Reflections on the meaning and measurement of Unobserved Economies: What do we really know about the "Shadow Economy"?

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Reflections on the Meaning and Measurement of Unobserved Economies: What do we really know about the "Shadow Economy"?[*]

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Abstract

This paper reviews the meaning and measurement of unobserved economies germane to tax evasion and macroeconomic information systems. These include the unreported, non-observed, underground, illegal, informal and unrecorded economies. It reviews the progress and shortcomings of national and international agency efforts to measure these unobserved economies, noting what they have in common, what distinguishes one from another and their interconnections. It then examines the meaning of Professor Schneider's Shadow Economy (SSE), and the veracity of his claim to have accurately estimated its size and trend worldwide by employing a MIMIC model methodology. It concludes that SSE estimates suffer from conceptual flaws, apparent manipulation of results and insufficient documentation for replication, questioning their place in the academic, policy and popular literature.

JEL classification: E26, O17, H26, E41, C51, C82, K42.

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Reflections on the Meaning and Measurement of Unobserved Economies:
What do we really know about the "Shadow Economy"?[*]

Edgar L. Feige[**]

Introduction

The past half century has seen an explosion of popular and professional literature referring to economies variously described as grey, black, subterranean, cash in hand, off the books, moonlight, undeclared, hidden, unofficial, concealed, parallel, invisible, occult, irregular, shadow, underground, non-observed, unreported, unrecorded, illegal, and informal. I propose that these economies are comprised of the activities of individuals, households and/or firms that evade, avoid, circumvent, elude, are excluded from, or not subject to the rules and conventions of established institutions. They all involve economic agents engaged in non-compliant behaviors that they seek to hide. This paper develops a broad conceptual framework establishing what these various economies have in common, and what distinguishes one from another. It briefly recalls the discovery of non-compliant behaviors and reviews earlier empirical efforts to measure their magnitude. Its primary focus is on the meaning, measurement and consequences of non-compliance with fiscal codes and violations of the rules and conventions of national income accounting.

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The paper employs a national accounting framework to specify the meaning and conceptual interrelationships among unreported, non-observed, underground, illegal, informal and unrecorded economies. The literature often uses these terms interchangeably although they have quite different meanings. We review the efforts of national revenue agencies to estimate the magnitude of tax evasion and the contributions of national and international statistical organizations to obtain exhaustive estimates of national income and output by measuring the non-observed economy. The paper's final section analyzes the meaning of Professor Schneider's Shadow economy (SSE) and examines the veracity of his claim to have estimated its size, trend, causes and consequences worldwide. [1]

Non-compliance

Since society penalizes non-compliant behaviors, entities that benefit from rule violations have incentives to undertake deceptive behaviors designed to defy detection, making non-compliant behaviors difficult and costly to observe and measure. Thus, non-compliance and "unobservability" are the common features of all behavior in unobserved economies (UEs). What distinguishes one UE from another is the particular rule being violated, making each UE distinctive in character, composition, and magnitude. The impact of a particular non-compliant behavior on the economy, society and polity depends on the nature and importance of the rule violated or avoided, and the extent of the rule violation.

Normatively speaking, the better the rule, the more harmful the consequences of non-compliance. Conversely, the worse the rule, the more beneficial are the consequences of violating it. "Bad" rules typically inhibit voluntary exchanges except where there are

[1] See for example: Schneider, Buehn & Montenegro (2010a; 2010b; 2010c; 2011); Buehn & Schneider (2012a); Schneider & Williams (2013); Schneider & Enste, (2013).

demonstrable negative external effects. "Good" rules prohibit coercive behaviors unless there are demonstrable overriding positive externalities (Epstein, 1995). Noncompliance with a bad law can be Pareto improving while breaking good laws can make society worse off (Leitzel, 1997). Non-compliant behaviors have real resource costs as actors attempt to conceal their behaviors and authorities try to detect them. In addition to affecting efficiency, non-compliance also has distributive consequences, shifting resources from the compliant to the non-compliant.

The study of non-compliant behaviors begins with the recognition that there are as many UEs as there are institutional domains with specific rules to be broken. For example, circumvention of the fiscal code by tax evasion gives rise to an *unreported* economy. Violations of the rules and conventions of national income accounting generate *unrecorded* and *non-observed* economies. Contravention of rules governing the production and distribution of prohibited goods and services such as drugs, prostitution, and human trafficking, gives rise to an *illegal* economy. Circumvention of labor market regulations specifying minimum wages, working conditions, social security, unemployment, and disability benefits give rise to an *informal* economy that deprives some workers of deserved benefits while conveying undeserved benefits to others. Violations of the former Soviet Union's Five Year Plans, its production quotas and price controls, permitted a quasi-market reallocation of goods and services in what became known as the *second* or *parallel* economy.[2] Circumvention of immigration laws gives rise to an *illegal alien* economy; of currency exchange regulations, a *black market* economy; of intellectual property rights, a *knock-off* economy; of environmental regulations, a *pollution* economy, and of rules governing public officials' ethical behavior, a *corruption* economy.

[2] See Grossman, (1977); Feldbrugge, (1989) and Ericson, (1984).

Given the variety of UEs we limit our attention to those involving tax evasion resulting from violations of fiscal rules, and those affecting the nation's information systems due to circumventions of the rules and conventions of national income accounting. What kinds of observable traces does non-compliant behavior leave behind that permits the social scientist to detect its presence? A relatively inexpensive means of hiding non-compliant transactions is to use cash as the medium of exchange. Since its usage does not leave a paper trail, it provides anonymity to those seeking to hide evidence of non-compliant behavior. Anomalies in cash usage provide clues to identify, quantify and track changes in non-compliance over time.

Philip Cagan was the first to notice an empirical anomaly in currency usage during World War II (Cagan, 1958). Economists had predicted, and continue to predict, the advent of a "cashless society"--anticipating a secular decline in the ratio of currency to deposits (or income) due to financial innovations and economic growth. Cagan's contradictory finding of an increase in the currency ratio led him to conclude that it was due to cash being used as a means to conceal income from the tax authority. He developed a simple currency ratio model that estimated U.S. "unreported income"[3] to be between 9-10 percent of GDP ($21-$25 billion) in 1945.

A second unexpected rise in the currency ratio during the 1970's and 80's suggested that tax evasion and unreported income might again be increasing. To the extent that national income and product accounts (NIPA) relied on income tax data as a basis for estimating components of aggregate output, there was concern that the national accounts might be systematically biased downward due to misreported income tax data resulting from tax evasion. A number of studies employing variants of Cagan's currency ratio method and Feige's (1979) transaction approach

[3] Unreported income, (a measure of the extent of fiscal non-compliance) is defined as the amount of net income not properly reported to the government due to non-filing, underreporting income and/or overstating deductions credits and exemptions.

suggested that a relatively large and growing portion of the nation's economy had shifted from the observed to the unobserved sector.[4] The "unobserved income hypothesis" (Feige, 1980, 1989a) maintained that observed "stagflation" could partially be explained by misguided macroeconomic policy based on biased estimates of income growth and unemployment due to an unnoticed shift from the observed to the unobserved sector of the economy.[5]

These academic findings stimulated the Internal Revenue Service (IRS) to estimate the extent to which growing non-compliance impeded the government's ability to raise revenues, and the Bureau of Economic Analysis (BEA) to respond to the concerns that the nation's national accounting information system might be systematically biased. The institutions whose rules were being violated had the greatest responsibility, incentives, resources and knowledge base to investigate these issues. They responded to the challenge with their own more detailed attempts to measure the extent and consequences of non-compliance.

