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The Cyclical Behavior of Shadow and Regular Employment

by

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ABSTRACT

Using data from the Italian Institute of Statistics, I examine the cyclical properties of three labor inputs - regular employees, regular self-employed, and underground workers. Results support the widespread view that, in Italy, the shadow employment functions as an improper tool for increasing the labor market flexibility. My analysis uncovers more details. While the contemporaneous correlation between shadow labor and output is significant, as time passes their association looses momentum. The opposite is found for regular employees, which show significant positive correlations with lagged output gaps only. Somewhat puzzling, self-employment seems to be the less sensitive to the course of business cycles. Possibly, hidden employment substitutes it as shock-absorber. Sectoral data tell different stories.

Key Words: Underground economy; VAR models; Labor Market Flexibility, Business Cycle

JEL Classification: C32, C53, E26, H26, J30.

NON-TECHNICAL SUMMARY

Virtually, each and every country has a dark side affecting the labor market. This shadow needs to be careful analyzed in order to achieve an exhaustive knowledge of economic systems. Since all individuals engaged in the shadow sector wish not to be identified, gathering accurate information about it is a very difficult task. As a matter of fact, very few data are available and even fewer remain if one wish to work with a minimum level of reliability. A notable exemption is Italy where, at the end of 2004, the Italian national institute of statistics (ISTAT) released a relatively long time series of the shadow employment. It is worth noticing that the dataset is i) "official" (it is drawn from ISTAT), ii) long-running (1980-2002), iii) national account consistent, iv) based on internationally accepted definitions and methods. Results support the widespread view that the shadow employment functions as an improper tool for increasing the labor market flexibility. But the analysis let to uncover even more intriguing details. While the contemporaneous correlation between shadow labor and output is significant, as time passes their association looses momentum. The opposite is found for regular employees, which show significant positive correlations with lagged output gaps only. Somewhat puzzling, self-employment seems to be the less sensitive to the course of business cycles. Possibly, hidden employment substitutes it as shock-absorber.

Sectoral data tell different stories. Indeed, due to selective labor/fiscal policies and/or to structural factors (such as firms' size), the expected penalty and the degree of regular market flexibility could be different across industries where, moreover, heterogeneous hidden workers (*e.g.*, unregistered immigrants vs native multiple-income hidden workers) are differently distributed. All that may explain why nation-wide results are not always mimicked at the industry level. In turn, it emphasizes the huge complexity of the phenomenon and the need for multi-faceted policies to address it.

FLUTTUAZIONI CICLICHE DELL'OCCUPAZIONE REGOLARE E DEL LAVORO NERO

SINTESI

Usando i dati recentemente rilasciati dall'ISTAT, questo lavoro esamina i legami che esistono, nel breve periodo, fra tre differenti input di lavoro. In particolare, si analizzano le componenti cicliche dei lavoratori in nero, dei dipendenti regolari e degli autonomi regolari. Vale la pena di enfatizzare che i dati provengono dall'ISTAT e, dunque, sono ufficiali. Inoltre, essi seguono definizioni e metodi accettati a livello internazionale e, ovviamente, sono coerenti con lo schema dei Conti Nazionali. La serie storica utilizzata risulta sufficientemente lunga e affidabile per poter guardare, per la prima volta, all'interno del mercato del lavoro con un'ottica nuova e stimolante. Dal punto di vista statistico, le componenti cicliche sono estratte facendo uso del filtro di Hodrick-Prescott, mentre le relazioni tra loro sono analizzate mediante i residui di vettori autoregressivi bivariati formati, alternativamente, da uno dei tre menzionati fattori produttivi e dall'*output*. I risultati indicano che, come spesso suggerito ma mai verificato, il lavoro sommerso consente alle imprese di disporre di un grado di flessibilità *extra*. L'analisi eseguita evidenzia ulteriori elementi. Il lavoro nero sembra seguire le vicende cicliche dell'impresa solo nel breve periodo. Passato un anno dallo *shock* le imprese, forse dopo aver constatato il perdurare della nuova fase ciclica, modificano anche lo *stock* di occupati dipendenti. Invero, nel periodo in esame, nonostante la lamentata rigidità del nostro mercato del lavoro, è stato possibile "cassintegrare/prepensionare" i dipendenti regolari. Sorprendentemente, gli autonomi non sembrano essere toccati dalle condizioni del ciclo economico. Una possibile spiegazione risiede nella citata possibilità per le imprese di modificare, subito, lo *stock* di dipendenti in nero e, in seguito, quello dei regolari. L'analisi per settori rivela numerose eccezioni a queste relazioni dinamiche complessive. Evidentemente, anche a causa di politiche fiscali e/o del lavoro differenziate per settori, i fattori che sottendono all'uso di lavoratori sommersi - la multa attesa, la disponibilità di lavoratori irregolari eterogenei (es. immigrato clandestino o dipendente pubblico) e il grado di rigidità del mercato del lavoro - non sono uguali tra i vari settori. D'altronde, è un fatto ben noto che il fenomeno del sommerso ha molti volti e il legislatore informato non può che tenerne conto.

Parole chiave: Economia sommersa, modelli VAR, flessibilità del mercato del lavoro, ciclo economico

Classificazione JEL: C32, C53, E26, H26, J30.

CONTENTS

It is a capital mistake to theorise before one has data.
Arthur Conan Doyle, *A Scandal in Bohemia*.

