DISKUSSIONSBEITRAG

aus der Fakultät für
WIRTSCHAFTSWISSENSCHAFTEN

der

UNIVERSITÄT DUISBURG - ESSEN
Campus Essen

Nr. 178
November 2009

Measurement and Relevance of the Shadow Economy in the European Union

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My presentation at the Sino-German Symposium on "Human Resources, Labor Market and Social Insurance" at the Wuhan University in April 2009 dealt with three subjects:

1. definition of the shadow economy (henceforth SE for short), in particular of underground or "black" activities as a part of the SE and theories on the causes and consequences of the shadow or in particular "black economy" (BE for short);
2. methods of estimating the size of the SE with a focus on the BE,[1] and
3. empirical results of such estimates and some controversies about their plausibility.

In what follows the focus is on the second topic and an attempt is made to review the most frequently used and discussed methods of measuring the net product (value added) of the SE. It is quite common to express this so called "size" of the SE in terms of a percentage of the official gross domestic product (GDP). However, this procedure is justifiable only for illustrative purposes[2] because SE-production is only partly, not totally[3] excluded from the official GDP.

It will be shown in Part 2 of the paper that the "state of the art" methods of measuring the SE are all but satisfactory, giving rise to some lasting methodological controversies. Emphasis is laid in particular on the so called monetary approaches. In Part 3 we comment on some statistical estimates of the size of the SE in various countries and over the course of time. Thanks to the great number of published estimates for more than 70 countries based on various methods we are also in a position to discuss the plausibility of the reported estimates.

1. Some remarks concerning the definition and theory of the "shadow economy"

1.1. Problems of terminology

According to Buehn et al. (2009) the shadow economy (SE) "includes all market based, lawfully produced goods and services that are deliberately concealed from public authorities to avoid payment of income, value added or other taxes and social security contributions; to get around certain labour market standards, such as minimum wages, maximum working

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[1] BE as opposed to SE means neglecting by and large all (unpaid) non-market production for own use in private households as the other part of the SE

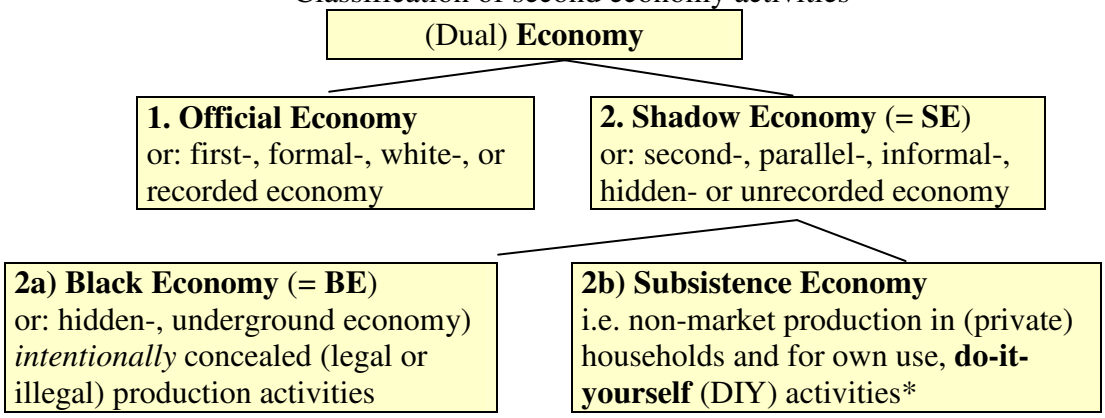
[2] The implicit interpretation of the ostensibly "better understandable" presentation of the size of the SE in terms of the GDP is that the estimated SE shows by which percentage the GDP should be higher if (allegedly) "correctly" measured. This is, however, bluntly wrong for the simple reason that estimates of the BE part of the SE are included in the official GDP (irrespective of their legal or illegal character). However, such official BE figures (of the German Federal Statistical Office for example) are, as a rule, not published in isolation, because - unlike the rest of the GDP - they do not meet the minimum standards of accuracy in official statistics.

[3] Excluded is only part 2b of the scheme in Fig. 1, covering primarily productive activities within private households. Such things are rightly excluded because they are explicitly considered as being beyond the "production boundary" of National Accounts. As the official GDP incorporates part 2a (the BE) it is not correct, though not uncommon, to define the SE as all those production activities that are not recorded in GDP.

hours, safety standards, etc…." This definition is not satisfactory, although it covers typical SE-activities since parts of the SE are clearly not "lawful" and not "market based". In Figure 1 some necessary distinctions are introduced.

Figure 1

Classification of second economy activities



* perhaps as a surrogate of (2a)

As in almost every economy a second or shadow economy (2 in Fig. 1) can be seen co-existing with the first economy, some authors speak of a "dual economy". The terminology, however, is far from being generally accepted and consistently applied. The term "shadow" economy (SE, 2 in Fig. 1) is notoriously taken for what better should be called underground or "black" economy (BE, 2a as part of 2).[4] Much confusion is also owed to the distinction between legal and illegal products and production.

"Moonlighting" (providing paid services to others, undeclared, however, to tax authorities by ways of a second job in the evening and on weekends) constitutes perhaps the most prominent example of "black" production. Here it is not the service itself (for example repair of a TV set or a car) that is illegal but the tax evasion which makes it "black". Other activities, also often called "black"[5] are as such illegal (or at least immoral) as for example illicit trade (drug trafficking, black market purchases of alcohol, narcotics etc.), smuggling, prostitution, slavery, bribery, fraud, receiving (to accept or have dealings with stolen goods),[6] forgery of documents, or corruption (as a kind of abuse of public power for private benefit). "Black" economic activities, however, are not necessarily illegal or even criminal.

Other prominent examples of SE (or rather BE) are illegal (alien) employment (often associated with illegal immigration and also aimed at avoiding taxes, social security contributions and eluding license requirements),[7] non-declared tips and sales (e.g. in agriculture) and

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[4] An example is the full title "Shadow Economy and Do-it-yourself Activities" of the quoted paper Buehn et al.

[5] It is not always clear whether or not they are included in the "production boundary" (that is the GDP definition), which in principle comprises 1, 2a and only parts of 2b of figure 1.

[6] Note that receiving, forgery, corruption and the like are *redistributive*, *not productive* activities and thus do not contribute to the GDP.

[7] Illegal employment (primarily in the construction business) is a black activity on the part of the employer just like moonlighting or undeclared tips and concealed income in kind is typical for employees and free-lance one-man entrepreneurs (self-employment is very common in the BE, because it is easy to conceal it from the taxman).

undeclared wages in kind,[8] "received" also by way of "self service" in the form of theft (pilferage) by employees, padding expense accounts, using office equipment for own use etc.