The IRS undertook studies (IRS, 1979; 1983) to improve audit strategies and to estimate the extent and nature of non-compliance with the U.S. tax code.[6] Slemrod (2004, p.84) concludes that the IRS' Taxpayer Compliance Measurement Program (TCMP) produced "the most comprehensive, and probably most accurate, data on tax compliance for any country at any time". The TCMP consisted of 45,000-50,000 intensive "audits from hell" of sample tax returns for the years 1973, 1976, 1979, 1982, 1985 and 1988. Thereafter, the IRS abandoned the TCMP in response to strenuous political opposition. In 2001, the IRS initiated a new National Research

[4] Gutmann, (1979) estimated what he called the "subterranean" economy; Feige, (1979; 1980), the "irregular economy" and the "unobserved sector" and Tanzi, (1983); Feige, (1989a) the "underground economy".
[5] Blinder & Rudd, (2012) present evidence for the competing hypothesis, namely, that the stagflation experience was entirely explicable in terms of supply shocks to the economy.
[6] See Feige (1989a, pp.33-36) for an account of the methods employed by the IRS.

Program (NRP) relying on less intrusive audits to estimate unreported income and the gross and net "tax gap," for the years 2001 and 2006.[7]

Suspicions that the nation's information system was biased motivated the Bureau of Economic Analysis (BEA) (Carson, 1984; Parker 1984) to clarify the relationship between unreported income on tax returns and unrecorded income that might be missing from the National Income and Product accounts (NIPA). The BEA, well aware of deficiencies in the tax data on which it relies for measuring components of the national accounts, accordingly included "misreporting adjustments"[8] in its estimates of income aggregates. These considerable adjustments improve the accuracy of NIPA accounts in the U.S., avoiding a key potential source of distortion.[9] The United Nations' System of National Accounts (Eurostat et. al, 1993) acknowledged the existence of underground, illegal and informal economies, but it was not until 2002 that a team of national accounts experts drawn from national and international statistical organizations produced "Measuring the Non-Observed Economy: A Handbook" (OECD, 2002).

Measuring the Non-observed economy (NOE)

Spurred by media reports of academic estimates of an alarmingly large unobserved economy obtained by macro-model methods (OECD, 2002, p.11),[10] the community of national income accountants collaborated in a major effort to obtain exhaustive and internationally comparable estimates of national income and product. The effort was particularly timely, given

[7] See IRS, (2012); Black, Bloomquist, Emblom, Johns, Plumley & Stuk (2012), Gemmell & Hasseldine, (2012). The "gross tax gap," defined as the difference between the tax that taxpayers should pay, and what is actually paid on a timely basis, was estimated at $345 billion in 2001. It rose to $450 billion in 2006. The "net tax gap" represents the amount of tax liability that will never be collected, despite enforcement efforts. It amounted to $290 billion in 2001 and $385 billion in 2006.

[8] Adjustments are made for non-farm proprietor income; corporate profits; interest paid; and wages and salaries on employment tax returns and not covered by unemployment insurance.

[9] In 2011, the last year for which all misreporting adjustments were tabulated, they totaled $1.3 trillion.

[10] The entire final chapter of the Handbook is devoted to a critique of these "macro model methods."

the disintegration of the Soviet Union, and the expansion of the European Union. The countries of the former Soviet Union (FSU) and of Central and Eastern Europe (CEE) were replacing the central planning Material Product System (MPS) of national accounting with the United Nations System of National Accounts (SNA). The European Union required member states to adhere strictly to SNA accounting conventions, since it employed the resulting estimates of gross domestic product (GDP) to distribute grants and levy contributions. An added impetus came from the shift in economic production toward the developing world and the globalization of trade, requiring that the national accounts of developing nations accurately and exhaustively measure the level and growth of their productive capacities.

Consistent and exhaustive measures of (GDP) also form the basis of key policy decisions of international agencies. These often depend on ratio indicators, among them per-capita GDP, government debt and deficits to GDP, research and development expenditures to GDP and CO2 emissions to GDP. Recent estimates of VAT tax evasion also depend upon the exhaustiveness of GDP accounting. [11] Recognizing that the quality of national accounts depend on the extent to which their coverage is exhaustive, the OECD's Handbook sought a common nomenclature among national statistical agencies, and consistent methodologies representing what statisticians and national accounts experts regarded as best practice for measuring the non-observed economy (NOE).

The National Income Accounting Framework

[11] New "top down" approaches to measuring VAT tax gaps rely on national accounts aggregates. See Reckon, (2009); European Commission, (2013a, 2013b, 2015) and IMF, (2013, 2014).

National income accounting seeks to provide an exhaustive measure of productive economic activity. Let Y_e = exhaustive income defined as the sum of observed income (Y_o) and the income produced in the non-observed economy (Y_{NOE})

1) $Y_e \equiv Y_o + Y_{NOE}$

According to the Handbook, the non-observed economy (NOE) is comprised of productive activities "that are missing from the basic data used to compile the national accounts because they are underground, illegal, informal, household production for own final use, or due to deficiencies in the basic data collection system" (OECD, 2002, p.3). If we include household production for own final use as part of the informal economy,[12] and deficiencies in the basic data collection system as reasonably included under the agency's definition of the underground economy,[13] the non-observed economy (Y_{NOE}) is defined as the sum of the underground economy (Y_u), the illegal economy (Y_{il}) and the informal economy Y_{in}, such that:

2) $Y_{NOE} = Y_u + Y_{il} + Y_{in}$

The definition of the underground economy (Y_u) comes directly from the 1993 United Nations System of National Accounts (SNA), according to which the underground economy includes legal production activities that are:

"deliberately concealed from public authorities for the following kinds of reasons:

[12] There is still considerable confusion concerning the precise definition of the informal economy, which varies depending upon source. Household production for final use is not part of the informal economy according to the 15th ICLS Resolution (OECD, 2002, p.41), however it is included in the Istat analytical Framework (OECD, 2002, p.43).

[13] The handbook refers to this as the "statistical" underground resulting from under coverage, non-response or underreporting by enterprises. (OECD, 2002, p.41).

• *to avoid payment of income, value added or other taxes;*

• *to avoid payment of social security contributions;*

• *to avoid having to meet certain legal standards such as minimum wages, maximum hours, safety or health standards, etc;*

• *to avoid complying with certain administrative procedures, such as completing statistical questionnaires or other administrative forms."* (Eurostat, et.al, 1993 p. 153 and OECD, 2002, p.139)

The illegal economy (Y_{il}) "consists of the income produced by those productive economic activities pursued in violation of legal statues defining the scope of legitimate forms of commerce". (Feige, 1990)[14] The U.S National Income and Product Accounts (NIPA) explicitly excludes illegal activities (Parker 1984, p.19) since they are considered "bads" rather than "goods" and "because they are by their very nature conducted out of sight of public scrutiny and so data are not available to measure them". (BEA, 2009, Chapter 2, p.2) However, both the United Nations System of National Accounts (SNA) and the European System of National Accounts (ESA)[15] require that all productive illegal activities be included in national accounts. Inclusion of the illegal economy is important to assure that the national accounts are consistent among countries and over time. Some activities, such as prostitution, may be legal in some countries and illegal in others. The legal status of some activities changes in time - for example, the recent legalization of marijuana in some parts of the U.S. Only when the national accounts are sufficiently exhaustive to include both legal and illegal production are they consistent among countries and over time. (OECD 2002, p.153)

[14] The System of National Accounts (Eurostat, et.al, 1993, p152) defines illegal production as the "production of goods and services whose sale, distribution or possession is forbidden by law" and "productive activities which are usually legal but which become illegal when carried out by unauthorized producers" The OECD (2002, p.38) employs the same definition.

[15] ESA, (1996, p.61).

Chapter 10 of the Handbook describes some of the complex definitional issues pertaining to informal sector production. However, there is no professional consensus concerning its definition. Charmes (2012, 2014) provides the most comprehensive coverage of the subject. For our purposes, it is sufficient to note that national accounts attempt to measure whatever non-observed production occurs in the informal sector.

Obtaining exhaustive measures of economic production requires the measurement of the non-observed economy (Y_{NOE}). Let β represent the fraction of the non-observed economy that a statistical agency has succeeded in measuring and (Y^{m}_{NOE}) represents the amount of measured non-observed income.