1 INTRODUCTION [1]

There are several reasons for why one might be interested in the cyclical nature of the shadow (hidden, irregular, underground, etc.) employment. First of all, it is likely that its share in the labor market is non trivial (Schneider and Enste 2000). Thus, the cyclical swings of Government revenues may also depend on the short term movements of the irregular workers (Ihrig and Moe 2004). Then, to the extent that black economy workers productivity is lower than that of the corresponding regular ones (Isae 2002; Boeri and Garibaldi 2002), different cyclical responses of labor inputs can have an impact on the overall productivity dynamics. In addition, the relative responsiveness of heterogeneous labor inputs may have implications for the costs of downturns, and how aggregate shocks are propagated across firms and over time (Choi and Tum 2002). Economic literature suggests that shadow employment may serve as a macroeconomic buffer for the regular sector employment over the course of business cycles. Ihrig and Moe (2001), Conesa *et al.*, (2001), Carillo and Pugno (2004) conclude that the irregular sector is procyclical; Busato and Chiarini (2004) suggest reasons for its countercyclicity. It is noteworthy that all these works do not distinguish between informal and irregular activities. Unlike them, this paper takes advantage of national account consistent data based on an official and clear-cut definition of underground economy to analyze the short-term behaviors of different labor markets. Given a sufficiently low expected penalty and a rigid regular market, the irregular labor may afford to increase all kinds of labor flexibility - occupational (hiring-firing), contractual (part-time, fixed-term, etc...) and wage. While I follow a measurement-without-theory approach, the logic of the fluctuations is straightforward. Making use of black economy workers, firms may reduce their wage bill (paying fewer taxes and bearing fewer costs due to labor market regulations) and may easily, costless and immediately, fire them to overcome adverse economic evolutions. On the other hand, if shadow employment actually works as a pad, during booms firms should increase it to “refill the black economy pool”. Moreover, before hiring “sunk” regular workers, firms may want to wait and see if the recovery is not

1 I would like to thank an anonymous referee and the participants at the XXX Simposio de Analisis Economico, University of Murcia, 15-17 December 2005, Murcia, Spain. All errors are solely those of author as are the opinion expressed herein. E-mail: m.bovi@isae.it.

short-living. Hidden workers afford firms the opportunity to wait and see. Thus, underground economy jobs should be more business cycle sensitive than the regular ones and there should be a positive correlation between the detrended series of output and hidden employment.

Due to selective labor/fiscal policies and/or to structural factors (such as firms' size), the expected penalty and the degree of regular market flexibility could be different across industries. Moreover, unregistered immigrants and native multiple-income hidden workers (such as retirees, civil servants, etc.), have different productivity, contractual power, etc. Since they often operate in distinct sectors (*e.g.*, illegal immigrants are usually engaged in agriculture, in construction and in the personal services sectors), it may induce diverse cyclical behaviors across industries. To the extent these considerations are true they call for a deep inspection of labor market dynamics, both at the overall and sectoral level.

This paper aims to test the cyclical behavior of irregular and regular labor inputs in Italy throughout the last two decades. Data are from the Italian national institute of statistics (ISTAT) which, recently, has made available national accounts consistent annual data for three kinds of labor inputs - regular employees, regular self-employed, and hidden workers, even at a sectoral level (ISTAT 2004). As far as I know, this is the first attempt to study these inputs separately and to perform a really comprehensive empirical analysis of the short-term labor input comovements. The reason is simple – ISTAT estimates are the only available data and, obviously, to examine shadow employment dynamics one needs a reliable time series over several years.

2 THE ESTIMATION METHOD OF THE SHADOW EMPLOYMENT. DESCRIPTION

Economic literature always refers to shadow activities by using, interchangeably, terms such as "underground" and "informal" (Fugazza and Jacques 2004; Ihrig and Moe 2001, 2004; Schneider and Enste 2000). Since 1993, however, there is an internationally accepted definition that clearly separates these contiguous phenomena (U.N. *et al.* 1993). It is described in the System of National Accounts (SNA93) and may be fruitfully used in the present context. According to SNA93, the non (directly) observed economy includes the illegal, the informal, and the underground sector. The former consists in (a)

production of goods and services whose sale, distribution or mere possession is forbidden by law (*i.e.* production and distribution of illegal drugs); (b) production activities which are usually legal but which become illegal when carried out by unauthorized producers (*i.e.* unlicensed practicing of a profession). To define the second, the SNA93 (IV–Annex) refers to institutional production units characterized by: (a) a low level of organization; (b) little or no division between labor and capital; (c) labor relations based mainly on occasional employment, kinship or personal and social relations, as opposed to formal contracts. There is no need to underline that informal activities are not necessarily carried out in order to evade taxes or other controls related to social security contributions. On the basis of the laws in force in each country, for example, this sector may be identified by referring to the "size" of the production unit or to the characteristics of the legislation (no obligation whatsoever to register with public authorities). The third sector represents the area of (legal) production activities that are not directly observed due to reasons of economic nature (deliberate desire to avoid taxes and/or to avoid observing the law provisions concerning the labor market) and/or statistical nature (*e.g.* due to the failure to fill out the administrative forms or statistics questionnaires).

ISTAT claims that non-observed does not means non-measured (Calzaroni 2000; Baldassarini and Pascarella 2003), and its estimation approach to measure the underground sector is known as the labor input method (OECD 2002). Briefly, it consists in i) the use of sources and survey techniques that make possible to measure the weight of unregistered work (this is achieved primarily by using labor status particulars declared by respondents in the household surveys; ii) the correction of the under-reporting of income by the enterprises through adjustments of the per capita production and value added values declared by the small production units (fewer than 20 employees) and iii) the checks for the consistency of the economic aggregates through the balancing of the resources and uses made at the level of each industry. ISTAT considers irregular employment the positive[2] difference between the number of persons recorded by household surveys and the number of jobs emerging from the business-side surveys. The assumption, repeatedly verified by ISTAT, is that individuals have fewer reasons than enterprises to conceal the nature of their work. As a result, ISTAT publishes annual estimates of the irregular input of labor in Full-Time-Equivalent (FTE) units. Two elements are worth noticing in the present context. First, underground activity and tax evasion are not necessarily the same thing. In fact, it there could be underground activity even

[2] In case of negative values ISTAT defines those workers as regular with multiple jobs. If there is no gap, ISTAT speaks about regular single jobs.

with no taxation, if firms do not observe the employment protection legislation; and tax evasion with no underground, if tax evasion deals with, *e.g.*, financial and/or real estate markets. Second, ISTAT focuses mainly on that part of tax evasion generated in the labor market. In turn, it means that the actual irregular GDP is larger than that estimated by ISTAT (Bovi 1999). However, this is not disturbing here since my focus is on hidden employment[3].