Part 2b in Fig. 1, the DIY or domestic self service sector is "unofficial" but not considered "black".[9] The so called "neighbour help" differs from moonlighting in that in this case work is done primarily for family or friends, and it is either unpaid, or rewarded by a reciprocity arrangement, settled over gifts etc. In contrast to 2a, most of 2b is deliberately *not* included in the GDP.[10] This applies in particular to unpaid non-market household production for own use[11] (e.g. by "housewives"). Part 2b is rightly excluded from the GDP because there is no point in lumping such different things as 2a and 2b together.[12] In our view, therefore, it would be better to concentrate on genuine black activities (that is on 2a), rather than to consider also 2b. This would also help to do away with the nuisance of continually mixing up "shadow" and "black".

To summarise: there is much confusion about terms like "hidden", "shadow", "underground" or "black" and it is not easy to draw a clear borderline between the first and second (shadow) economy, or black and white because there is no one-to-one relation between these distinctions and criteria like

- the production boundary (included in vs. excluded from the GDP)
- the notion of "illegal" or "irregular" in the context of production
- production for own use (non-market production, usually without a transaction taking place) or for others (market production)
- the kind of remuneration in the case of a (market) transaction (barter or monetary and in the latter case transactions for cash, debt, or bank transfer).

The only criterion various "black" activities have in common is the lack of visibility because they are purposively hidden (the motivation for which is primarily to evade tax[13] and escape from excessive regulation). Such activities are necessarily unregistered and thus can only be imputed (with greater or, presumably, lesser precision).

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[8] As mentioned in Footnote 2, wages in kind and undeclared tips and sales are explicitly estimated and included in the official GDP.

[9] This part of the economy has a long tradition, going back to times where the market was not yet dominant and the family was not only a consuming but also a productive unit. Hence 2b is still most relevant in rural regions where a lack of specialised and specific tasks is still pervasive. Furthermore 2b can occur as a substitute for 2a.

[10] If 2b and thus all own account production of members of the households and do-it-yourself activities were included in the GDP virtually the whole adult population would be economically active and unemployment would be eliminated almost completely. In a similar vein it would not be meaningful to add the (necessarily vague and only imputed) value of (quantitatively) insignificant production (e.g. preparation of meals, and even fruits of pastime such as gardening, mushroom collecting etc.) or unpaid personal services within private households (e.g. upbringing of kids) to the value of the monetary transactions. This is not to say that they do not contribute to welfare. Such considerations not only cast doubt on the above mentioned habit of expressing the volume of the SE production in terms of the GDP (SE cannot be added to a "true" GDP" without double counting) but also on the so-called "unobserved income hypothesis" (see below).

[11] Examples: cleaning, decorating, maintenance, servicing of dwelling, care of children and sick people, transportation of members of the household. Owner occupied dwelling is an exception of the general rule to exclude unpaid services for own use from the GDP in National Accounts.

[12] We come back to this point in Part (2) of Section 1.2.

[13] Tax evasion is not a necessary criterion of the shadow economy (however, possibly in general a motivation for hiding economic activity which therefore is "black"). Many activities of the 2b type (e.g. unpaid work of "housewives" or negligibly small revenues from casual jobs) are exempted from taxes anyway, so tax evasion can hardly be an issue.

1.2. Some remarks concerning causes and consequences

(1) ***Factors affecting the size of the SE***: In view of the above mentioned motivation for an "immigration into the underground" or into the black economy (BE), it is evident that the tax burden (and also the complexity and perceived fairness of taxation) along with excessive regulations[14] is perhaps the most important determinant of black activities. Other factors are unemployment and reductions in the number of working hours in the official economy, the gap between wages in the official and non-official economies and (most importantly) the "wage wedge" between (gross) labour costs and the considerably lower net wages (due to taxes and social contributions) which offers the opportunity for a mutually beneficial trade for both sides, customer and supplier of BE-production. The size and the efficiency (e.g. in fighting "black" activities) of the government is certainly also significant.[15]

(2) As to the ***reasons for studying the SE,*** the so called "unobserved income hypothesis" is often mentioned, according to which the (alleged) disregard of SE in the GDP might result in a distortion of official estimates of production (GDP),[16] inflation, unemployment and other figures of official statistics.[17] And this in turn might give rise to a destabilising counter-cyclical policy. Another concern is of course a possible erosion of the basis of taxation (endangering the viability of the massive redistribution and welfare system) and the triggering of a vicious cycle of continually higher taxes and ever more incentives to move into the black economy by which the basis for taxation diminishes, which in turn calls for raising taxes again as a response to the immigration into the BE.

(3) It should be noted that ***the effects of SE*** are not altogether disadvantageous and therefore it would be unwise to fight against it by every possible means. It would be better to indirectly reduce the incentives to immigrate into the SE by deregulation and lowering of the tax burden. Moreover, it is generally accepted that if the BE would be reduced it would not (at least not to the same extent) be substituted by official economy and that the SE may well promote flexibility, relieve social tensions and signal peaceful protest against excessive tax burden and an opaque, unfair, inefficient and overly complicated system of taxation and regulation[18] (see in particular Cassel (1984) for such arguments and for more SE-theory than could be expounded here).

2. Methods of statistically estimating the size of the shadow economy

2.1. Overview and comments on some indirect methods

In this part we start with a short review of statistical methods to estimate the size of the SE with only short remarks on methods other than the monetary and model approach. We will finish with a more detailed description and critique of the monetary and model approach (in sections 2.3 and 2.4). Concerning the methods the usual distinctions[19] made are as follows:

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[14] Not only on the product market, but also on the labour market. Typical regulations are a reduction of working time, or of the retirement age, minimum wages, licence (minimum qualification) requirements. In a way these things amount to erecting barriers for newcomers to enter the labour market and thereby reducing competetion.

[15] A small public sector in general goes together with a small SE (for example Japan, USA).

[16] It is said for example that the productivity slowdown in the USA in the 1970s and 80s was overstated.

[17] See Footnote 10 for reasons to doubt the relevance and justification of this not unpopular presumption.

[18] A complex tax system with many tax exemptions (loopholes) - for which Germany sadly achieved a certain eminence - may encourage legal tax avoidance, tax evasion and even result in lower tax morals.

[19] Here we have again in no small measure confusion regarding the terminology.

1. ***Direct Methods:*** these use
   a) surveys, i.e. questioning the relevant part of the population whether or not they are or were engaged in SE activities, assuming honest replies, or
   b) data gained from tax auditing, e.g. records of *discovered* non-declared taxes and *penalties inflicted* on BE operations, hence data representing documented evidence of a rather spectacular part of the BE only.[20]

   These methods are considered to provide a lower bound of the size estimate only.
2. ***Indirect*** (or Indicator) ***Methods*** which are oriented at
   a) non-monetary indicators, such as discrepancies between aggregates of National Accounts, employment statistics and physical input (electricity consumption) or the dynamics of the ratio "transaction volume divided by the GDP" [21]
   b) monetary indicators with two variants
      1. a naïve fixed (cash-deposits) ratios (Cagan, Gutmann) approach, and
      2. the approach of Tanzi, based on the estimation of a currency demand function.
3. ***Model approach,*** estimating the SE as a variable in a "structural equation model" (SEM), a method in statistics also known LISREL[22] or SEM. In such an approach the SE, though not directly observed and measured (hence though not "manifest") is conceived as a "latent" variable η "caused" by a number of q manifest variables x_1, …, x_q (such that η is a linear function of these x-variables and a random term ζ) and η for its part is viewed as causing other manifest variables (or effects) $y_1,\ldots,y_p$ called "indicators". This also explains the name MIMIC (= multiple-indicators multiple-causes) instead of LISREL for this type of a model. The belief that the purely formal construct of a variable η in fact represents the size of the shadow or black economy is based on the nature of the x and y variables being included in the model (for example x_1 = tax burden, x_2 = amount of regulation, or y_1 = employment etc).

