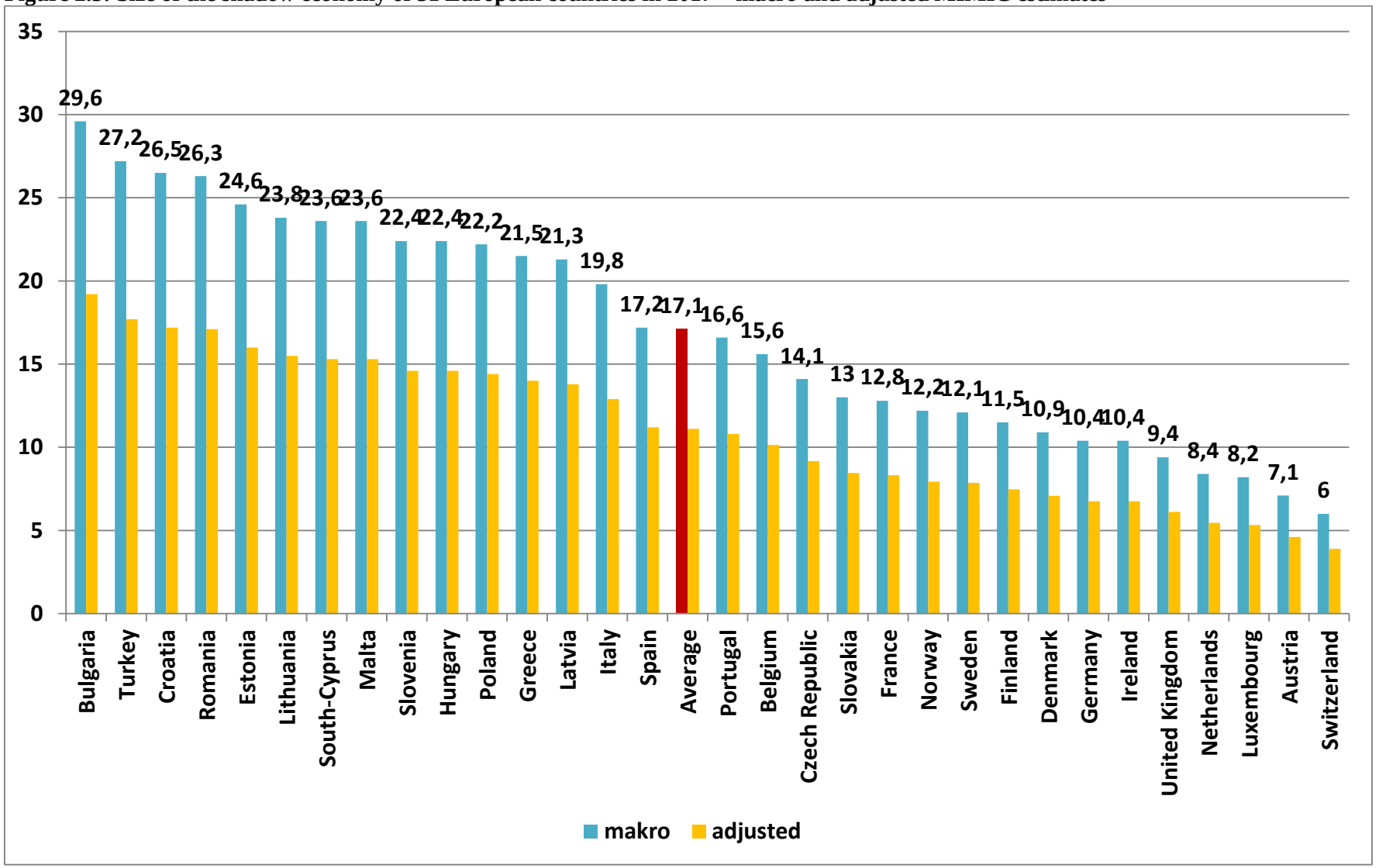
No.	Kinds of shadow economy activities (rough estimates!)	Estonia		Germany	
		Size in % of official GDP average 2009–2015	Proportion of total shadow economy	Size in % of official GDP average 2009–2015	Proportion of total shadow economy
1	Total shadow economy (estimated by the MIMIC and calibrated by the currency demand procedures)	28.0	100%	16.2	100%
2	Legally bought material for shadow economy and DIY activities	6.0	21%	3.1	19.1%
3	Illegal activities (smuggling etc.)	2.0	7%	1.2	7.4%
4	Do-it-yourself activities and neighbours' help[1)]	2.0	7%	1.5	9.2%
5	Sum (2) and (4)	10.0	35%	5.8	35.7%
6	"Corrected" shadow economy, but legal activities (position (1) minus position (5))	18.0	65%	10.4	64.2%
	[1)] Without legally bought material which is included in (2)				

Source: Own calculations, Linz, September 2016.