Then,

$$3) \quad Y^{m}_{NOE} = \beta\, Y_{NOE.} = \beta(Y_u + Y_{il} + Y_{in})$$

Recorded income --the published, official income aggregate -- (Y_{rec}) is the sum of observed income Y_o and measured non-observed income (Y^{m}_{NOE}). The "unrecorded" economy (Y_{urec}) is the difference between exhaustive income and recorded income.[16]

$$4) \quad Y_{urec} = Y_e - Y_{rec} = Y_e - (Y_o + Y^{m}_{NOE}) = Y_e - [Y_o + \beta\,(Y_u + Y_{il} + Y_{in})]$$

and $Y_{urec} \rightarrow 0$ as $\beta \rightarrow 1$.

The Size of the Non-Observed Economy

[16] Some fraction of "unreported income" due to tax evasion is recorded in the measurement of the underground component of non-observed income in the form of a "misreporting adjustment". However, one must be very careful not to equate the underground component of NOE with "tax evasion" since unreported income from various sources such as capital gains does not reflect productive activities.

The Handbook's publication enabled various national statistical agencies to undertake measurements of NOE, striving to produce exhaustive measures of GDP. The Handbook acknowledged that it is "incumbent on national accountants to inform users of the extent of the *non-observed economy* - i.e., how much economic activity escapes direct measurement – and the extent of *non-measured economy*[17]- i.e. how much of the non-observed economy may still be missing from GDP after making the various adjustments of the kind described in this Handbook." (OECD 2002, p.192).

In 2003, the United Nations Economic Commission for Europe inventoried the practices of the twenty-nine countries that had attempted to measure their NOE.[18] By 2008, the inventory included rudimentary descriptions of the estimation procedures employed by forty-three countries and a sparse assortment of point estimates of their Y^{m}_{NOE} (UN, 2008, p.10). However, the UN surveys did not indicate how measures of NOE changed over time nor did the surveys include information concerning the amount of measured NOE (Y^{m}_{NOE}) that each nation regularly included in its published national accounts statements.

National accounts measurements of NOE require a variety of imputations employing diverse statistical inferential methods to model lacunae in the basic data sources available to national accountants. Direct surveys and commodity flow approaches that balance supplies and uses of individual products are used to contribute to the accounts' accuracy. Complex imputation methods vary from country to country, activity to activity and over time, requiring intensive documentation, reporting transparency, estimation of confidence intervals,[19] and

[17] We have called this the "unrecorded" economy.

[18] UN (2003, p.13) Table 1 erroneously listed the NOE adjustment of GDP for Kyrgyzstan in 1999 as 48 percent. The correct figure is 13 percent.

[19] Manski (2015) emphasizes the importance of communicating uncertainty in official statistics. Particularly germane is the issue of permanent statistical uncertainty arising from "incompleteness or inadequacy of data collection that does not diminish with time" (p. 637).

extensive professional oversight. Adherence to these standards is necessary to mitigate misinterpretation of official statistics and to address concerns regarding the reliability of these exhaustive measures of GDP. To date, despite major expenditures of time and resources by national and international agencies, we still lack regular comprehensive country reporting of the major components of recorded income, namely observed and measured non-observed income.

In the absence of any official compilation of measures of non-observed income since the 2008 UN survey, Table 1 presents time series estimates of the ratio of measured non-observed income (Y^{m}_{NOE}) to GDP, generously provided by twenty-seven statistical agencies from the Former Soviet Union (FSU) and Central, and Eastern Europe (CEE) in response to my request for information. [20] Entries in bold print in Table 1 are those included in the latest United Nation's publication. (UN, 2008, p.10).

Whereas the statistical agencies of the United States, Sweden, Netherlands and Australia report that measured NOE accounts for roughly 1 percent of recorded GDP, the CEE and FSU country's estimates range from 5 percent to 35 percent and display considerable variation over time. The rising temporal pattern of some of the estimates may reflect a steep learning curve and the availability of improved statistical resources over time. Other apparent anomalies such as the observation that Estonia's measured NOE is half the size of that of Lithuania and Latvia's, or that Kazakhstan's is twice the size of Kyrgyzstan's may be the result of respondents reporting estimates derived from different approaches to measurement. In theory, output, income and expenditure approaches to measurement should produce the same result; however, in practice they may differ considerably because they are derived from largely independent and less than perfect data sources. The UN's (2008) survey reveals that measured NOE estimates derived

[20] This is an updated version of Table 1 originally presented in (Feige & Urban, 2008, p.292).

from the output approach are often twice as large as those estimated from the expenditure approach. [21] These discrepant results are an indicator of the degree of uncertainty associated with the estimation procedure and typically serve as a signal that further work is required to reconcile the results. The estimates reported in Table 1 all employ methodologies proposed by the

[21] UN (2008) reports that the Czech Republic, Latvia, Poland and Norway disclose both output and expenditure based estimates of measured NOE. The former are roughly twice the size of the latter.

						Table 1 Measured Non-Observed Income														
	Period							**Y^{m}_{NOE}/(GDP)*100**												
	Average																			
		1990	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06	07	08
FSU																				
Armenia[1]	29.3					27	31.6	34.3	28.9	25.6	29	30.2	28.2	29.4	**28.9**	29	27.3	27.4		
Azerbaijan [2]	20.0											19.5	22.7	19.2	**20.7**	19.7	16.7	13.9		
Belarus[3]	10.4	5.7	6	10.7	11	10.1	11.9	13.2	10.9	11	11.7	11.1	10.6	11.1	**10.7**					
Estonia[4]	9.5				9.8	9.3	10.6	11.4	10.4	8.8	8.7	8.9	7.4	**9.6**	7.7					
Georgia[5]	30.7							26.9	27.4	30.3	30.3	33.7	33.4	33.2	33.1	**28.3**				
Kazakhstan[6]	25.2	12.2	13	21.7	23	24.3	32.9	37.1	37.9	30.3	27.4	24.7	23.9	22.6	**21.6**					
Kyrgyzstan[7]	12.7						8.4	9.4	10.3	11.9	13.2	13.1	14.4	16.5	**17**					
Latvia[8]	16.9								16	16.8		18	17.5	16	13	11.5	11.7	11		
Lithuania[9]	19.2			20.1	19	20.7	19.1	20	21	17.9	17.7	18	18.3	**18.9**		16	14.4	12.9		
Moldova[10]	30.5				33	29.6	26.2	24.2	31.4	30.1	34.4	34.6	**31.6**							
Russia[11]	13.6				5.3	8.5	10.4	11.7	11.9	11.9		24.8			**24.3**					
Tajikistan[25]	25.0														**25**					
Turkmenistan[25]	17.2													**14.8**			**18.1**			
Ukraine[12]	18.0											20	16.3	17.7	**17.2**	18.9				
Uzbekistan[13]	30.3									31			29.5							
CEE																				
Albania[14]	31.1							30.2	28.9	30.7	32.8	34.2	30.4	30.5	**30.8**					
Bulgaria[15]	18.3							27.8	31.2	12.3	12	16.3	**10.2**							
Croatia[16]	9.9						9.5	9.5	9.5	8.6	8.3	8.5	8.3	8.2	7.5	7.4	7.3			
Czech R.[17]	7.8									7.9	8	7.7	7.5	6.9	6.9	6.5	6.2	6.2	5.9	
Hungary[18]	15.6			16	16	16	16	16	16	16	16	**11.9**	16							
Macedonia[19]	14.7								14.4	16.2	13.7	12.9	14.9	14.4	**16.3**					
Montenegro [20]	6.6													7.8			5.3			
Poland[21]	15.4					17.2	16.6	15.9	15.2	15.3	14.5	14.6	14.3	15.4	15.8	14.5	15.9	15.9		
Romania[22]	16.5			6.7	8.9	12.6	16.6	18.4	18.6	23.3	21.1	21.1		**17.7**						
Serbia[25]	14.6														**14.6**					
Slovakia[23]	14.1						11.8	14.2	13.4	14.5	14.9	14.9	15.2	14.6	14.9	13.6	13.8	13.9	13.8	13.6
Slovenia[24]	7.1						6.4	6.3	6.5	6.1	5.8	6.9	6.8	7.5	8	8	8	8	8	
Boldfaced Figures [25]																				