A short remark concerning the methods of group 2a should be made here. Some indirect methods of group 2a are oriented at discrepancies between certain statistical figures (e.g. income and production on a macroeconomic level or between the labour force and officially recorded *employment*[23]) which should not diverge if there were no SE, or they infer the existence of the SE from an "excessive" (judged by some measure) amount of variables such as the currency circulation or the *electricity* consumption (or more general "physical inputs" as compared to output) in private households.[24] The problem with such methods is that at least one of the figures to be compared with one another (in order to end up with a "discrepancy" or "inconsistency" that is supposed to reflect the SE) is hardly reliable because it is gained only

[20] Obviously surveys and the mentioned administrative records will only provide a lower bound for the size of the SE.
[21] The transaction approach of Feige can also be viewed as a monetary method.
[22] Linear Independent Structural Relationships.
[23] The method is in Section 3 referred to as the "employment method".
[24] This physical input method seems to be a method that is applicable only to the household production part of the SE. Other input indicators, such as the turnover of DIY (do-it-yourself) businesses were also discussed as possibly related to the SE (to "moonlighting" in particular).

from imputation, for example the total "employable" population as opposed to the number of actually employed persons officially reported by surveys or payroll statistics.[25]

To compare the results of the income approach (with aggregates like compensation of employees, property income etc.) and the expenditure approach (private consumption, government expenditure, investment and net exports) in National Accounts appears to be particularly doubtful because such preliminary estimates of the GDP are in general not published[26] and if so, the order of magnitude of such discrepancies is a great deal smaller than what usually is supposed to be the size of the SE. Furthermore, the method not only erroneously and tacitly assumes no measurement errors in all NA aggregates; it also assumes that discrepancies indicate black activities. If anything, discrepancies primarily result from statistical "errors and omissions" as both methods of estimating GDP are based on different source data.

Another rather dubious approach is the so-called transaction method of Feige, which we only briefly mention here. This method requires the knowledge of the "transaction volume" M_tV_t (using money M and the transaction velocity [not the income velocity] of money) and to compare it with the GDP. The difference between transactions and the GDP is not only due to the SE but is also attributable to intermediate consumption (purchases of material) and purely financial transactions.[27] As with other methods, a "golden age" (with *no SE*) is required and is of course difficult to establish empirically.

The SE or, to an even greater extent, the BE, prefers to conceal its activities from the government, in particular from the tax authorities and hence also from statistical observation. It is therefore *by definition* statistically invisible and unrecorded. Hence to "measure" the SE is something like a contradiction in terms. As an aside, Schneider and Enste (1999) were perhaps not quite aware of the absurdity of their statement destined to describe their "scientific"(!) impetus and motivation, as "a scientific passion for knowing the unknowable", as if the unknowable could be an object of scientific inquiry.

2.2. Assessing methods with reference to axioms

Before proceeding by discussing other - perhaps more reliable - methods with their merits and shortcomings, it appears useful at this point to consider some criteria that a sensible and acceptable method should fulfil. In what follows we present a tentative collection of six "axioms", that is qualities of a method, that are desired if not necessary for being good statistical practice. These are

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[25] Note that workers holding more than one job will be counted twice in payroll surveys but only once in household surveys (employment statistics).

[26] It is well known that three "approaches", viz. the income, expenditure and production approach (using [indices of] net-production figures of sectors like agriculture, industry, trade etc.) ideally and essentially (by and large) should end up with the same result (such that each of the methods is capable of acting as a cross-check of the other approaches). However, in published GDP data, initial discrepancies are already removed ("adjusted" or "reconciled"), hence it is as a rule not possible to exploit (alleged) inconsistencies in statistics. For example the initial discrepancy between the production and the income approach to GDP amounted to only 0.8% in 1995 in Germany (according to Braakmann (2004)). The figures were then balanced by raising the result of the production method by + 0.7 % and lowering the result of the income method by - 0.1%. In actual fact such initial discrepancies are, however, not published and therefore cannot be known by the user of statistics.

[27] Financial transactions only change the structure of financial assets (existing wealth), and they do not contribute to production (i.e. creating new wealth) as measured by the GDP.

- ***Validity:*** the method should adequately cover the target concept, or in other words, reflect properly what is intended to be measured. It also should primarily be based on observations rather than pure speculation, and if assumptions are needed they should be small in number, amenable to empirical verification, or at least plausible
- ***Data basis***: data required by the method should be reliable, readily available, sufficiently detailed and suitable for the concept in question (for example the SE as a whole or for underground economy only); in a similar vein, the estimation method should yield
- ***Detailed results:*** the method should allow for sufficient distinctions between different types of SE activities and results should be analytically useful (provide information not only on the size[28] but also the structure of SE, on correlations with other variables, or on the relative importance of various driving forces [or "causes"] of the SE etc.)
- ***Theoretical foundation*** of the method: it should be derived from a micro- or macroeconomic model; this can for example hardly be said about the MIMIC method, where it is only the nature of the variables in the model that are taken into account that may lend credence to our belief that we have effectively measured what we intended to measure.[29]
- ***Cross checks with other methods:*** the method should - most importantly - allow for such checks[30] and plausibility checks; it also should give some numerical indications of the ***goodness of fit*** (something like R-squared, the coefficient of determination in statistics)[31], finally it should comply with
- ***Good statistical procedure (professional integrity):*** the method should be well documented and its results should, in principle at least, be reproducible.

It can safely be stated that the methods presently in use for measuring the SE are far from meeting these criteria. Results are simply referred to as "derived from the x-method" or even worse we find statements like "on the basis of the x and the y-method". Furthermore, it is a rare event to find more hints concerning the estimation than just the figure (for the size relative to the GDP) and the name of the method applied. It is also uncommon to make cross-checks with the results of other methods, or to explicitly consider the plausibility of the estimated figures. Finally, little or next to nothing is known about the accuracy of the estimates. All of this is definitely not in line with professional integrity in statistics and this current state is all the more deplorable as by its very nature the SE (or BE in particular) is

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[28] A common (and in statistics rather unusual) practice in this field is to offer simply one figure, supposed to be the "size" of the SE, without a breakdown into relevant parts of the SE or an indication of the relative significance of certain determinants. There are many more interesting aspects of the SE than just its size. In statistics in general a figure taken in isolation is of limited value only.