3 THE ESTIMATION METHOD OF THE SHADOW EMPLOYMENT. ISSUES

While it is simple to describe, and it is internationally recognized to be a very good one such as to be recommended as the most appropriate to estimate the input of labor (OECD 2002), the practical application of the ISTAT method is more difficult (OECD 2004):

- labor force surveys provide estimates of the (supply-side) numbers of workers, while data from enterprise surveys usually refer to the (demand-side) number of jobs. The two sets of data must therefore be standardized by converting them to comparable units such as hours worked or full-time equivalents;
- the comparison between the two independent sets of data needs to be made at as detailed a level as possible. Ideally this should be by size-classes as well as by detailed kinds of activities;
- the method depends crucially on the availability of comprehensive estimates of labor inputs.

As mentioned, ISTAT works out FTE units (see Calzaroni 2000 for details). As for the other two items, ISTAT uses microdata (five-digit industry level according to the classification of economic activities ATECO[4] 2002), and considers that the results of the household labor force survey, supplemented by demographic data, provide exhaustive estimates. The Italian survey collects information on the kind of activity, hours worked, and the approximate number of employees in the enterprises where the respondents work. The survey also

[3] It makes this paper different from works dealing with the relationships between regular and irregular GDP (see, for example, Busato and Chiarini 2004a; Giles 1997).

[4] ATECO 2002 is identical to NACE Rev.1.1 (the reference classification for economic activities) at four digit level.

collects information on secondary jobs, which are relatively common in Italy for persons whose main job is with the government. In addition ISTAT, via *ad hoc* analyses, tries to take into account non-resident undocumented foreigner workers, which can not be directly observed by the usual sources used to uncover other kinds of black economy. Finally, even if ISTAT knows (and surveys) only regular firms, from households' answers it can detect irregular workers engaged both for regular and for irregular firms.

The literature has raised concerns over the ability to uncover the real status of workers via surveys. Even if it is reasonable to assume that individuals have less reason than enterprises to conceal the nature of their work[5], Boeri and Garibaldi (2002) point out that if employees cooperate in shadow activities they may decide not to declare to be working. As reported in their paper, a joint ISTAT-Fondazione Curella survey reports that about 25% of the black economy is wrongly assigned to the inactive status by the labor force survey. Also, some individuals who indicate to their interviewer that they are self-employed may actually be laboring in the underground economy. A study of the US General Accounting Office[6] found that, in 1992, 56% of the tax gap (the difference between the amount of income taxes owed and the amount voluntarily paid) could be attributable to misclassified workers - individuals who reported they were self-employed but were actually employees. In general, the respondent may want to avoid telling anyone the truth about sources of income, and so will have concocted a convenient story intended to arouse the least suspicion. A non-specific but legitimate sounding job would appear the easiest way out for those individuals. Thus, supply-side sources can capture illegal workers which, instead, should be considered outside the underground sector. Then, one can speculate that unemployment could be overstated in the surveys because respondents who should have been classified "out of the labor force" are fearful that they would lose benefits unless they indicated they were looking for work (Gutmann 1978). Finally, as Tanzi suggests (1981), the first issue for the irregular sector worker when approached by the interviewer, is whether to become a respondent and not what to answer. It seems reasonable to assume that he is more likely to be a non-respondent than he would be if he were not in the irregular sector. In the ISTAT approach, non-respondent are included in the "statistical underground", which is allocated to the observed economy. In 1998 the percentage of non response was 3% of total GDP (ISTAT 1998). Evidence

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5 In fact, the existence of such a situation is not a mere hypothesis but, rather, a reality that has been repeatedly verified by ISTAT.

6 US General Accounting Office, "Estimates of the Tax Gap for Service Provider", GAO/GGD-95-59, Dec. 1994.

reported in Di Nardo *et al.*, (2000) may give an idea of the potential bias. In that paper is described a survey carried out in San Giuseppe Vesuviano, a town near Naples known for its widespread black economy employment. The standard method was that of the census survey, but conducted three times for the same universe in a period of a few months. Once by an interviewer not known to the local area; once by an interviewer who was known, using the indirect method of contacting 'key observers'; and once by a known interviewer using the direct, door-to-door survey method, but establishing trust with the respondents and exploiting (fortuitously) her particular personal situation - she had to finish her thesis and she was pregnant. Where the standard method produced a result of 31.1% and that of the "informed persons" one of 35.8%, the third approach got 43.7%. While this kind of research may suggest that the bias could be significant, its scientific content and replicability is questionable. Just to mention, what about other "particular" personal situations? Those shares are in fact directly indicated by (more or less) informed persons, so the amount is "subjective", as shown by their threefold evidence. As should be clear, the ISTAT method is different because it estimates hidden workers indirectly. Finally, it is really hard to imagine how this method could be structurally implemented in the system of national accounts.