Sources:

[1] Personal Correspondence: Anahit Safyan-National Statistical Service, Republic of Armenia.
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[12] V.Golovko, State Statistics Committee of Ukraine "Experience of Ukraine in measuring of non-observed economy"
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[17] Personal Correspondence: N. Holikova and Vladimir Kermiet: National Accounts Department.Czech Republic
[18] Personal Correspondence: I. Bedekovics and Peter Szabó: National Accounts Department, Hungary
[19] United Nations (2003,p. 225) United Nations, (2008, p.300)
[20] Personal Correspondence, Branka Susic -Statistical Office of Montenegro
[21] Personal Correspondence: R. Popiński, Central Statistical Office of Poland.
[22] Ciupagea (2004)
[23] Personal Correspondence: V. Cicmanec, P.Baláž and Jaroslav Sedivy: Statistical Office Slovakia
[24] Personal Correspondence: A. Flajs, Statistical Office of the Republic of Slovenia.
[25] United Nations (2008, p.10)

Handbook, but the respondents did not identify their specific measurement approach, assess the reliability of their reported estimates, nor did they specify which of their estimates were finally included in their reported GNP statistics.

Exhaustive measures of economic aggregates are increasingly important in light of the growing extent to which investors and policy makers rely on national accounts data to guide consequential resource allocation decisions. Recent "top down" methods to estimate the VAT "tax gap" (Reckon, 2009; European Commission, 2015) rely critically on the exhaustiveness of the EU's national accounts to estimate the theoretical VAT tax liability, which when compared

with actual VAT tax collections yields the VAT tax gap estimate. The allocation of grants and levies similarly depend upon the exhaustiveness of the EU's member country national accounts. These dependencies make the accounts susceptible to "Campbell's Law":

> The more any quantitative social indicator is used for social decision-making, the more subject it will be to corruption pressures and the more apt it will be to distort and corrupt the social processes it is intended to monitor. (Campbell, 1975, p.35)

The recent inclusion of estimates of the size of the illegal economy in the recorded GDP of some European countries has heightened public skepticism regarding the reliability of the accounts. [22]

If we are to gain greater confidence in their reliability, it is incumbent on international statistical organizations to monitor, assess and report on the accuracy of measures of the non-observed economy that national statistical agencies include in their reported national accounts. Complete and timely reporting of measured NOE components included in reported GDP estimates should be required of all statistical agencies. Gyomai & van de Ven (2014) suggest that:

> Officially publishing estimates of the size of the NOE and its components…may help limit the proliferation of alternative estimates based on macro-econometric models, with the risk that these alternative measures eventually shape policies instead of the official national accounts embedded measures. (Gyomai & van de Ven , 2014, p.9)

[22]The Economist, (2015). Illegal drugs and prostitution boosted the United Kingdoms' GDP between 1997 and 2009 by £7 billion to £11billion, accounting for roughly .7% of GDP (Office for National Statistics, 2014, p.4). Eleven other OECD member nations added illegal income to their GDP estimates. These ranged from .1 percent of GDP for Germany to .7, .9, and 1 percent for Poland, Spain and Italy respectively. (van de Ven, 2015, p.11).

Macro Model Estimation Methods

The national accounting community concludes that the "lack of transparency in describing the procedures used to compile the national accounts is the main reason why outsiders resort to macro-models and produce estimates that undermine the credibility of the national accounts" (OECD 2002, p.192). The Handbook devotes an entire chapter (Chapter 12) criticizing these macro-model estimates-- specifically, monetary methods, global indicator methods and latent variable methods -- calling into question their relevance for national income accounting, the validity of their assumptions and their stability, reliability and precision.

The limitations of currency demand methods for estimating the size of unobserved activities are well known and extensively documented.[23] Small changes in assumptions regarding velocity, hoarding, dollarization, financial innovation, and benchmarking radically alter the resulting estimates, render them subject to wide error margins. However, to the extent that cash remains the preferred medium of exchange for transactions that individuals seek to hide, its temporal path contains clues to the evolution of non-compliant activities. The stubborn uptrend in per capita cash holdings in the face of dramatic increases in currency substitutes remains the most significant trace evidence of increased unobserved activity over time.[24]

The transactions method [25] has not been used for four decades, given the proliferation of financial transactions and the difficulty of obtaining the data required to estimate their volume. Global indicator methods (e.g. Electric Consumption Methods) [26] have fallen from favor. Their

[23] For example, Feige (1986; 1989a), Thomas (1992), Bajada &Schneider (2005) and Breusch (2005c).
[24] Feige (2012a; 2012b).
[25] Feige (1979).
[26] Dobozi & Pohl, (1995); Kaufmann & Kalibera (1996); Johnson, Kaufmann, & Schleifer, (1997); Johnson, Kaufmann, & Zoido-Lobaton (1998); Friedman, Johnson, Kaufmann, & Zoido-Lobaton (2000), Eilat & Zinnes, (2002).

simple assumptions are typically violated and the methodology produces anomalous results.[27] However, latent variable methods have had a surprising resurgence since Frey and Weck-Hannemann (1984) introduced the innovation of treating the "hidden" economy as a latent variable.

Frey and Weck-Hannemann defined the hidden economy as "that part of the economy that escapes official measurement" and employed a Multiple Indicator Multiple Cause (MIMIC) model to estimate its size and trend in 17 OECD counties for the period 1960-1978.[28] They provided sufficient data and documentation to enable Helberger & Knepel (1988) to readily replicate the results and examine their robustness. While finding the methodology "basically meaningful and intellectually fascinating",[29] Helberger and Knepel concluded:

> A re-analysis of the data shows that the results of the Frey and Weck-Hannemann's model are extremely unstable and cannot be regarded as reliable statements about the shadow economy of these 17 countries. Even minor variations in the number of countries included in the analysis, in the period under investigation or in the index, which is defined, lead to a pronounced instability. A critical look at the observational variables used in the model lead to the conclusion that the authors cannot even be sure what they have investigated is indeed the shadow economy. The latent variable could equally

[27] Feige & Urban (2003, 2008).

[28] In interests of full disclosure, Bruno Frey presented the original paper at the Netherland Institute for Advanced Study 1982 International Conference on the Unobserved Economy. As editor of the conference volume, I rejected the paper from inclusion (Feige, 1989a) because it was implausible to believe that the model's latent variable was measuring the "hidden" economy and because the most significant variable in the analysis (tax morale) had been arbitrarily constructed from a source found to be completely unreliable. See Strümpel (1966). The paper was subsequently published as Frey & Weck-Hannemann (1984).

[29] Helberger & Knepel (1988, p.975).

> well be interpreted in other ways. It could be, for instance, that they have measured the development of the welfare state. Helberger and Knepel (1988, p.965)

Giles (1999) and Giles and Tedds (2002) subsequently employed the MIMIC methodology to estimate the hidden economies of New Zealand and Canada. Their careful studies acknowledge the difficulty of interpreting the latent variable and the uncertainty associated with their resulting estimates. Hill (2000) and Smith (2002) criticized the complexity of the Giles and Tedds MIMIC methodology and like Helberger and Knepel they found fault with the specification of causes and indicators. Breusch (2005a, p.388) severely criticized their MIMIC application while commending the authors for documenting their calculations and providing their data in sufficient detail to permit replication and analysis of their results. Breusch's analysis finds that "radically different estimates are obtained when minor changes are made to the starting values of the estimation algorithm" (p.372) and that the temporal results were essentially derived from a single variable whose interpretation could not be sustained as an index of underground activity relative to observed GDP. Moreover, the size of the underground economy was established using a benchmark from a separate currency demand model that was unidentified, so that the "estimates" of its key parameters are merely numerical accidents without connection to the data" (Breusch, 2005a p.387). He concludes, "that the overall level of the series estimated by Giles and Tedds is a mirage". Tedds and Giles (2005) response to Breusch's critique acknowledged these shortcomings, admitting that they render "the specific results regarding the size and form of the underground economy reported in the book ineffectual" (Tedds & Giles 2005, p.394).