[29] We may also say that the simple assumption that transactions in cash is the preferred type or even the defining feature of operations to be called "black" is too poor a theoretical underpinning as there are many other processes that may provoke an "excessive" demand for currency as well.

[30] For this the three independent methods of estimating the GDP is a prominent example. As mentioned above, a consequence of macroeconomic identities is that different estimates should lead, in principle at least, to similar results. This balancing principles is the fundamental method of estimation aggregates (which otherwise perhaps could not be estimated) in the framework of National Accounts. The general idea is that reconciling similar results of different and independent methods may yield trustworthy figures.

[31] In addition to R-squared "information measures" such as the Akaike- or Schwarz criterion are in use. They strike a balance between the goodness of fit and a "parsimonious specification". A high value of R^2 and a low information measure is desirable.

hidden and nobody ever knows its magnitude for sure. If estimates are presented then they are likely to be believed whatever their methodological status. It is meritorious that Koch (2007) emphasised a lot that "estimation business" should be more aware of this responsibility.

2.3. Monetary methods

Methods using monetary variables as indicators of the size of the shadow economy (SE) - or of the "black economy" (BE) to be more precise - are known as "monetary" or "currency" methods. They are by far the most widely used methods. Accordingly, here the merits and demerits are more thoroughly discussed in the literature than in the case of any other method. The general idea is that in the "hidden" economy cash transactions are preferred because they don't leave observable traces in bookkeeping and bank transfers.[32] Monetary methods exist in the following variants

1. A naïve variant (the "***fixed ratios method***") consists of interpreting some significant changes (as compared to a base period 0) in money aggregates (banknotes, called also M0, M1, M2 or so) or in certain monetary indicators such as the currency/deposits ratio (C/D-ratio) as indications of increasing black activities. The underlying assumption is that such ratios should remain fixed on the base period level if the SE (or BE) were not rising.[33] The empirical evidence shows great fluctuations of the C/D ratio. There is no obvious reason why the C/D ratio should remain constant over longer periods even if there were no SE and much less why a rising C/D ratio should be attributable to an increase in the SE only.
2. The more sophisticated variant of this method, the "***currency demand method***" (CDM), introduced by the Italian Vito Tanzi, requires the statistical estimation of a *currency demand function* where the dependent variable (e.g. currency C or the logarithm of C) is explained by interest rates, tax burden, indicators of the intensity of regulation and other explanatory variables in the framework of a regression equation.[34] This method has more appeal because we not only look at data but "explain" them using a model that fits them (more or less) well. This approach also allows to regard only part of the change in a dependent variable (such as C, ln(C) or the C/D-ratio[35]) as caused by more or less SE and to separate an extra (excessive, or "illegal") demand for currency from the normally expected one. The method rests on the assumption that with base period values of the

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[32] Note that the preference for cash applies only to the "black activities" where there is a need for hiding. There is no point in hiding DIYing, which in some European countries (the UK for example) is a favourite pastime. This of course raises the question: How can we estimate the whole SE and not only the underground economy (the BE part of the SE) using a money (currency) approach?

[33] In particular, in the "cash /deposits ratio" method (of Gutman) it is assumed that we will have more SE to the extent that C_t/D_t is greater than C_0/D_0 where C denotes currency, D demand deposits.

[34] Tanzi's original regression equation reads as follows: $\ln (C/M2) = a_0 + a_1\ln(1+T) + a_2\ln(W/NI) + a_3\ln(R) + a_4\ln(Y) + e$ where T denotes a (weighted) average tax rate, C currency, M2 money supply (= C+D), W/NI ratio of wages and salaries in national income (as a proxy of wealth), R interest paid on time deposits (with $a_3 < 0$ as expected), Y real national income per capita and e as usual the error term (Tanzi 1983). In other CDM exercises, for Austria for example regressors were introduced such as the complexity of the tax system or the intensity of government regulations. See Schneider/Enste (1999), p. 30f. In other estimations (Austria 1956 - 91 and 1956 - 85) Schneider regressed the logarithm of real currency in circulation per capita on the lagged dependent variable, the real private consumption expenditure per capita, interest rate, tax burden (direct and indirect taxes), and again an indicator of the complexity of the system of taxation, and an indicator of the intensity of regulation (he made use of no less than 8 regressors in a sample of 30 annual observations only).

[35] C could also be the "real" (deflated) currency in absolute figures or per capita. Denominators other than D could be the GDP, Private Consumption or similar macroeconomic variables.

explanatory variables, the regression function should give the normal (or "legitimate" in analogy to "illegal") currency (cash) demand.

The "illegal money" has to be multiplied by V, the income velocity of money[36] in order to arrive at an estimated SE turnover reflecting the size of the SE (It is assumed that V in the SE equals V of the official economy).

Note that the distinction between expected and excessive demand for currency represents a *marked* progress as compared to the naïve fixed ratios method. Note also that this regression approach permits, in principle at least, to deal properly with the standard criticism against "monetary methods", i.e. that increasing black activities are not the only driving force behind the currency demand. Other determinants are changing payment habits, hoarding or the role of an "international reserve currency". It should be possible to check the relevance of such arguments by adding appropriate regressors to the regression equation.[37] In this case only the unexplained residual variation in the regression equation would be indicative of increasing BE activity.

3. According to a third approach, presumably the least well reasoned approach, black activities are assumed to be associated with the preferred use of bills of a certain (*higher*) *denomination* only (e.g. 100 $ or 100 €, 200 €). A rising number of large denomination notes might, however, also be due to inflation.[38] It is also maintained (Graf (2009), p.13-14) that typical black transactions will be based rather on "normal cash", i.e. "banknotes that are more usual for everyday transactions".[39] Such controversies again demonstrate that methods to measure the SE (or perhaps only the BE-part of it) are built on vague assumptions and plausibility arguments.

The third method is sometimes no longer mentioned at all. Instead Schneider/Enste (1999) name Feige's transaction method dealt with above as a third variant of the currency methods.

As a rule all these "currency approaches" rest on the assumption that "black" activities are predominantly settled in cash in order to conceal it from tax authorities and to leave no observable traces. As indicators of the SE (or rather the BE) the amount of cash money seems to be a good choice. It is fortunately also a readily available statistical figure.

A problem with all monetary approaches (and other approaches as well[40]) is that they need a "golden age" with no SE (which may then serve as *the* "base"-period 0).[41] However, in practice it seems difficult, if not impossible, to identify empirically such a period with no SE at all when we are not even sure how the SE should be measured.

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[36] V is the ratio of a "flow" term (income) defined for an interval (year for example) and a stock (money) defined for point in time. Hence when a stock ("illegal money") has to be transformed into a flow (size of the SE in terms of the GDP) it is necessary to multiply the stock by V.