2.6. Concluding remarks

The presentation of these five methods has the sole purpose of briefly explaining them. Detailed criticism is provided in Schneider (2017), Feld and Schneider (2010), and Williams and Schneider (2016). Hence, it is not repeated here. In the next chapter 3 some detailed comparison will be undertaken. The first four methods will be used as a benchmark against the MIMIC macro and adjusted results.

Figure 2.3: Size of the shadow economy of 31 European countries in 2017 – macro and adjusted MIMIC estimates



Source: Own calculations.

3) A comparison of the MIMIC (macro and adjusted) results with micro survey results and National Accounts Discrepancy method

3.1. 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 3.1 which contains 16 OECD countries for the years 2011–2012 (averages). For most countries the MIMIC results are considerably larger, especially in the cases of Belgium, Czech Republic, Hungary, Norway and Poland. Amazingly, some MIMIC estimates, macro and even more the adjusted ones, come very close to the National Accounts Discrepancy method. For example, in Austria the non-observed economy is 7.5% by the National Accounts Discrepancy method and 7.6% using the macro MIMIC estimation while the adjusted one is only 4.9%, hence, considerably lower than the National Accounts Discrepancy method. Also somewhat close are the results for the Slovak Republic and for Israel, but one clearly sees the MIMIC macro and adjusted results are considerably higher than the ones 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 at 8.4 percentage points, Sweden with 6.4 and Belgium with 6.4, for a number of countries the differences are less than three to four percentage points.

What can we conclude from Table 3.1? 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 come at least for two or three countries quite close to this calculation of the shadow economy. Hence, the statement of 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 3.1: 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)	
		% of GDP	Macro (2)	Adj. (3)	(2)–(1)	(3)–(1)
1	*Slovenia*	*10.2*	*23.9*	*15.5*	*13.7*	*5.3*
2	*Norway*	*1*	*14.5*	*9.4*	*13.5*	*8.4*
3	*Israel*	*6.6*	*19.7*	*12.8*	*13.1*	*6.2*
4	*Belgium*	*4.6*	*17*	*11*	*12.4*	*6.4*
5	Mexico	15.9	27.9	18.1	12	2.2
6	Hungary	10.9	22.6	14.7	11.7	3.8
7	Sweden	3	14.5	9.4	11.5	6.4
8	Canada	2.2	11.7	7.6	9.5	5.4
9	Poland	15.4	24.7	16	9.3	0.6
10	Czech Rep.	8.1	16.2	10.5	8.1	2.4
11	UK	2.3	10.3	6.7	8	4.4
12	Netherlands	2.3	9.6	6.2	7.3	3.9
13	France	6.7	10.9	7.1	4.2	0.4
14	*Italy*	*17.5*	*21.4*	*13.9*	*3.9*	*–3.6*
15	*Slovak Rep.*	*15.6*	*15.7*	*10.2*	*0.1*	*–5.4*
16	*Austria*	*7.5*	*7.6*	*4.9*	*0.1*	*–2.6*

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

Table 3.2 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 3.1. For most countries, the discrepancy method is considerably higher than the MIMIC results; also compared to the MIMIC adjusted results. We have, at least for Africa, the opposite picture, i.e. that the National Accounts Statistics Discrepancy method indicates considerably higher sizes of the shadow economy than the MIMIC results. Hence, again, the criticism that the MIMIC estimates are unrealistically large and high may be not true, at least not for 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% and the MIMIC result is 38%, a difference of 15.4 percentage points.