Schneider's Shadow Economy (SSE)

Despite these critiques of MIMIC model applications, Friedrich Schneider and several co-authors subsequently employed the methodology to estimate what he calls the "shadow" economy.[30] Schneider's most recent claim -- to have estimated the size and trend of the shadow economy worldwide, for 162 countries to the accuracy of one decimal place[31]-- has been widely cited in the academic literature and popular press, gaining visibility and influence by being published as a World Bank working paper.[32] What distinguishes Schneider's work from earlier MIMIC model applications (in addition to its ambitious scope) is the difficulty of obtaining the documentation of his data, methods, and sources required to replicate his results and check their robustness and reliability. [33] Breusch's (2006a) review of Schneider and Bajada (2005) study that purports to estimate the size of the shadow economy for 145 countries, states the problem explicitly: "It is impossible to reconstruct these results from the documentation that is provided here or in other Schneider papers on which this chapter is based. Neither the data nor the model details were forthcoming from Schneider when I asked for them." (Breusch, 2006a, p.493).[34]

[30] Schneider's MIMIC model specification for the OECD countries is virtually identical to the original Frey &Weck-Hannemann specification critiqued by Helberger & Knepel except for employing a more controversial "benchmarking" procedure. Compare Schneider &Williams (2013, p. 47) with Frey & Weck-Hannemann (1984, p.40).

[31] The first mention of an error margin of MIMIC results appears ex nihilo in Schneider & Williams (2013, p. 30 and p.50). "Estimates of the size of the shadow economy by the MIMIC method are generally thought to have a margin of error of +/- 15 per cent". No explanation is offered as to how or where this error margin was derived.

[32] Schneider, Buehn &Montenegro (2010a; 2010b).

[33] Breusch (2005b) succeeded to replicate the earlier Italian study of Dell' Anno & Schneider (2003) and the Asian-Pacific 17 country study of Bajada &Schneider (2005).

[34] Over the past decade, I have encountered similar problems when attempting to obtain sufficient data and documentation to replicate Schneider's work. See (Feige & Urban, 2008, p. 288). Buehn and Montenegro have now provided the raw data for the Schneider, Buehn & Montenegro (2010a, b) study. However, requests for further documentation required for replication, concerning data sources, data inconsistencies, transformations and calibration specifications were not forthcoming.

The Problem of Definition

The term 'shadow economy" was originally introduced into the literature as the English translation of "Shattenwirtschaft", and is most often associated with the work of Professor Schneider, whose early papers used the term without defining it.[35] Schneider and Enste's (2000b) widely cited survey paper on "shadow economies" mentions several possible definitions but concludes: "In general, a precise definition seems quite difficult if not impossible" (Schneider & Enste, 2000b, pp.78-79). Among the Handbook's key criticisms of "macro model results" is that:

> the activities that the models aim to measure are not precisely defined; it is often unclear whether the models are estimating non-observed or non-measured production, or whether they include informal or illegal activities as well as underground activities. (OECD, 2002, p.187)

Possibly responding to this critique, Schneider subsequently adopted the SNA's 1993 definition of the "underground economy" (Y_u)[36] as his own definition of the "shadow economy".[37] He explicitly excludes the illegal economy and the informal economy from his definition of the shadow economy. Schneider's shadow economy (SSE) therefore represents a single component of the non-observed economy, namely the "underground economy" (Y_u) as defined by the SNA.

5) $SSE \equiv Y_u$.

[35] Schneider & Neck (1993).
[36] Eurostat et.al,(1993, p. 153) and OECD, (2002, p.139).
[37] Schneider (2005, p.600); Schneider, (2007 p.5); Schneider and Buehn (2009. p 2); Schneider (2009, p.1081); Schneider,(2010, p 443); Schneider, Buehn & Montenegro, (2010a, p.5); (2010b, p.5); (2010c, p.444); (2011, p.55); Buehn & Schneider (2012a, p.141); (2012b, p.175); Torgler,Schneider & Schaltegger (2010, p.305); Schneider&Williams (2013, p.25) among others.

How then do MIMIC model estimates of SSE compare to estimates of measured non-observed income (Y^m_{NOE}) computed by national statistical agencies for comparable periods? Since SSE is defined to be only the underground component of non-observed income, it follows that if β is close to unity, SSE/Y^m_{NOE} <1. Table 2 reveals that contrary to expectation, Schneider's shadow economy (SSE) (as a percent of GDP) is on average, two and a half times larger than the national accounting measures of the non-observed economy for the FSU and CEE countries. For the OECD countries for which we have comparable estimates, it averages eight times larger.

Table 2 Comparison of SSE with Y^m_{NOE} as a percent of GDP

Country	SSE*	Y^m_{NOE}**	SSE/Y^m_{NOE}		Country	SSE*	Y^m_{NOE} **	SSE/ Y^m_{NOE}
FSU					**Other**			
Armenia	49.9	28.9	1.7		Australia	14.3	1.3	11.0
Azerbaijan	61.6	19.8	3.1		Austria	9.7	7.9	1.2
Belarus	50.2	11.0	4.5		Belgium	22.0	3.5	6.3
Estonia	39.3	8.7	4.5		Brazil	39.6	12.8	3.1
Georgia	68.1	32.0	2.1		Italy	27.0	15.8	1.7
Kazakhstan	45.2	24.0	1.9		Ireland	16.1	4.0	4.0
Kyrgyzstan	41.2	14.8	2.8		Mexico	30.5	12.1	2.5
Latvia	39.6	14.6	2.7		Netherlands***	13.7	1.0	13.7
Lithuania	30.5	17.2	1.8		Norway***	18.2	1.7	10.7
Moldova	47.3	33.5	1.4		Spain	22.7	11.2	2.0
Russia	48.9	24.6	2.0		Sweden	19.2	1.3	14.8
Ukraine	55.9	18.0	3.1		Turkey	31.0	1.7	18.7
Uzbekistan	37.2	29.5	1.3		United States	8.8	0.8	11.0
CEE								
Albania	35.1	31.7	1.1					
Bulgaria	37.4	12.8	2.9					
Croatia	35.7	8.6	4.1					
Czech R.	19.4	7.1	2.7					
Hungary	25.7	14.6	1.8					
Macedonia	38.3	16.3	2.3					
Poland	28.0	15.0	1.9					
Romania	36.5	20.0	1.8					
Serbia	41.1	14.6	2.8					
Slovakia	19.0	14.6	1.3					
Slovenia	28.0	7.3	3.8					

Source * Schneider & Williams (2013, pp.149-154); **Average values from Table 1 and UN (2008, p.12); *** Schneider (2005, p.611).

These discrepancies document why the national accounting community is so critical of macro model estimates. The OECD's Handbook discusses macro model estimates "not because they are considered useful in obtaining exhaustive estimates of GDP or in estimating underground production, but because they tend to produce spectacularly high measures, which attract much attention from politicians and newspapers." (OECD, 2002, p.187). If Schneider's results were accurate estimates of the "underground" component of NOE, one would have to conclude that national accounting information systems have grossly failed to obtain exhaustive measures of national income, product and expenditure. Since the allocation of both public and private resources is heavily dependent on the accuracy of these national information systems, we must further examine the reliability and robustness of SSE estimates based on currency demand MIMIC model methods. To anticipate our conclusions: once the curtain of complexity surrounding the MIMIC procedure is lifted, we find that Schneider's estimates are so arbitrary, fragile and poorly documented that they cannot be taken seriously as estimates of the non-observed economy nor of tax evasion as is sometimes erroneously claimed to be the case.[38]

Examining the Veracity of Schneider's Mimic Model estimates.