[37] Unlike the above mentioned variables such as the amount of regulations, tax burden etc. these variables are *not* seen as determinants or correlates of the BE, hence the values of such regressors (like currency demand of foreign countries etc.), should not be set on their base period value, but on their current value in order to derive the "excessive" (and thus BE induced) currency demand.

[38] In the course of inflation higher denominated bills no longer appear as large as they once were. Furthermore 100$ or 200 DM bills are (or were in the case of the DM) often used in other countries for storing wealth.

[39] Graf's argument is mainly: "Higher denominations could be detectable with more ease".

[40] Including the transaction method.

[41] Such a "no-SE situation" is needed in order to determine the "normal" cash money demand which is supposed to prevail when tax burden and other influences are held constant at the period 0 level.

The rationale of the CDM approach is that excessive currency demand relative to the level when the regressors take on the values of the "no-SE situation" can only be brought forth by "black" economic activities. The logic inevitably runs into difficulties if the actual currency demand (as the dependent variable) were less than the expected one at the base period levels of the regressors, because it is hard to imagine a negative size of the black economy as a consequence of negative excessive currency demand. This is not always unlikely, as can be seen in Fig. 2, where the massive dissolution of cash hoards in Germany at the end of 2001 (approaching the introduction of the €) is a point in case.

Furthermore the CDM approach tacitly makes the unwarranted assumption that the SE is entirely and uniquely determined by the regressors and that the regressors correctly capture and reflect all of its causes. This assumption is not tenable for a number of reasons:

- The factors influencing the monetary variable (e.g. currency) as the dependent variable of the regression are in general only rather vaguely determined, e.g. the case of the above-mentioned "complexity of the tax system" or the "intensity of government regulations". They have to be translated into operationally defined observed variables (e.g. the number of relevant directives, legislative acts or so) which may serve as regressors x_1, …, x_q. It is difficult to prove that the regressors do in fact adequately represent these factors.
- The (observed) dependent variable y is clearly not the (unobserved) target concept, say z, the size of the SE. Hence the method relies on a *theory* relating y somehow to z, and it is important to note that this theory is not verified by the regression (however good y as a function of x_1, …, x_q fits the data). A well-fitting currency demand function is no evidence to support a theory stating that currency demand is an indicator for the SE.
- Moreover, there are numerous examples of empirical applications of the CDM where quite different specifications of the regression equation for the currency demand resulted in a roughly equal "goodness of fit" (as measured by the adjusted R squared). Furthermore, coefficients of the regressors may not be stable and functions with regressors apparently not related to the SE may possibly yield an equally good fit.

If anything, the currency demand function, as it is at the heart of the CDM, is not uniquely determined and to infer the size of the SE from currency statistics (serving as indicator for the SE only) is far from straightforward.

Note that each of the three arguments above applies analogously (perhaps with even greater force) to the MIMIC approach, another statistical method to measure the size of the SE, to be dealt with in Section 2.4.

As with other methods, carrying out the CDM in practice also requires the estimation of the velocity of money V *in the SE*[42]. This velocity again seems to be something that is not easy to measure (if attempts are made at all to measure it, and not just to assume it).

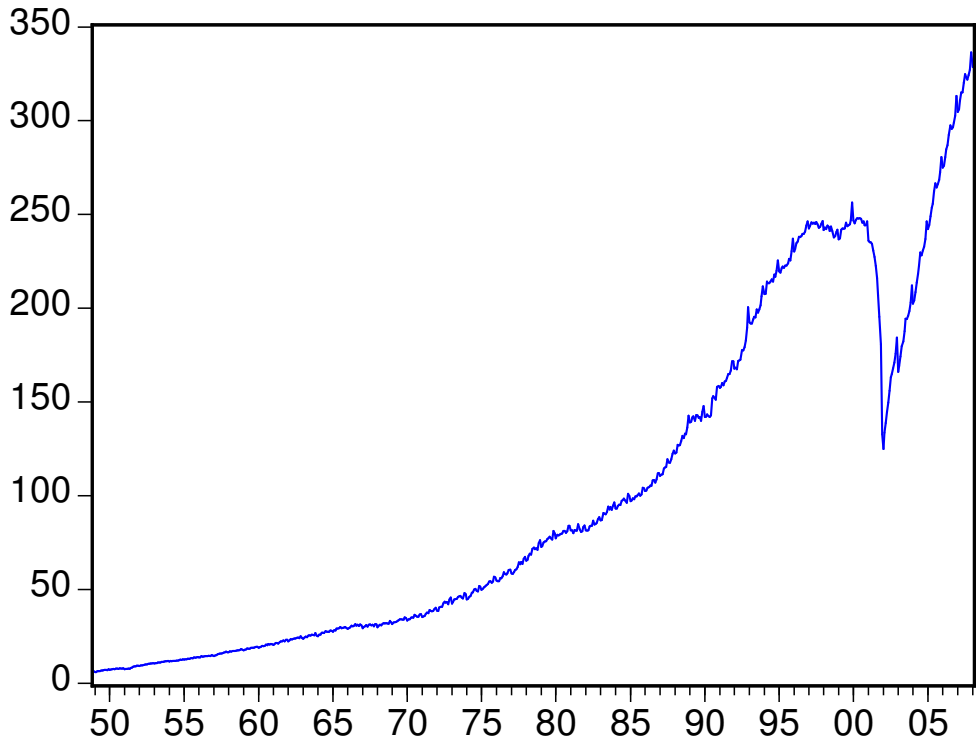
The main objection against the CDM or other variants of monetary methods is, however, that an increase in cash transaction is neither necessary nor sufficient for indicating more black activity and that currency demand is influenced by many more factors than just an increasing size of the SE. One of those factors is most definitely the fact that some currencies like the $

[42] More precisely V *in the BE* is in particular to be estimated, because the fundamental idea of the method that transactions in cash are preferred in order to conceal them applies primarily to the BE part of the SE. The velocity V in the BE is also required in the transaction method.

or increasingly also the Euro (€) are held as "international reserve currencies"[43] or as a medium to better protect wealth from inflation than if wealth were stored in the own national currency.[44]

Figure 2

German currency (banknotes only) in circulation (DM until 2001, then Euro €)



Data provided by the German Central Bank

In former days this applied also to the Deutschmark (DM), a currency which was also held as a sort of "parallel currency" in some Eastern European countries. The existence of international hoards became most markedly apparent in 2001 when, to an incredible extent, hoards held in DM were obviously dissolved in Germany and abroad (see Fig. 2 for the DM banknotes in circulation 1949 - 2008)[45] in order to prepare for the imminent replacement of the DM by the Euro (€) in January 2002.

At the end of this process, in the last months of 2001 the amount of DM-banknotes was melted down to about half of the level it had only two years previously in 1999. Thereafter it only gradually reached its normal level in the first months of 2002. A look at the money aggregate M1 (comprising demand deposits in addition to currency) revealed, however, that the DM-bills evidently were transformed into deposits (Graf (2009)). Interestingly and surprisingly such a far-reaching, almost revolutionary change in the monetary situation of

[43] Obviously a steadily growing currency circulation of the US $ or other leading currencies is not necessarily related to an expanding shadow sector of the respective economy.