4 THE CYCLICAL DECOMPOSITION

Growth-rate correlations are subject to some bias due to first-differencing. The transfer function of the first-difference filter, which shows the proportion of variation in the underlying series that is "transferred" to the first differenced series, can be expressed as $2\times[1-\cos(\varpi)]$, which is greater than one for frequencies higher than the business cycle frequency band. That is, first-differencing boosts the relative importance of high-frequency components of time series. An alternative approach of estimating trend and cyclical (high frequency) components of time series is the use of statistical filters, in either their univariate or multivariate form. One of the most common statistical filters is the Hodrick and Prescott (1997), developed as a mechanical and statistical procedure to extract very low and very high frequencies, fewer than two years and more than eight years approximately, from time series. Although this data window seems arbitrary, it comes from the seminal study by Burns and Mitchell (1944), carried out at the National Bureau of Economic Research, which concluded that the US economy presents very clear business cycles lasting up

to eight years. In fact, economists generally agree on that (Christiano and Fitzgerald 2003). Basically, the Hodrick-Prescott (HP) filter decomposes a time series (y_t) into a trend/smoothed component (St) and cyclical component (C_t). Technically, the HP filter is a two-sided linear filter that computes the smoothed series S_t of y_t by minimizing the variance of y_t around S_t, subject to a penalty that constrains the second difference of S_t. That is, the HP filter chooses S_t to minimize:

$$\sum_{t=1}^{T}(y_t - S_t)^2 + \lambda \sum_{t=2}^{T-1}[(S_{t+1} - S_t) - (S_t - S_{t-1})]^2$$

where λ denotes the smoothness parameter. Once the smoothed series has been obtained from the problem, the cyclical component (C_t) is obtained from $C_t = y_t - S_t$. Parameter $\lambda>0$ is the penalty on variation, where variation is measured by the average squared second difference. A larger value of λ makes the resulting $\{S_t\}$ series smoother; less high-frequency noise. For $\lambda \to \infty$, the trend series becomes linear.

Following a different but related approach, other studies (Baxter and King 1995, 1999; Christiano and Fitzgerald 2003) designed and implemented specific band-pass filters. These filters are used to isolate the cyclical component of a time series by specifying a range for its duration. Roughly speaking, the band-pass filter is a linear filter that takes a two-sided weighted moving average of the data where cycles in a "band", given by a specified lower and upper bound, are "passed" through, or extracted, and the remaining cycles are "filtered" out. The various band-pass filters differ in the way that they compute the moving average. Even in this case the band pass filters are designed to isolate fluctuations in the data that persist for periods of 1.5 or 2 through 8 years. The authors claim that this kind of filter can improve two practical problems encountered when using the Hodrick-Prescott filter: unusual behavior of cyclical components at the sample's beginning and end, and the choice of a smoothing parameter for non-quarterly data. In turn, the main practical problem with this sort of filter is that the ideal filter requires an infinite amount of data. Moreover, the fixed length symmetric filters employ a fixed lead/lag length, thus the resulting filtered series will lose observations from both the beginning and end of the original sample. This is particularly disturbingly in the present case. On the other hand, there exist asymmetric filtered series which do not have this requirement, but asymmetric filters induce phase shift, which could distort correlations between filtered series, the main statistical object of this paper. Turning the attention to the λ-problem for annual data, suggestions about the smoothness parameter range from a low of 10 to a high of 400 (Baxter and King

1999). However, I set λ=10 since Baxter and King (1999) show that such a value performs quite well in removing frequencies larger than thirty-two quarters. Also, in a previous work those authors (Baxter and King 1995) show that setting the smoothing parameter to about 10 produces a Hodrick-Prescott filter that is very similar to their band-pass for annual data. Thus, one can be sufficiently confident that the results of this paper are robust to the Baxter and King filtering procedure, as well. In addition, setting the smoothing parameter to 10 in the present case is consistent even with the recent Ravn-Uhlig procedure (2002) to improve the HP filter[7]. Finally, the HP-detrended series will not lose any observations. Data are transformed as the difference between the log of variables and the Hodrick-Prescott trend of the log of variables. So, the time series I use in the following section represent short-term fluctuations around the trend.

5 THE STATISTICAL ANALYSIS

One common way to properly analyze the empirical relationships between time series is the vector autoregression approach. The VAR approach (Sims 1980) sidesteps the need for structural modeling by treating every endogenous variable in the system as a function of the lagged values of all the endogenous variables in the system. Consider the VAR(p) model

$$\Phi(L)\mathbf{y}_t = \varepsilon_t$$

where $\Phi(L) = \mathbf{I} - \Phi_1 L - \Phi_2 L^2 - \ldots - \Phi_p L^p$.

Provided that the stationary conditions hold (*i.e.* that roots of $|\mathbf{I} - \Phi_1 z - \Phi_2 z^2 - \ldots - \Phi_p z^p| = 0$ lie outside the unit circle) we have the vector moving average representation of $\mathbf{y}_t$ as

$$\mathbf{y}_t = \Phi^{-1}(L)\varepsilon_t = \varepsilon_t + \sum_{i=1}^{\infty} \psi_i \, \varepsilon_{t-i}$$

where ψ_i is an m×m coefficient matrix. The ε_t*'s* represent shocks in the system.

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[7] In the frequency power rule of Ravn and Uhlig (2002), the smoothing parameter is equal to the number of periods per year divided by 4, raised to a power (Ravan and Uhlig recommend using a power value of 4), and multiplied by 1600. In the present case the value is (1/4)^4*1600=λ=6.25, which generates cyclical series observationally equivalent to the case with λ=10.