Table 3.2: Comparison between National Accounts Statistics and MIMIC results for eight Sub-Saharan African countries over 2010–2014

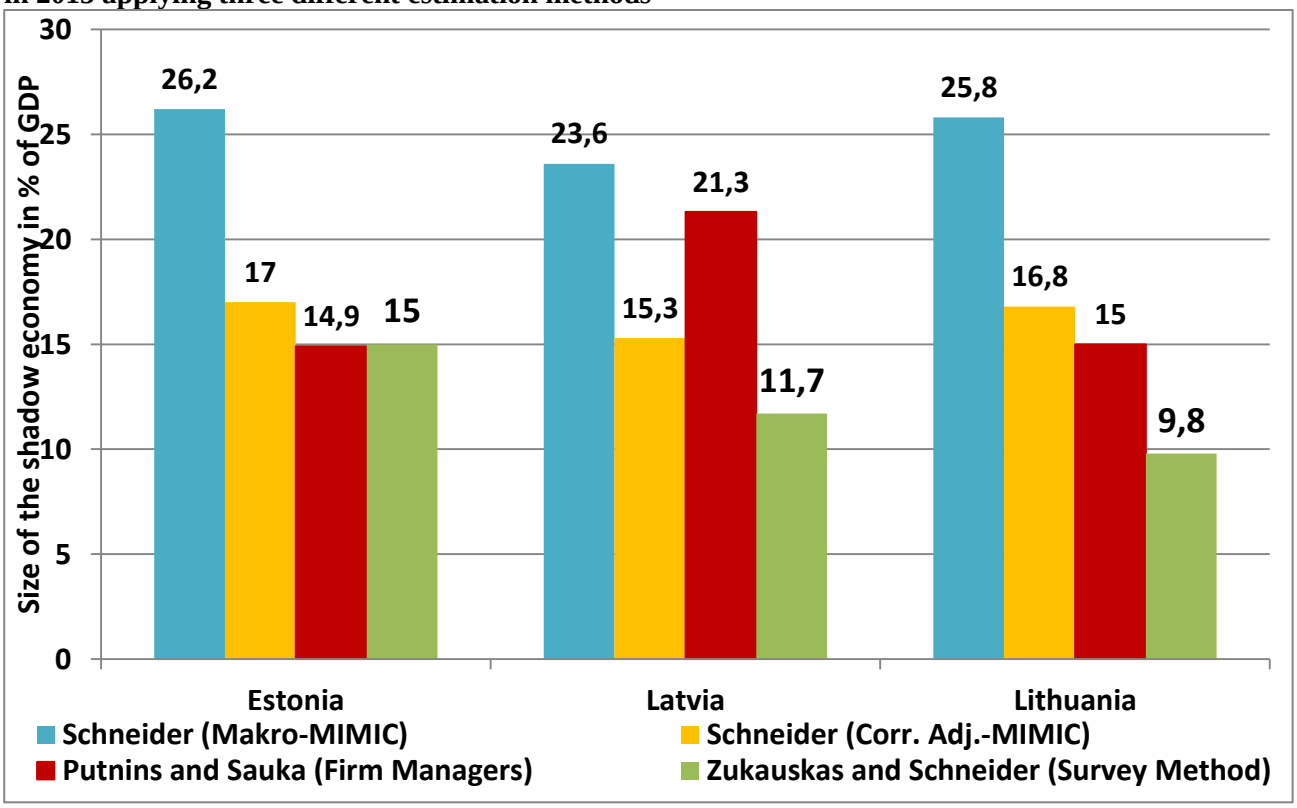
Country	Methods (averages over 2010–2014)			Differences	
	(1) National Accounts Statistics[1)]	(2) MIMIC	(3) MIMIC Adjusted	(2)–(1)	(3)–(1)
Guinea-Bissau	**53.4**	**38**	**31.8**	**–15.4**	**–21.6**
Mali	**55**	**40.4**	**26.3**	**–14.6**	**–28.7**
Togo	**40.1**	**28**	**24.7**	**–12.1**	**–15.4**
Guinea	**48.1**	**37**	**24.1**	**–11.1**	**–24**
Burkina Faso	**43.1**	**32**	**26**	**–11.1**	**–17.1**
Senegal	**47.5**	**40**	**20.8**	**–7.5**	**–26.7**
Benin	**55.6**	**49**	**18.2**	**–6.6**	**–37.4**
Cote d'Ivoire	**34**	**35**	**22.8**	**1**	**–37.4**
Correlation: 0.73 **Spearman's Rank Correlation: 0.857*****					