[44] Cash may also be needed for transactions where no production (value added) is involved, such as the purchase of antiques or of financial assets like bonds or shares.

[45] Data provided to me by the Deutsche Bundesbank. See Graf (2006), p. 11 and Buehn et al. (2009) for similar graphs.

Germany did not leave its mark in the estimates of the size of the German shadow sector presented by those academics who ostensibly make CDM-based estimates of the SE.[46]

To perform plausibility checks of such estimates is rather uncommon[47]. Yet there are reasons, based on plausibility considerations, to believe that they are arguably grossly overstated.[48] This will be shown in Section 3.

2.4. Model based methods: black economy as output of a black box

In this section we again encounter a method supposed to measure the SE which relies on the validity of a causal interpretation of statistical data, however, in a mathematically much more refined way. For the method addressed here various names are in use.[49] In what follows it is referred to as MIMIC. The method as such is certainly quite interesting from a purely statistical point of view. Whether or not it is promising in the particular field of estimating the size of the SE remains to be seen. As already pointed out, most of the objections to the CDM (the underlying theory relating observed and unobserved variables, whether the variables really reflect what they intend to measure, the variety of possible specifications of equations which possibly fit the data equally well etc.) apply to MIMIC as well. Moreover, the MIMIC model approach is often used in combination with the CDM. The reason is that to estimate a time series of (absolute) *levels* rather than of changes in the level of the latent variable SE the model has to be "calibrated" using a point estimate (for one point in time) of the of the absolute size of the SE taken from another method. And as recourse is here habitually made to the CDM, it does not come as a surprise that empirical results derived from MIMIC and those from CDM used to be quite similar.[50] Obviously this way similarity of results does not prove validity of either or both methods. None of the methods can serve as a cross-check for the other.

The basic idea of MIMIC is easy to grasp and is visualised in Fig. 3.

The SE, though not precisely defined, is conceived as a latent (unobserved) variable η, "defined" by its linear and stochastic relation to certain manifest (observed, statistically measured) variables x and y. The x-variables are known as "causes" of η (in the sense of independent variables, or "regressors" in a regression model "explaining" the dependent variable η) as high η-values go along with high x-values.[51] At the same time the variable η, representing the SE in turn makes certain effects y happen (or is "causing"[52] them in the sense of a "factor" in factor analysis). The y-variables therefore may be viewed as visible manifestations or "indicators" (e.g. cash holdings, growth rate of production) of the SE.

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[46] There was nobody who interpreted this reduction of DM banknotes as a "sign of a marked slowdown of black activities" (Graf (2009), p. 11). A central argument of Graf reads as follows: "If, however, cash amounts of this size can be dissolved without reactions in private consumption expenditures, former increases in cash also cannot be taken as evidence of larger transactions of Germany's sector of black activities" (p. 14).

[47] As mentioned above, it is uncommon in the case of other methods of measuring the SE as well.

[48] They were put forward by Graf (2009) or Koch (2007) for example. Graf (2009) argues that despite an ever-growing currency circulation black activities played a rather minor or even decreasing role for the most part during the DM regime in Germany.

[49] In addition to MIMIC we find also DYMIMIC (Dynamic MIMIC) or DSEM (Dynamic Structural Equation Model). Statisticians prefer the above mentioned term LISREL.

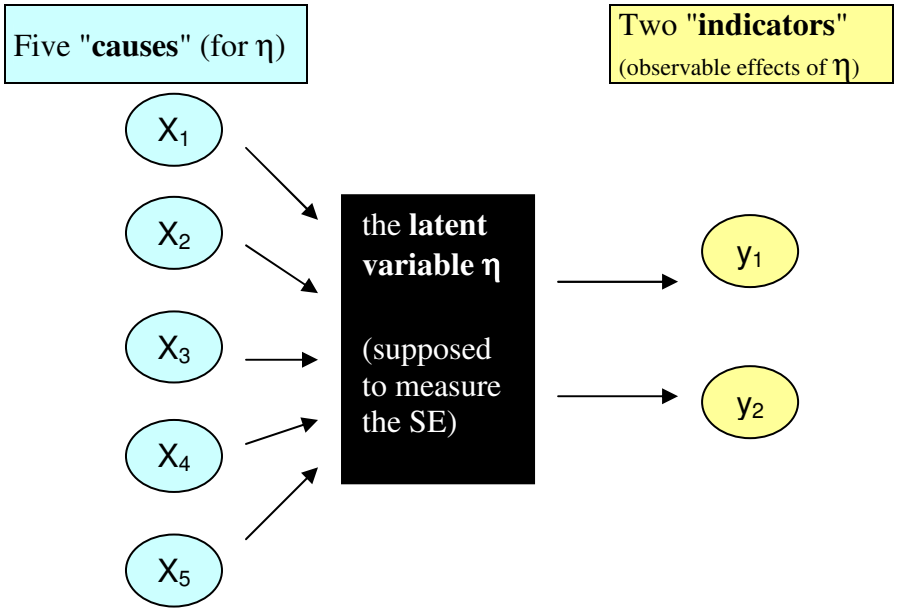
[50] That this is the reason for MIMIC and CDM being relatively close together in most empirical applications is explicitly acknowledged in Buehn et al. (2009).

[51] This idea seems to rule over the choice of "cause"-variables x such as the level (actual and perceived) of taxes, employment, wages and prices in official economy etc.

[52] Note that the y-variables are statistically related to η in the same way as η is related to the y-variables.

Figure 3

Example of a Conceptualisation of the shadow economy in a MIMIC [1)] model
(a model of Martin Eiglsperger)*



causes [2)]: x_1 = ratio VAT/GDP, x_2 = working time, x_3 = disposable income, x_4 = marginal tax rate (income tax), x_5 = total amount of tax and social contributions	**indicators** [2)]: y_1 = Value added (net production, contribution to the GDP) of the corporations (sectors S.11 and S.12 (used for normalising the model), y_2 = Employment participation rate
other candidates for "causes": tax burden (actual and perceived), intensity of regulation, wages and prices in official economy relative to SE, unemployment rate , inflation rate, certain dummy variables [3)]	other candidates for "indicators": domestic currency in calculation, (growth rate of) production in official economy, employment in official sector (decreasing), tax revenue (decreasing) etc.

1) multiple indicators - multiple causes
2) in the case of Eiglsperger's model
3) to capture events like German reunification or move from DM to €

* cp. Eiglsperger (2004), see also Buehn et al. (2009) for another example of a MIMIC model

The model thus combines a part resembling regression relating q different x-variables and the single η variable as follows (equation for the t-th of T observations t = 1, …, T)

(1) $\eta = \boldsymbol{\gamma}'\mathbf{x} + \zeta$

on the one hand, and a part resembling factor-analysis[53]

[53] In factor-analysis we usually have a number of latent variables ("factors") $\eta_1, \eta_2, \ldots, \eta_m$. Likewise a MIMIC model may also have more than just one η variable, where, however, unlike factor analysis η_1 and η_2 will be

(2) $\mathbf{y} = \eta\boldsymbol{\lambda} + \boldsymbol{\varepsilon}$.