Suppose we have a unit change in ε_t then its effect in $\boldsymbol{y}$ s periods ahead is

$$\frac{\delta y_{t+s}}{\delta \varepsilon_t} = \psi_s .$$

Accordingly the interpretation of the ψ matrices is that they represent marginal effects, or dynamic multipliers, or the model's response to a unit shock (or innovation) at time point t in each of the variables. The response of y_i to a unit shock in y_j is given by the sequence, known as the impulse response function (IRF),

$$\psi_{ij,1}, \psi_{ij,2}, \psi_{ij,3}, \ldots,$$

where $\psi_{ij,k}$ is the ijth element of the matrix ψ_k (i, j = 1, . . . , m). Generally speaking an IRF traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. However, unless the error covariance matrix $E(\varepsilon_t \varepsilon_t')$ is a diagonal matrix, the shocks will not occur independent from each other. The conventional practice in the VAR literature is to single out the individual effects by first orthogonalise the error covariance matrix, *e.g.* by Cholesky decomposition, such that the new residuals become contemporaneously uncorrelated with unit variances. Unfortunately orthogonalization is not unique in the sense that changing the order of variables in $\boldsymbol{y}$ changes the results. The economic theory may be used to solve the ordering issue, but in the present case there are not commonly accepted theoretical indications, especially about dynamics. In addition, the nature of this paper is eminently empirical. So, my solution is to follow the “agnostic” approach of Pesaran and Shin (1998). These authors construct an orthogonal set of innovations that does not depend on the VAR ordering. The generalized impulse responses from an innovation to the jth variable are derived by applying a variable specific Cholesky factor computed with the jth variable at the top of the Cholesky ordering. The exercise can be thought of as tracing out how the observation of a forecast error in one equation of the system would lead to revisions in the forecast path of all model variables. To analyze the propagation mechanisms of macroeconomic shocks between output and labor inputs, I perform three bivariate VAR models which include the output gap and, alternatively, each of the three labor gaps. The pure shape of impulse functions is not fully informative of whether a detected reaction path is also meaningful in a statistical sense. Thus, I also display the upper and lower limits of a 95% Monte Carlo band. Clearly, if these bands contain the zero line one can conclude that there is evidence of no reaction.

The generalized response profiles can not offer information about economic causation among the variables. To this end, I perform block/exogeneity Granger causality tests (Granger 1963, 1969). As known, the logic of the Granger causality is based on the concept that an effect can not precede its cause[8]. In the present bivariate VAR the Granger approach amounts to test the information content of the past values of output (input) in improving (linear) predictions of the present value of input (output). Thus, I compute the Wald statistic for the joint exclusion of the lagged term(s) of output in the input equation and *vice versa*. VAR innovations are both serially uncorrelated and uncorrelated with the lagged terms of the variables but, as already noticed, they can be contemporaneously correlated. So, side-by-side with the Granger causality, it may be interesting to analyze the instantaneous causality (or instantaneous linear feedback). Geweke (1982) proposes to perform the following two regressions:

$$x_t = \sum_{i=1}^{r} \beta_i x_{t-i} + \sum_{j=1}^{s} \lambda_j y_{t-j} + \varepsilon_{1t} \tag{1}$$

$$x_t = \sum_{i=1}^{r} \beta_i x_{t-i} + \sum_{j=0}^{s} \lambda_j y_{t-j} + \varepsilon_{2t} \tag{2}$$

The existence of instantaneous causality amounts to a non-zero partial correlation between the two variables conditional on their history. Asymptotically, and under the null of no instantaneous causality, Geweke's test is

$$\ln[\mathrm{Var}(\varepsilon_{1t})/\mathrm{Var}(\varepsilon_{2t})]^{*}n \sim \chi_1^2 .$$

If we further assume that the errors are independent and identically normally distributed, we have an exact, finite sample F-statistic which, in the present experiments seems to be preferable. Actually, I perform an omitted variable test by comparing the residual sum of squares computed with and without the zero-restriction imposed on the current term of equation 2. Main VAR diagnostics and outcomes are reported in Appendices 1 and 2.

[8] Should be clear that when I speak about "input-output" relationships, I do not necessarily expect that inputs must "precede" the output. In fact, it may well happen that inputs demand is based on lagged output. Otherwise stated, I just have no *a priori* about the kind of relationship linking the gaps.

6 RESULTS

The visual inspection of the results (Appendices 1 and 2), shows that all the proposed VARs meet the necessary and sufficient condition to give a reasonable statistical description of the data. The picture emerging from the experiments highlights some interesting stylized facts. As for aggregate data (Appendix 1), the instantaneous linear feedback between output gap (Y) and black economy employment gap (B) confirms the expected procyclical nature of the latter. Indeed, as suggested by the absence of significant lagged correlations, shadow employment works as a "flash" buffer only. In contrast, HP-detrended regular employees (E) and Y are significantly correlated only after some lag, with information flows running from output to input. Thus, findings support the view that in the last two decades even regular employees were fired/hired according to the cycle, although with a delay of more than a year. Possibly, this for two main reasons. First, despite the often claimed labor market rigidity (Nicoletti *et al.*, 1999), Italian firms have had even "regular" devices to fire regular employees. Tools such as the Cassa Integrazione Guadagni (CIG, wages guarantee fund), and the widespread use of early retirements have been largely used as shock absorbers in the last decades (Bertola and Garibaldi 2003; Bovi 2005). Second, it should be recalled that the hidden sector's absorptive capacity is limited and can become saturated during profound and/or long-lasting recessions, as happened during the 1993 crisis. Somewhat puzzling, the regular self-employed gap (S) seems to be "totally" orthogonal to the business cycle, that is S shows neither Geweke, nor Granger, nor Pesaran-Shin links with Y. Tentatively, it may be rationalized by thinking of B playing the flash buffer role instead of S. In the medium term, the relationship between Y and S could be hampered by the feedbacks coming from regular employees. Due to *ad hoc* tax amnesties and/or to selective policies and/or to different sectoral structures, industries may have a different degree of labor market rigidity and/or a different expected penalty. As a consequence, aggregate outcomes are not necessarily mimicked at the sectoral level. In fact, the industry-level VAR experiments detect different cyclical behaviors (Appendix 2). Taking as cut-off rate the 95% significance level, it seems that value added gap and regular employees gap share a contemporaneous feedback only in the manufacturing and in the trade sectors. This finding is particularly interesting because, leaving aside the construction and the (small) media sectors, those industries are the only ones which can use the CIG to "regularly" increase their flexibility. In the construction industry only Y and S comove at the zero lag which, perhaps, my help in justifying the absence of contemporaneous