1) **Mostly the Discrepancy method is used.**
Source: Medina et al. (2017), p. 28

3.2. MIMIC versus micro survey methods results

In Figure 3.1 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 by Schneider. If one compares the adjusted MIMIC macro results from Schneider with the other two approaches for the case of Estonia, they are quite close. The MIMIC adjusted value is 17% of GDP, the survey method of firm managers is 14.9% and the pure survey method by Zukauskas and Schneider is 15%. Somewhat different results are achieved for Latvia, where the macro MIMIC estimates with 23.6% come quite close to the 21.3% of the survey method of firm managers and the adjusted MIMIC results are with 15.3% much lower, as is the pure survey method of Zukauskas and Schneider with 11.7%. In the case of Lithuania, the results of the adjusted MIMIC estimates and those of Putnins and Sauka are quite close with 16.8% and 15% and the pure survey results of Zukauskas are considerably lower with 9.8%. But again, one clearly sees, applying two different survey methods and comparing them with the MIMIC estimations, the results show that the adjusted MIMIC estimations are quite close to the other estimations. Only the pure macro MIMIC estimations are considerably higher.

Figure 3.1: A comparison of the size of the shadow economy (in % 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.

3.3. Macro versus micro methods - newer results

Finally, in Table 3.3 the widest comparison is undertaken with 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% and 25.1% 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% and 22.6%. 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% and 16.6% 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% and 16.0%. 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 3.2 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 how these results can be evaluated with respect to their plausibility. Table 3.3 demonstrates that the micro approach 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 so unreliably high.

Table 3.3: Alternative estimates of the shadow economy as percent of GDP for Czech and Slovak Republics

Estimation method	Source	Year	Czech Rep.	Slovak Rep.
Currency Demand Deposit Ratio (panel GMM difference)	*Alm and Embaye (2013)*	*2006*	*23.2%*	*25.1%*
Consumption-Income Gap Method (switching reg.)	*Lichard et al. (2014)*	*2008*	*17.6%*	*22.9%*
Deterministic Dynamic General Equilibrium Model	*Elgin and Öztunali (2012)*	*2008*	*16.8%*	*16.6%*
MIMIC	**Buehn and Schneider (2013)**	**2008**	**15.2%**	**16.0%**
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).

3.4. Macro versus micro methods – older results

Similar, but much older results than those for the Czech and Slovak Republics are shown for Germany in Table 3.4. In Table 3.4 eight different approaches have been applied for Germany over the period 1970 to 2005. It goes from the survey approach (IfD Allensbach (1975), Feld and Larsen (2005)) to Discrepancy between expenditure and income, Discrepancy between official and actual employment, Physical Input method, Transactions approach, Currency Demand approach, MIMIC approach and Soft Modelling approach. For the year 1980 we have values for seven of the eight approaches. Only the survey approach is missing. If we take the value of 3.6% for the year of 1975 as a benchmark we see that the survey method has by far the lowest value. The highest values we get are for the Discrepancy method between official and actual employment with 34%, followed by the Transaction approach developed by E. Feige with 29.3%, then from the Discrepancy method between expenditure and income with 13.4%, followed by the Currency Demand approach with 12.6%, the MIMIC approach with 9% and a somewhat lower value from Soft Modelling with 8.3% (year used 1975). But again Table 3.4 nicely shows the huge variations in estimating the size of the shadow economy in the case of Germany.

Table 3.4: The size of the shadow economy in Germany according to different methods (in % of official GDP)

Method/Source	Shadow economy (in % 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, 1984)	23.0	38.5	*34.0*	-	-	-	-	-
Physical input method (Feld and Larsen, 2005)	-	-	*13.5*	14.5	14.6	-	-	-
Transactions approach	17.2	22.3	*29.3*	31.4	-	-	-	-
Currency demand approach (Kirchgässner 1983; Langfeldt, 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 (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	*8.3*	-	-	-	-	-

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

As a last comparison in Table 3.5 the results of the shadow economy estimations for five OECD countries, Canada, Germany, Great Britain, Italy, and the United States are compared using nine different methods over the period 1970 to 1990. Table 3.5 will not be interpreted here in detail, but it shows that surveys of households and tax auditing (except for the United States) lead to considerably lower results compared with the Discrepancy methods, Physical Input methods and especially the Transaction approach. Table 3.5 nicely demonstrates that estimating the size and development of the shadow economy over 1970 to 1990 was an extremely difficult task, but some progress has been made over the last 25 years.