In equation (1) the q × 1 column vector **x** contains the values of q "causes" for observation t, that is x_{1t}, …, x_{qt} and the 1 × q row vector $\boldsymbol{\gamma}'$ assembles the corresponding regression coefficients. In (2) **y** is a column vector of p indicators y_{1t}, …, y_{pt}. Moreover there are two distinct sets of (q and p) random variables in the vectors $\boldsymbol{\zeta}$ and $\boldsymbol{\varepsilon}$ respectively, and assumptions about variances of and covariances between the random variables ζ and ε are crucial for the estimation of the coefficient vectors $\boldsymbol{\gamma}$ and $\boldsymbol{\lambda}$.[54]

Thus MIMIC incorporates two systems of equations (a mixture of factor and regression analysis) by virtue of which the SE seems to be made measurable. However, due to the complexity of the system, and for other reasons that will be explained shortly, the SE emerges as the output of a kind of black box. It may all the more appear as a mere artefact given the following facts:

- The SE (as variable η) is in the first place only a formal (mathematical) "construct". There is no generally accepted definition of the SE or model of the SE based on economic theory underlying the two systems of equations. If there were such a definition it should be possible to estimate the size of the SE by aggregating its properly quantified components. This, however, is not the way the SE is measured. MIMIC only provides a global figure with no indication of how it could be broken down into components.
- What makes us believe that this statistically generated latent variable η is indeed the SE and that we have validly measured the size of the SE is only the idea that the kind of variables chosen in order to act as "causes" and "indicators" (consequences) in the model seem to have something to do with what is usually meant by the SE.
- There are no simple rules for selecting suitable variables for the model and to assign a variable to either the x or the y set of variables. Conspicuously we find quite similar and consequently well correlated variables on both sides, the "causes" and the "indicators" (e.g. variates reflecting the development of income).[55] Of course, as a rule decisions on the variables used in a statistical model predetermine how it fits the data. It seems not unlikely that this applies on a larger scale even to a model like MIMIC.[56]
- As mentioned MIMIC does not provide values for the *absolute* size of the SE, but only information about the relative importance (relevance) of causes/effects and coefficients allowing the dynamics of the SE to be estimated. In order to deliver a time series in absolute terms, these estimates have to be linked to a benchmark derived from applying another method (preferably of course applied to the same data), e.g. the CDM.

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associated with other (possibly only partly overlapping) x and y variables. Equation 2 is also known as the measurement model within the MIMIC model.

[54] cp. Buehn et al. (2009) and (identical in this part) Buehn and Eichler (2009) for more details.

[55] For example the tax burden of households is put on the x side and tax yield of the treasury on the y side, or strangely enough, the unemployment rate U may appear on the "causes" side while its counterpart, the employment participation rate E = 1 – U, is placed on the "indicators" side.

[56] The x-variables are correlated with η by virtue of the regression model. On the other hand, the "factor" η is necessarily correlated with the y-variables, so if each x is sufficiently correlated with each y it should be possible to find the appropriate intermediate variable η properly "explaining" these correlations.

- Furthermore the model requires the researcher to make a number of assumptions and decisions, which may call the reproducibility of the results of this kind of black box into question. To name only a few of the steps involved here:
  - The model requires stationary (with no trend) series as the x and y variables (or appropriately transformed x and y variables), so the data have to be "de-trended" by taking differences or by applying time series regression models such as RegARIMA models.[57] So in the course of a complicated "pre-testing" of the data, the time series used as x and y variables have to be checked for non-stationarity (test for unit roots) and cointegration, and not the absolute x or y values but rather their residuals, called "innovations", are treated as the true "causes" and "indicators".[58]
  - As with other statistical methods the MIMIC model requires a competent treatment of outliers (extreme values), that is detection and deletion of identified outliers.
  - For technical reasons (because the estimation of the coefficient vectors $\boldsymbol{\gamma}$ and $\boldsymbol{\lambda}$ amounts to an eigenvalue problem) one of the λ coefficients has to be "normalised" introducing a priori values, for example by setting $\lambda_1 = 1$.[59]

Hence MIMIC requires quite a few methodological decisions to be taken, raising the question of the reproducibility of the results when a different researcher uses MIMIC.

In summary: MIMIC is not unreservedly recommendable. Though it is quite sophisticated as a *statistical* method, there does not seem to be significantly more justification in measuring the SE this way than by other methods. Not much economic theory of the SE appears to have been applied in a MIMIC estimate of the size of the SE. However, given the notorious difficulties in defining "shadow" or "black" economic activities and given the fact that such activities are deliberately concealed (hidden) such that they can only be measured "indirectly" (at best), the idea of a "latent" variable or purely statistical artefact is as such not out of place,[60] and in view of this, MIMIC seems to be no more objectionable than any other approach.

Finally, when measured against the (admittedly demanding) axioms of good statistical measurement as expounded above in section 2.2, we are still quite far away from an unequivocally valid measurement of the SE. None of the methods satisfies all these axioms, or even most of them. This situation is clearly unsatisfactory. It leaves us somewhat helpless when judging the trustworthiness of empirical estimates.[61] As will be shown in the following

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[57] See Eiglsperger (2003) for details.

[58] It seems strange to conceive growth or decline of the SE as brought forth by certain (random) "innovations" in variables which may be somehow conceptually related to the SE. However, this in essence seems to be what happens when the MIMIC approach is used. Note further that variables of the model may be treated differently, for example one may use first differences only in the case of some, not all variables, and "differenced" series are used alongside with RegARIMA residuals.

[59] It is maintained, however, that the "choice of the indicator to fix the scale of the latent variable does not affect the result", Buehn and Eichler (2009), so the problem discussed above appears to be of minor importance.

[60] An example where use is successfully made of factor analysis and the notion of a latent variable (or "factor" in the context of factor analysis) is the measurement of "intelligence". It is not easy to define "intelligence" exactly and it would be pointless to measure it by asking people whether or not they think that they are intelligent (and possibly also to what extent). So in principle quantifying a vague concept by modelling it as a latent variable (in the sense meant in statistics) is as such nothing to be frowned upon. Sometimes it may even be the only sensible approach available. Everything depends on the details of the model.

[61] It is the function of axioms to give reasons to prefer one method over the other and thus to assess the results of various methods.

and final part of this paper we may, however, at least be able to identify truly unacceptable estimates.