Breusch's (2005a; 2005b) exemplary efforts to replicate and analyze the reliability of MIMIC methods sets a high professional standard rarely surpassed. In his detailed examination of studies by Giles & Tedds (2002), Dell' Anno & Schneider (2003), and Bajada & Schneider (2005), Breusch explains that "understanding their results requires peeling away the layers of econometric complication, which include MIMIC modeling, prediction, and benchmarking." (Breusch, 2005a, p.387). He carefully attempts to replicate the empirical results of each study, noting data transformations, calibration procedures and their consequences. He expresses

[38] See Schneider (2012); Murphy (2012, pp.11-12); Schneider, Raczkowski & Mróz (2015).

particular concern about the "control that the researchers exercise over their methods to ensure that the results are interesting, and reasonable (meaning challenging but not too outlandish)" (Breusch, 2005a, p.388). Breusch demonstrates how key assumptions of the MIMIC model are violated[39] and skillfully demonstrates the arbitrary nature of the calibration procedures. He discovers,

> transformations of the data that are not documented…and as a result of these ancillary treatments, it is not always clear to the reader how, and by how much, the results of the MIMIC model are stretched and squeezed to fit some outside evidence. … The upshot is a method that lacks objectivity because it is open to manipulation and misrepresentation. (Breusch, 2005b, p.3)

As we will see, arbitrary choices made by the investigator determine the signs of the causal variables, the time path of the "shadow economy" and its size.

In order to assign a scale to the latent variable, the MIMIC model requires choosing an indicator variable for normalization, typically given a unit coefficient.[40] Bajada and Schneider (2005) chose currency holdings as their normalizing indicator with a unit coefficient, while Dell'Anno & Schneider (2003) choose real GDP as their normalizing indicator, but specify that it have a coefficient of *negative* one. The coefficient specification is highly consequential since the signs of the coefficients of the structural causal variables of the model depend upon the sign of the coefficient assigned to the normalizing indicator. Breusch points out that their conclusions - that increases in the tax burden, the size of government and the extent of self-employment all increase the size of the shadow economy - are a direct result of their arbitrary choice of a

[39] Breusch (2005b, p.28).
[40] Bollen (1989, Chapter 6).

negative one coefficient for their normalizing indicator variable, real GDP.[41] Dell' Anno and Schneider (2006) confirm these findings and go on to justify their arbitrary choices of the signs of the normalizing coefficients by appealing to "reduction ad absurdum".[42] They state:

> When the "sign" of the coefficient of scale is changed from positive to negative, all the structural parameters of the causes change from positive to negative and visa versa (keeping the same absolute values), e.g. if a positive value is assigned to (the scale coefficient) the relationship between tax burden and SE it becomes than negative [sic]. In our view, these results completely diverge from well-known theories and empirical results that assert a "positive" link between the underground economy and these variables. (Dell'Anno & Schneider, 2006, p.5)

All of Schneider's MIMIC model papers conclude that higher tax rates increase the size of the shadow economy. Tax evasion theory, however predicts that this relationship is either ambiguous[43] or negative[44]. Similarly, Schneider's arbitrary parametric choices force the conclusion that increased regulation unambiguously increases non-compliance. However, audit studies find that stricter income reporting regulations invariably improve compliance. Therefore, the results obtained by employing the conventional unit value as the normalizing coefficient are neither absurd, nor inconsequential. Schneider achieves consistent substantive results conforming to his prior beliefs by selecting indicator variables and normalization coefficients

[41] Dell'Anno's earlier working paper, [Dell'Anno (2003, p. 24)] acknowledges the "strong dependence of outcomes by the choice of the coefficient of scale" and that "the signs of the determinants of the hidden economy…are a function of the researcher's choice". Unfortunately, these key admissions no longer appear in the published Dell'Anno & Schneider (2003) version of the paper.
[42] Dell'Anno & Schneider (2006, p. 5); Dell'Anno (2007, p.262) .
[43] Allingham & Sandmo (1972).
[44] Yitzhaki (1974).

that vary from study to study. Table 3 lists the various indicator variables chosen for normalization in different papers and their chosen coefficient.

Table 3 MIMIC Indicator Variables and Normalization Coefficients*

Paper	Page	Indicator Variable for Normalization	Coefficient
Dell'Anno & Schneider (2003)	102	Real GDP	-1
Bajada & Schneider(2005)	394	Currency Holdings	1
Schneider (2005)	604	Annual Rate of GDP Change	-1
Schneider (2005)	605	Average Working time (per week)	-1
Schneider (2007)	11	Annual Rate of GDP	-1
Schneider (2007)	12	Average working time	-1
Buehn & Schneider (2008)	15	GDP	1
Buehn & Schneider (2008)	15	GDP	-1
Herwartz, Schneider & Tafenau (2015)	1580	GDP per capita	-1
Schneider & Buehn (2009)	8	Growth Rate GDP	-1
Schneider & Buehn (2009)	10	GDP per capita	-1
Schneider & Buehn (2009)	11	GDP per capita	-1
Tafenau, Herwartz & Schneider (2010)	632	GPD per capita	-1
Feld & Schneider (2010)	130	Average working time(per week)	-1
Schneider (2010)	450	Annual Rate of GDP	1
Schneider. Buehn, & Montenegro (2010)	449	Currency	1

* The various models also include different additional indicator variables, some of which occasionally appear as causal variables, thereby violating the MIMIC specification requirement that the indicators are conditionally independent of the causes, given the latent variable.

Breusch (2005b, p.18) initially called attention to the fact that "the assignment of a negative coefficient to the normalizing indicator variable will reverse the sign of the latent variable. Since the latent variable is interpreted as a series of changes, that decision will *invert* the time path of the final result."[45]

[45] Dell'Anno's (2003, p.24) working paper hints at this inversion by stating "if the parameter of scale is chosen to equal +1 (instead -1) the estimated shadow economy became specular to time series displayed". However, Dell'Anno and Schneider's published version omits this observation, giving the impression that the negative relationship between the growth rate of GDP and the hidden economy is a result of the empirical findings rather than their arbitrary choice of a -1 normalizing coefficient. Dell'Anno & Schneider (2003, p. 106, 112).

One of the most bizarre, albeit largely unnoticed, changes of empirical results, occurred when Schneider reversed his conclusions regarding the trend of the worldwide shadow economy. Schneider, Buehn & Montenegro (2010a) initially reported estimates the size of SSE as a percentage of GDP for 162 countries, concluding that between 1999 and 2007, virtually all of the world's shadow economies *increased* in size. Shortly thereafter, they produced a revised version of the paper, with the same title, models and parameter estimates, (Schneider, Buehn & Montenegro, 2010b) claiming that virtually all of world's shadow economies had *decreased* in size during the same period.[46] This remarkable inversion of the time path results was mysteriously attributed to "a serious calibration error (sign switch)."[47] No further explanation was offered. The only clue as to what may have occurred appears as an inconspicuous addition of the following words to footnote 24 in the revised version of the paper. "*The Mimic index has been adjusted to the positive range by adding a positive constant*." [48](Emphasis added) My correspondence with the authors of the paper failed to obtain any further clarification.

Subsequent versions of the Schneider, Buehn, Montenegro results only confuse the matter further. Schneider and Enste (2013, Chapter 4, Table 4.2, p. 37) reports the size and trend of the shadow economy in 151 countries taken from the *original* version of Schneider, Buehn and Montenegro (2010a, Table 3.3.6) as mostly increasing between 1999 and 2007. The same chapter [Schneider and Enste (2013, Chapter 4, Table 4.3, p. 43)] includes results of the size and

[46] All of the estimated parameters for each of the seven MIMIC model specifications reported in Version 1 (Schneider, Buehn & Montenegro 2010a) are identical to those of Version 2(Schneider, Buehn & Montenegro 2010b). Only the labels for the model specifications have changed. Nevertheless, the reported size of the shadow economy and its trend has changed for every one of the 162 countries.