feedback between the other two inputs and Y. In the personal services sector (where, according to ISTAT, there are no self-employed) hidden employees play the flash-buffer role. Maintaining the 95% rule and turning the attention to the Granger causality, it results that lagged values of Y help in predicting E in agriculture and in the industrial sectors. The causality runs instead from output to underground workers in the construction, trade, and personal services sectors. The former sector is the only one to show a "complete" Granger causality - all labor inputs are unidirectionally caused by the value added. A similar outcome holds for the other industrial sector, where only B is not Granger caused by Y. The Pesaran-Shin propagation mechanism of shocks shows that in these two industrial sectors there are significant input-output feedbacks. In the manufacturing sector the reaction is two-way. The output response to a surprise in the employees gap may be tentatively rationalized by thinking about a productivity shock[9]. The effect of the value added shock on E is more lengthy (four vs two years). In the construction sector all inputs reply to Y, but an unexpected variation in output does not affect any input. The different starting points and the durations of the feedback may be due to the nature of the input, in that the response of B and S is smaller, quicker and shorter than the "more structured" E input. The only other non-zero Pesaran-Shin reactions are found in the personal services sector. They are both two-way (in this sector there are only two inputs, E and B), with B and Y linked for few years. The feedbacks between E and Y last relatively more years and are stronger. In this industry comovements should be seen in the light of the fact that labor cost and value added are equal. In addition, it is strongly affected by the (frequently reiterated) legalizations of unregistered immigrants, which imply a one-shot *ex lege* change of status from B to E[10]. Finally, the inputs in the transport and in the hotel and restaurant services sectors seem to be linearly independent from their value added gaps in each and every trial.

9 By definition, the labour productivity involves both input and output.

10 In the last decade there were four legalizations: 1990, 1995, 1998, 2002. In this latter legalization, 274,000 B FTE units became regular employees (ISTAT , 2004).

7 CONCLUSION

Virtually, each and every country has a dark side affecting the labor market. This shadow needs to be careful analyzed in order to achieve an exhaustive knowledge of economic systems. Since all individuals engaged in the shadow sector wish not to be identified, gathering accurate information about it is a very difficult task. As a matter of fact, very few data are available and even fewer remain if one wish to work with a minimum level of reliability. A notable exemption is Italy where, at the end of 2004, the Italian national institute of statistics released a relatively long time series of shadow employment. It must be noticed that these data are “official”, national account consistent and built on a precise and internationally accepted definition which clearly separates the hidden activities from the illegal and the informal ones. All that affords, for the first time, the opportunity to look into the black economy box with a new and intriguing perspective. In particular, I deal with the cyclical behavior of three kinds of labor inputs - regular employees, regular self-employed, and hidden workers. Empirical results afford the occasion to eventually support the widespread theoretical/anecdotal view that, in Italy, shadow employment functions as an improper tool for increasing the labor market flexibility. But now we can say even more than that. While the contemporaneous correlation between shadow labor and output is significant, as time passes their association looses momentum. The opposite is found for regular employees, which show significant positive correlations with lagged output gaps only. Somewhat puzzling, self-employment seems to be the less sensitive to the course of business cycles. It may be due to the presence of hidden employment. Sectoral data tell different stories, emphasizing the huge complexity of the phenomenon and the need for multi-targeted policies to address it.

To conclude, some *caveat*. I can not exclude that my outcomes are biased because of measurement errors, such as those stemming from black economy workers with wrongly assigned labor status, or from non-exhaustive surveys. In addition, the sample is small and the data are annual. This may affect the results when analyzing cyclical behaviors (Hamermesh 1993). So the results can not be definitively conclusive, and should be seen as *prima facie* evidence. Then, I focus on full time equivalent units. While they measure the amount of labor input used in producing GDP, they do not allow studying the impact of GDP dynamics on the number of jobs/persons. On the positive side, as Charles Babbage would say, errors using inadequate data are much less than those using no data at all and, probably, it is too conservative to define ISTAT data as “inadequate”.

APPENDIX 1
Bivariate VAR Analysis (Output vs Labor Input). Sample 1980-2002

In each IRF graph, the ±2 S.E bands are drawn from 1000 Monte Carlo replications.

Tab. 1a **Input: Black Economy Employment. One lag. Instantaneous Causality: [0.04]**

Multivariate tests			
Portmant. Q-Stat 3 lags = 4.92 [0.77]a	Normality J-B = 1.76 [0.78]	Hetero X^2 No Cross Terms = 7.98 [0.79]	Hetero X^2 Cross Terms = 10.0 [0.82]

All variables (source: Italian Institute of Statistics) are in logs and HP detrended. a=adjusted version. P-values in squared brackets. For instantaneous causality (Ho: no causality) the p-value refers to an F-test of omitting the contemporaneous gap from the other gap VAR equation (based on the Newey-West HAC Standard Errors & Covariance).

Tab. 1b **Input: Regular Employees. Two lags. Instantaneous Causality: [0.15]**

Multivariate tests			
Portmant. Q-Stat 3 lags = 8.57 [0.07]a	Normality J-B = 5.89 [0.20]	Hetero X^2 No Cross Terms = 24.8[0.42]	Hetero X^2 Cross Terms = 34.7 [0.78]

a) See table 1a.

Tab. 1c **Input: Regular Self-Employed. One lag. Instantaneous Causality: [0.07]**

Multivariate tests			
Portmant. Q-Stat 3 lags = 12.7 [0.12]a	Normality J-B = 1.50 [0.83]	Hetero X^2 No Cross Terms = 17.1[0.15]	Hetero X^2 Cross Terms = 18.6 [0.23]

a) See table 1a.