3. Some comments on the published results of econometric estimates of the size of the shadow economy

In an attempt to look for some numerical information about black economic activities one inevitably comes across Prof. Dr. Friedrich Schneider. The academic estimation (or "guess-timation") scene is – at least in Germany – dominated by Schneider, who has devoted decades, if not all of his academic life to precisely this topic.[62] He almost monopolised this field and became renowned for the huge amount of estimates he presented for many countries (more than seventy) all over the world such that in the course of time he rose to a kind of Pope in these affairs. Although he produced piles of academic papers he did not bother with communicating much detail about the methods he used. By such reasons he only recently became an object of criticism. Not only are his methods not laid down in sufficient detail and hence remain somewhat opaque, but his results also seem to be considerably biased upwards.

Table 1
Some estimates of the size of the shadow economy in percent of the GDP
(according to F. Schneider)

Europe		Asia	
Country	Size*	Country	Size (year)
Greece	29.6, 28	India	22.4 (1989/90)
Italy	26.0, 24	Taiwan	16.5 (1990/93)
Spain	22.4, 21	Hongkong	13 (1989/90)
Sweden	18.6, 18	Thailand	71 (1989/90)
Germany	13.5, 15	South Korea	38 (1989/90)
Switzerland	6.7, 9	Philippines	50 (1989/90)

* first figure 1994/95 , second 2005

In Table 1 we present some of his estimates for a number of European countries and some Asian countries. It is interesting to see how different methods entail widely divergent results. It seems plausible that southern European countries such as Greece or Italy[63] may have shadow economies of a considerable size (about 25 or 30% of the GDP), and that this holds

[62] Schneider seems to be an outstanding expert in making at least a dozen papers out of one and thereby arriving at an impressing publication record. I have never seen anybody who has so cultivated the habit of publishing an enormous amount of papers which differ from one another only microscopically. In my view this is one of the truly perverse consequences of the qualification systems (career criteria) prevailing in universities in these days. Another aberration arising from these conditions, and on which I commented during the seminar in Wuhan, is to present a talk which hopefully nobody understands due to the advanced mathematics with which one tries to impress the audience. In economics and statistics it is becoming ever more popular now to show off with mathematical wizardry and take pride in ones expertise in things of only limited interest for others or even no practical relevance whatsoever.

[63] While Schneider reported estimates around 26%, official Italian estimates amount to around only 17% for Italy (see Koch (2008), p. 93). Koch also quoted reservations (suspected upward bias) the European Commission expressed about Schneider's estimates for European countries p. 95).

true also (to a smaller degree, however) for Scandinavian countries due to the high tax rates in these countries, whereas Germany might have a SE sector of only moderate size.

In the literature we can find only very few comparisons of estimates derived from different methods applied to the same country and the same period in time. If there are such studies at all, the results seem to vary substantially, e.g. (according to Schneider) Mexico in 1989/90: the electricity input method resulted in 49% while the currency method (CDM) delivered 33%. In another study, Schneider compared average measures of the size of the SE for a group of 5 countries[64] in the interval 1970 – 1990 ranging from 3.1% (survey method) and 7.9% (MIMIC) to no less than 24.4% (derived from comparing official employment figures with an imputed total labour force). We also see conspicuously high discrepancies when different researches use the same method for their estimates.[65]

As mentioned above already, some estimates of the SE (mostly Schneider's CDM-based estimates) are not infrequently suspected to be grossly overstated. There are basically two methods that can be found in the literature to substantiate such suspicions in this respect, namely:

1. to refer to at least equally plausible if not more probable other explanations for the observed development of monetary aggregates, by comparing time series of money (cash in particular), consumption, or other variables and their respective growth rates
2. to demonstrate numerically that implications and consequences were extreme and ridiculous if the estimated figures were to be taken seriously and accepted as they are, so that the estimate thereby appears disqualified.

The inherent dilemma of the first method, that is making inferences from a purely descriptive approach to statistics only (instead of estimating an econometric model) is, however, that it is difficult, if not impossible to come to definite and clear-cut conclusions about the relative strength of various influences affecting e.g. demand for cash (the SE, changing habits in payment, hoards or demand for a currency abroad etc.). This applies in particular when such factors are likely to work in different directions, such that one factor is offset by another. In the absence of a method allowing unequivocal inference of a *causal* ordering from observation only[66] it is always possible to give contradictory explanations for the same statistical figures. We may well argue that a rising (declining) "cash-ratio" such as currency in relation to private consumption expenditure, or cash relative to the turnover of DIY-shops, should be tantamount to a larger (smaller) SE. However, it is also possible to argue that if cash ratios decline over time, the SE may still be increasing[67] because other factors were in place that worked against the SE influence, such that the decline would have been smaller if such factors had not been effective. Hence the problem of methods dependant on assuming a certain causal mechanism underlying the statistical (numerical) observations is that hardly any mechanism can be proved to be the only one having generated the observations.

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[64] Canada, USA, Germany, the UK, and Italy.

[65] Conspicuous is also the speed with which the SE grew after the end of the Soviet Union according to Schneider: in Russia from 14.7% (in 1989/90) to 41% (in 1994/95) or in Georgia from 24.9% to 63%.

[66] Philosophically there are good reasons to doubt that there ever will be such a method. If assumptions about causality are crucial for a statistical method to measure something, the method is always rightly considered vulnerable and therefore as a rule - and as stated also in our first axiom in section 2.2 - a method based on observation should take precedence over a method built on (causal) assumptions.

[67] See Graf (2009), p. 10 for references to this logic in the arguments of other authors.

The second way of criticising an empirical estimate is more promising. It consists of showing how intolerable implications of the estimate would be if it were correct. Koch (2007) for example tried to show that, if Schneider's estimate of an average German SE volume of about €350 billion in the years 2004 to 2007 were correct, this would mean that

- if only unemployed persons had been engaged in such hidden activities their per capita income must have been well above the general average and the time spent for such kinds of work must have been 26% of the regular working time, which appears highly unlikely to everybody, likewise
- if every active (in the sense of employment statistics) person were engaged in the SE with an average wage of €10 per hour, this would amount to 55.5% extra working hours (in addition to the regular average working time);and
- if the estimate of SE production in the construction sector were correct, the black value added of this sector must have been about 160% of the white one, which again is hardly imaginable.

There are more such examples of a rough check of estimates which subsequently appear to be biased upwards in no small measure.

This should be sufficient to show that despite quite a few doubts about all estimation methods currently in use, it should fortunately be at least possible to identify and discard inappropriate methods. What is primarily to be done in this situation is firstly to reach a consensus about definitions and stop mixing up "shadow" and "black", and secondly to start publishing details on methods, underlying data and "intermediate products" in an estimation process in order to make transparent assumptions and limitations of results. This applies also to official statistics. It is difficult to understand that an estimate is good enough to enter official GDP figures but at the same time too doubtful to be published separately. We should also stop taking figures that are based on insufficiently documented methods for granted. Finally, it is difficult to see a benefit in having estimates in abundance while it is questionable as to what is being measured and how it is derived.

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Abbreviations

ARIMA auto regression integrated moving average model (RegARIMA when combined with a regression)

CDM = currency demand function method

DIY = do it yourself

DM = Deutsche Mark, former currency in Germany

SE = shadow economy

BE = black economy

GDP = gross domestic product