[47] The lead footnote of the "revised" version (Schneider, Buehn & Montenegro 2010b) reads "Unfortunately the estimates of the original version (WPS 5356) needed to be revised due to a serious calibration error (sign switch). We apologize for this, especially as we now have in this version a negative trend for the size and development of the shadow economies over 1999 - 2007, which we did not have in the original version."

[48] Schneider, Buehn & Montenegro (2010 c) makes no mention of the "calibration error" but includes the reference to the adjustment required to make the MIMIC index positive in footnote 8, p.453.

trend of eighty-eight countries taken from the *revised* (Schneider, Buehn and Montenegro (2010b, Table 3.3.1) paper, showing a downward trend for the shadow economy.[49] Neither these nor other published versions of the same Schneider, Buehn and Montenegro estimates, (Buehn & Schneider, 2012a; Schneider and Williams, 2013) make mention of the "calibration error". These subsequent versions also omit mention of the mysterious addition of the positive constant required to make the MIMIC index positive.[50]

Another major point of contention regarding Schneider's MIMIC model estimates is their size. It is important to recognize the MIMIC model produces only an index of SSE. Its size is determined by a separate 'benchmarking" calibration procedure. Following Schneider, Buehn & Montenegro (2010a, b), the size of SSE (N^*_t) at time is given as:

6) $N^*_t = \tilde{N}_t / \tilde{N}_{2000} \times N^*_{2000}$

where, $\tilde{N}_t$ denotes the value of the MIMIC index at time t, $\tilde{N}_{2000}$ is the value of the index in the base year 2000 and N^*_{2000} is an exogenous estimate of SSE in the year 2000. The "exogenous" estimates for each of the 162 countries come from unspecified currency demand models. No documentation is given concerning the source or specification of each countries' currency demand model required to produce the necessary N^*_{2000} "benchmark". This makes it impossible to determine either what each currency model was designed to measure, or determine the interval of uncertainty of the estimate.[51] Slemrod and Weber's (2012) critique of Schneider's benchmarking approach concludes that it "makes the estimates nearly impossible to interpret,

[49] Both tables, taken from different versions of the paper reference their source simply as Schneider, Buehn and Montenegro (2010).
[50] Note its absence from footnote 17 in Buehn and Schneider (2012a, p. 159).
[51] Breusch (2005b, p.28) and Slemrod &Weber (2012, pp.49-50) also demonstrate that when currency is also used as an indicator along with a measure of income, the strict assumptions required of the correlation structure of the MIMIC model is violated. Ahumada, Alvaredo, & Canavese (2007) demonstrate how income elasticity estimates greater than or less than one in currency demand models will further bias these shadow economy estimates.

since the estimates for each country are a function of other estimates, where the exact model used (by other researchers) to obtain these estimates are often directly violated in MIMIC." (Slemrod &Weber, 2012, p.49).

Breusch concludes his trenchant critique with a stern warning to the profession:

> The literature applying this model to the underground economy abounds with alarming Procrustean tendencies. Various kinds of sliding and scaling of the results are carried out in the name of "benchmarking", although these operations are not always clearly documented. The data are typically transformed in ways that are not only undeclared but have the unfortunate effect of making the results of the study sensitive to the units in which the variables are measured. The complexity of the estimation procedure, together with its deficient documentation, leave the reader unaware of how these results have been shorted to fit the bed of prior belief. There are many other results in circulation for various countries, for which the data cannot be identified and which are given no more documentation than "own calculations by the MIMIC method". Readers are advised to adjust their valuation of these estimates accordingly. (Breusch 2005b, p.28-29)

Despite these explicit and powerful warnings concerning the veracity of Schneider's MIMIC model results, his estimates have been repeatedly and inappropriately used as "the dependent variable in regression analyses in order to determine what causes noncompliance" (Slemrod and Weber (2012, p. 49). SSE estimates have now been regressed on virtually every

conceivable variable for which comparable temporal cross-country data exist. These include: *tax morale* (Torgler & Schneider, 2009); *direct democracy* (Teobaldelli & Schneider, 2013); *unemployment* (Bajada & Schneider, 2009); *regulation* (Enste, 2010a; 2010b); *the quality of institutions* (Torgler & Schneider, 2009; Dreher, Kotsogiannis & McCorriston, 2009; Dreher, Méon, & Schneider, 2014); *the influence of public institutions* (Schneider, 2010); *corruption* (Schneider, 2007; Schneider & Buehn, 2009; Bovi & Dell'Anno (2010); Buehn & Schneider, 2012b)**;** *the official economy* (Dell'Anno, 2008)**;** *enforcement* (Buehn and Schneider, 2012a); *voice, accountability and corruption (*Torgler , Schneider & Macintyre, 2011); *work in the shadows* (Schneider, 2014); *energy prices* (Suslov & Ageeva, 2009); *decentralization* (Buehn, Lessmann & Markwardt, 2013; Dell' Anno & Teobaldelli, 2015); *trust* (D'Hernoncourt & Méon, 2012); *education* (Buehn & Farzanegan, 2013); *pollution* (Elgin & Oztunali, 2014); *intelligence* (Salahodjaev, 2015*); inequality* (Dell' Anno, 2015); *religion* (Schneider, Linsbauer &Heinemann, 2015); *internet usage* (Elgin, 2013); *quality of life* (Kireenko & Nevzorova, 2015) and *electronic payments* (ATKearney, Schneider, & VISA, 2010; ATKearney, VISA & Schneider, 2013).

Commenting on such studies, Slemrod and Weber (2012, p. 50) note:

> While estimates obtained from such an analysis may appear reasonable ex-post, they are not interpretable as estimates of any causal effect. They are useful neither for confirming ex-ante hypotheses nor for learning additional information about what factors cause the size of the informal economy to differ across countries. (Slemrod & Weber, 2012 p. 50)

A decade has passed since Breusch's critical evaluations of Schneider's earlier MIMIC model estimates. None of Schneider's subsequent studies using this methodology has been, or can be, tested for robustness because to date, he has not provided sufficient documentation required for replication. What we have learned of Professor Schneider's work, can be summarized as follows:

1) The ambiguous meaning of the latent variable estimated by the MIMIC model suggests that Schneider has not measured the entity he has defined; he has simply defined the entity he has measured.
2) His substantive conclusions concerning the effects of the causal variables on the size of the shadow economy are not determined by the data, but rather by his arbitrary choices of indicators and normalizing coefficients.
3) The downward trend he now reports for the world's shadow economies between 1999 and 2007 results from an arbitrary and unexplained addition of a constant to the MIMIC index he originally calculated.
4) The magnitude of his shadow economy estimates are the result of his benchmarking the MIMIC index to currency demand model estimates of undocumented provenance whose specifications typically violate the assumptions of the MIMIC model.
5) The proliferation of published studies regressing his unreliable shadow economy MIMIC estimates on virtually every other available temporal cross-country variable cast no light on the causes of the shadow economy nor are they useful for testing any other ex-ante hypotheses.

Given the MIMIC model's complexity, the arbitrary procedures employed in its applications, the absence of information concerning the range of uncertainty associated with its estimates, and the

lack of appropriate documentation required for replication, leads one to the inescapable conclusion that Schneider's reported results are not credible estimates of any unobserved economy.

Summary and Conclusions

Every effort to observe and measure non-compliant behaviors confronts the social scientist with the analogue of the "observer effect" in physics, namely that the very act of observation affects the phenomenon being observed. The presence of any observer, be it the tax authority, a government agency charged with enforcing regulations, a statistical agency, or an experimental researcher [52]leads individuals, households and firms to change their behavior. Agent's attempts to avoid detection distort observation and makes measurement difficult and costly. Nevertheless, measurement is essential if we are to understand the causes and the efficiency, equity and stabilization consequences of non-compliant behaviors. The distinguishing feature of each non-compliant behavior is determined by the particular rule it violates, and its social, economic and political impact depends upon the importance of the rule violated and the extent of the violation.