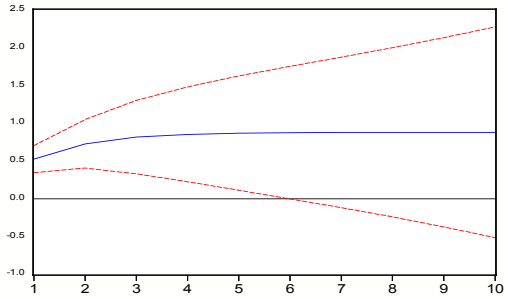
Tab. 1d **VAR Granger Causality/Block Exogeneity Wald Tests**

X^2 [P-value]	X^2 [P-value]	X^2 [P-value]
Output => Shadow 0.83 [0.41] Shadow => Output 0.66 [0.36]	Output => Employees 21.0 [0.00] Employees => Output 1.36 [0.51]	Output => Self-Empl.1.19 [0.27] Self-Empl. => Output 2.24 [0.13]

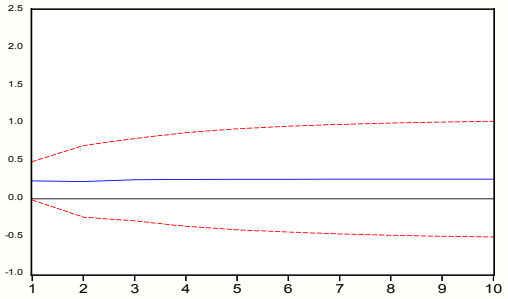
a) See table 1a.