Table 3.5: A comparison of the results of the shadow economy estimations of five OECD countries using nine different methods over the period 1970–1990

No.	Method	Size of the shadow economy (in % of GDP) in:																			
		CANADA av. over				GERMANY av. over				U.K. av. over				ITALY av. over				U.S. av. over			
	Year	70–75	76–80	81–85	86–90	70–75	76–80	81–85	86–90	70–75	76–80	81–85	86–90	70–75	76–80	81–85	86–90	70–75	76–80	81–85	86–90
1	Surveys of households	-	1.3	1.3	1.4	3.6	3.6	-	-	1.5	-	-	-	-	-	-	-	3.7	4.5	5.6	-
2	Tax auditing	-	2.9	2.9	-	-	-	-	-	-	-	-	-	3.0	3.9	-	10.0	4.9	6.3	8.2	10.0
3	Discrepancy between expenditure and income	-	-	-	-	11.0	10.2	13.4	-	2.5	3.6	4.2	-	3.2	4.3	-	9.3	3.2	4.9	6.1	10.2
4	Discrepancy between official and actual employment	-	-	-	-	23.0	38.5	34.0	-	-	-	-	-	-	18.4	-	-	-	-	-	-
5	Physical input (electricity) method	-	8.8	-	11.2	-	14.4	-	14.5	-	10.3	-	13.2	-	15.2	-	19.3	-	7.8	7.8	9.9
6	Currency demand (Tanzi)	5.1	6.3	8.8	12.0	4.5	7.8	9.2	11.3	4.3	7.9	8.5	9.7	11.3	13.2	17.5	23.1	3.5	4.6	5.3	6.2
7	Cash deposit ratio (Gutmann)	13.8	15.9	11.2	18.4	-	-	-	-	14.0	7.2	6.2	-	23.4	27.2	29.3	-	8.8	11.2	14.6	-
8	Transactions approach (Feige)	-	26.5	15.4	21.2	17.2	22.3	29.3	31.4	17.2	12.6	15.9	-	19.5	26.4	34.3	-	17.3	24.9	21.1	19.4
9	Model approach (Frey/Weck-H.)	-	8.7	-	-	5.8	6.1	8.2	-	-	8.0	-	-	-	10.5	-	-	-	8.2	-	-
	Number of used methods	2	7	5	5	6	7	5	3	5	5	4	2	5	8	3	4	6	8	7	5

Source: Schneider in Petersen and Gallagher (2000, p. 333).

4) Summary and conclusions

In this paper, we describe two conventional and two 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 shadow economy share. The statistical discrepancy method is briefly described and all four are used as a benchmark for the MIMIC macro and adjusted methods. Then a detailed comparison of the results for the latest studies is undertaken showing that the 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 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.

What conclusions can be drawn?

(i) The traditional surveys mostly consider only households and may contain non-responses and/or incorrect responses. Quite often, results of the financial volume of black hours worked and not of value-added are calculated. The new methods described in this paper are promising and overcome these weaknesses.

(ii) The Discrepancy method which is used mostly by statistical offices is quite often a combination of estimate procedures, which are different from country to country, and detailed questionnaires. The precise calculation method is often not clearly documented.

(iii) The macro approaches lead to quite high estimations and are only macro estimates. They have a double counting problem including do-it-yourself activities, legally bought material and neighbours' help.

(iv) Using the MIMIC model one gets only relative coefficients and not absolute ones. One has to use a calibration procedure and has to select starting values which have a great influence on the size and development of the shadow economy. Again, MIMIC estimates lead to high macro values and the double counting problem exists. Here, with the help of an adjustment procedure, at least part of this double counting problem can be solved.

What open research questions remain?

(i) We have no superior method. All have still serious problems and weaknesses. If possible, one should use several 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 chapter 3.

(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 theoretically open.

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