Early crude attempts to estimate non-compliant economic activity suggested the existence of a growing unobserved economy sufficiently large to be of concern to both tax authorities and the custodians of the nation's information systems. In response, fiscal agencies set themselves the task of measuring the amount of revenue lost due to unreported income. Their studies confirm that substantial amounts of revenues are not collectable but that the income categories subject to the strongest reporting regulations have the highest rates of compliance.[53] The theory

[52] Milgram (1963).
[53] IRS (1973, 1983, 2005a, b, c, 2006, 2012).

of tax evasion predicts that improving compliance requires penalizing evaders and increasing probabilities of detection while also refining the design of optimal tax systems to reduce the costs of compliance. Rule simplification, improved information and service provision, enhancements in the efficiency and equity of public goods delivery systems all serve to enhance voluntary compliance. [54] Recent efforts to assess the extent of revenue losses due to tax evasion involve both "bottom-up" tax gap estimates based on audits, surveys and data matching as well as "top-down" estimates whose reliability depends critically upon the exhaustiveness of the NIPA aggregates required for their construction.[55]

In response to academic challenges, national and international agencies responsible for the collection and dissemination of macro economic information now employ a coherent nomenclature describing the components of the non-observed economy (NOE) they seek to measure as well as prescribed best practice methods for obtaining exhaustive measures of national income and product. Misreporting adjustments accounting for unreported income missing from the tax return data used to construct components of the accounts are included in measures of NOE. The statistical agencies of many countries now produce measures of the three major components of the NOE, namely, the underground, illegal and informal sectors. The complex inferential methods employed to estimate these non-observed components include modeling, surveys, and reconciling the supplies and uses of commodity flows.

Decisions concerning the allocation of private and public resources increasingly rely upon the exhaustiveness, compatibility and accuracy of national information systems. In order to improve confidence in these information systems, as well as the outcomes of decisions based on

[54] Slemrod (1990); Alm (1996) ; IRS (2011) and Sandmo (2012).
[55] HM Revenue and Customs (2014a, b) and European Commission (2015).

them, recorded national accounts must be published on a timely basis along with detailed estimates of both the observed and measured non-observed components of the accounts. Where possible, reporting should include estimates of error ranges to reflect associated uncertainty. The methods employed to construct measures of the non-observed sector need to be transparent and strictly monitored for reliability and compatibility across countries and over time. To date, these confidence-building requirements have yet to be met for many countries, as we still lack consistent reports that document the manner and extent to which measures of the NOE affect published national estimates of key macroeconomic aggregates. The United Nations Economic Commission for Europe can rectify this situation by collecting and systematically publishing this information in an expanded and updated edition of its Survey of Country Practices. [56]

MIMIC model applications treating the "shadow economy" as a latent variable purport to measure the underground component of the NOE. Analyses of these applications reveal that the statistical and economic assumptions of the MIMIC model are typically violated and that resulting latent variable bears little relationship to any unobserved economy. The methodology has been shown to be so malleable that it can be readily manipulated to obtain virtually any desired result, however the complexity of the procedure often obscures these manipulations.

The major proponent of this arcane methodology is Professor Friedrich Schneider who claims to have estimated the size and trend of the shadow economy worldwide.[57] If the veracity his results were substantiated, they would represent an important contribution to the field. To date, insufficient and inaccurate documentation concerning key data sources and procedures has precluded replication of his results. However, we know that his estimates critically depend upon

[56] See UN (2003; 2008).
[57] Schneider (2005, 2007); Schneider & Buehn,(2009); Schneider, Buehn &Montenegro (2010 a;2010b; 2010c; 2011).

his choice of indicator variables and the sign of their normalizing coefficients for which theory provides little guidance. The size and trend of his latent variable is arbitrary and fragile, its meaning is obscure, and his estimates bear no relationship to existing national accounting measurements of the non-observed economy component he claims to estimate. It is time to acknowledge that both the conceptual and empirical basis of Schneider's shadow economy is insubstantial. The repeated use of his flawed MIMIC estimates as dependent variables in subsequent studies is empirically unjustified. These fundamental defects of the MIMIC applications documented by various researchers are increasingly acknowledged and cited by Schneider, but he chooses to ignore the implication of these critiques,[58] namely, that the estimates he continues to present are untenable and do not contribute to our stock of useful knowledge.

It does not speak well for our profession that these conceptually faulty, highly manipulated, and largely undocumented estimates continue to be repetitively published in our academic journals. This practice would be curtailed if all journal editors adopted and enforced the Submission Guidelines and Data Availability Policies required by the American Economics Association. [59] It is also unfortunate that our literature continues to confound various unobserved economies without carefully distinguishing which set of institutional rules are being violated by the behavior of concern. Tax evasion, the non-observed economy, the illegal economy, the corruption economy, the illegal alien economy may overlap to some extent; however their nature, measurement, consequences and policy implications are quite different. Policy makers are cautioned neither to blur these distinctions nor to be influenced by unsubstantiated estimates

[58] Responding to Breusch's (2005b) critique, Dell'Anno & Schneider (2006, p17) conclude that: "the MIMIC model is still one of the best approaches to this purpose".
[59] https://www.aeaweb.org/aer/submissions.php

of the so called "shadow economy". The popular press needs to become more circumspect about citing them uncritically. It is time to bring greater credibility to the study of unobserved economies by acknowledging that to date; distinctions among them are too often ignored and that the results obtained by prevailing applications of the MIMIC methodology are unworthy of a place in the academic, policy and popular literature. Further research must begin with a greater willingness to acknowledge the critical limitations of what we too often claim to know.

Future research must continue the quest to understand the nature, causes, consequences and extent of noncompliant behaviors. Extensions of the theory of tax evasion demonstrate how individual decisions regarding tax compliance can affect the performance of the entire economic system.[60] Reliable empirical estimates of the extent, trend and costs of noncompliance are required to mobilize the public resources necessary to deal with its consequences. Greater creativity and inventiveness is necessary to develop unobtrusive measures of non-compliant behaviors and a deeper understanding of traces that these behaviors leave behind.[61] Cash, and more recently virtual currencies, being preferred media of exchange for suspect transactions, provide promising clues to trends in non-complaint activities.[62]

If MIMIC applications are to be employed, their cause/indicator structure must be consistent with both the statistical assumptions of the latent variable specification and with relevant economic theory pertaining to the particular non-compliant behavior being estimated. Calibration methods must only employ exogenous estimates, e.g. point estimates of tax gaps independently derived from audit studies or exogenous national accounts estimates of measured

[60] Sandmo (2012).
[61] For example, Pissarides & Weber (1989) and Feldman & Slemrod (2007) respectively rely on anomalies in food expenditure and charitable contribution patterns as traces of misreported income.
[62] Unexplained changes in per capita cash holdings and changes in the velocity of cash as evidenced by changes in the average lifetimes of note denominations yield potential traces of non-compliant activities. (Feige (1989b).

NOE. Above all, macro approaches to measurement must adhere to stricter standards of transparency by fully providing data, sources, transformations, statistical assumptions, estimation methods, pre-testing biases, and error margins of results. All publishable studies must be readily replicable in order to test the reliability and robustness of the findings.

Ultimately, a preeminent goal of social policy is the achievement of greater voluntary compliance with good rules. Creative approaches are needed to reduce compliance and administrative costs, target appropriate deterrence measures, improve the perceived equity of institutional rules, enhance the efficiency and quality of public goods delivery and innovatively restructure choice architecture through increased reliance on "nudges". [63] Non-compliance research is not limited to violations of fiscal rules and conventions of national income accounting. The profession faces major challenges in its efforts to observe measure and understand the causes and consequences of non-compliant behaviors involving undocumented workers, illegal immigrants, human, drug and arms traffickers, and planetary polluters. These issues will continue test the theoretical, observational and measurement skills of the social science community for many years to come.

[63] Thaler &Sunstein (2008).

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