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

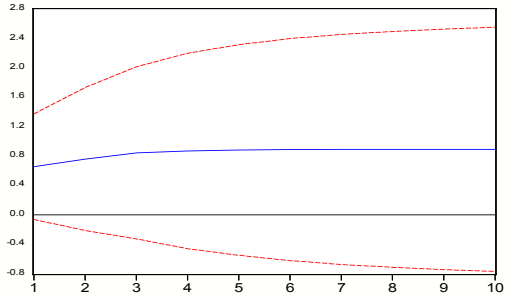
Response of Output to Output



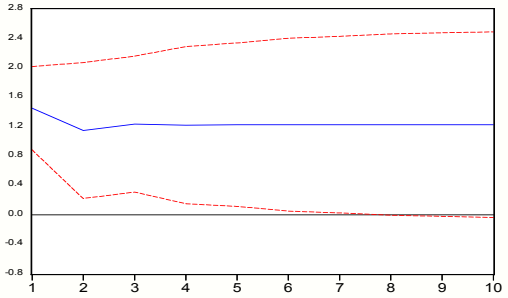
Response of Output to Shadow



Response of Shadow tp Output

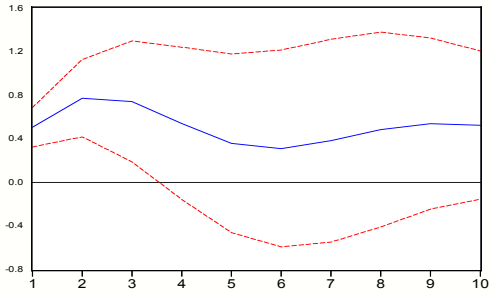


Response of Shadow to Shadow

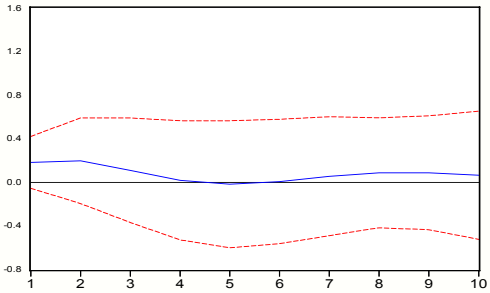


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

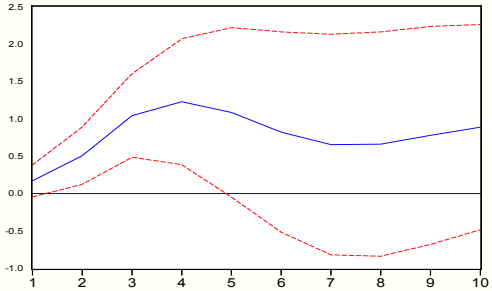
Response of Output to Output



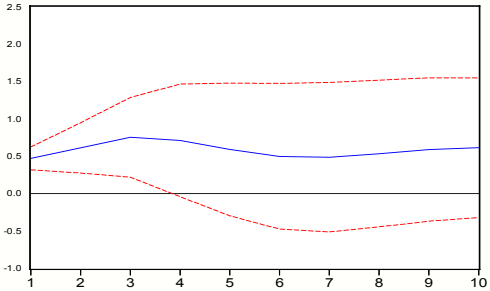
Response of Output to Employees

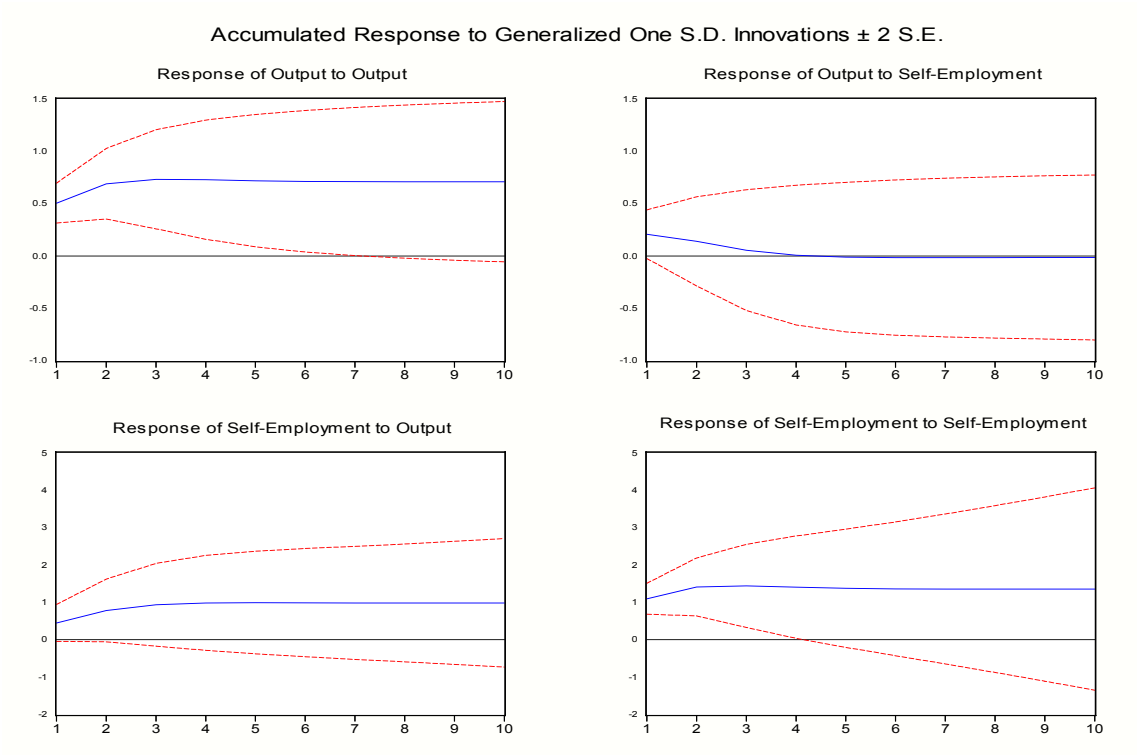


Response of Employees to Output



Response of Employees to Employees




Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.
Response of Output to Output
Response of Output to Self-Employment
Response of Self-Employment to Output
Response of Self-Employment to Self-Employment

APPENDIX 2
Bivariate VAR Sectoral Analysis (Output vs Labor Input). Sample 1980-2002

In each IRF graph, the ±2 S.E bands are drawn from 1000 Monte Carlo replications.

AGRICULTURE, FORESTRY AND FISHERING

Tab. 2a **Input: Black Economy Employment**
One lag. Instantaneous Causality: [0.14]

Multivariate tests			
Portmant. Q-Stat 3 lags = 6.79 [0.56][a]	Normality J-B = 1.56 [0.82]	Hetero X^2 No Cross Terms = 7.60 [0.82]	Hetero X^2 Cross Terms = 7.81 [0.93]

a) See table 1a.

Tab. 2ba **Input: Regular Employees**
Two lags. Instantaneous Causality: [0.75]

Multivariate tests			
Portmant. Q-Stat 3 lags = 6.18 [0.19][a]	Normality J-B = 5.38 [0.25]	Hetero X^2 No Cross Terms = 24.1[0.46]	Hetero X^2 No Cross Terms = 39.8 [0.57]

a) See table 1a.

Tab. 2ca **Input: Regular Self-Employed**
Two lags. Instantaneous Causality: [0.14]

Multivariate tests			
Portmant. Q-Stat 3 lags = 6.26 [0.18][a]	Normality J-B = 4.14 [0.39]	Hetero X^2 No Cross Terms = 17.2 [0.84]	Hetero X^2 Cross Terms = 34.4 [0.79]

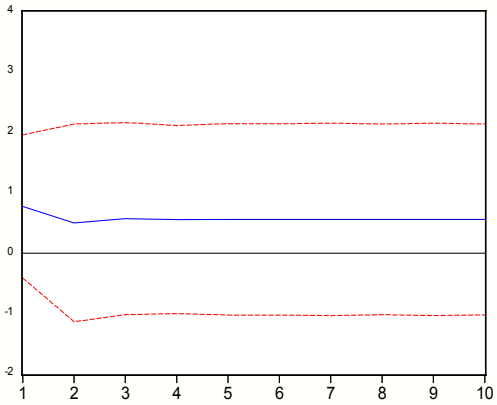
a) See table 1a.

Tab. 2da **VAR Granger Causality/Block Exogeneity Wald Tests**

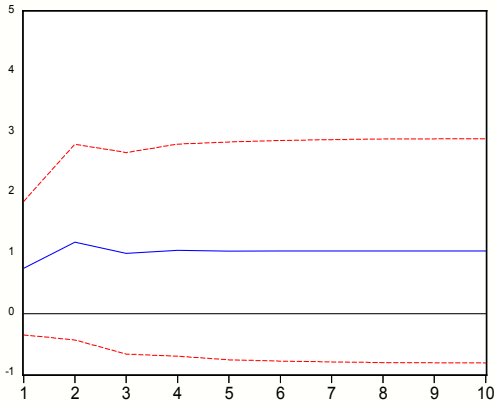
X^2 [P-value]	X^2 [P-value]	X^2 [P-value]
Output => Shadow 0.92 [0.34] Shadow => Output 0.02 [0.90]	Output => Employees 0.66 [0.72] Employees => Output 0.20 [0.91]	Output => Self-Empl. 5.81 [0.05] Self-Empl. => Output 0.36 [0.83]

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Black

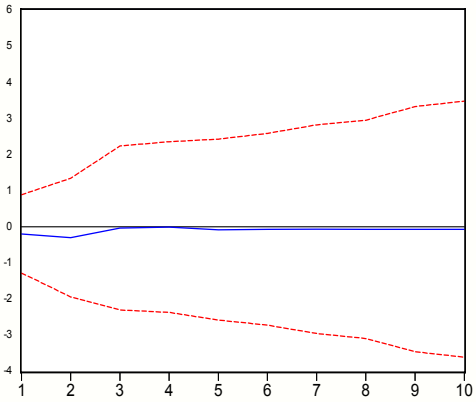


Black to Output

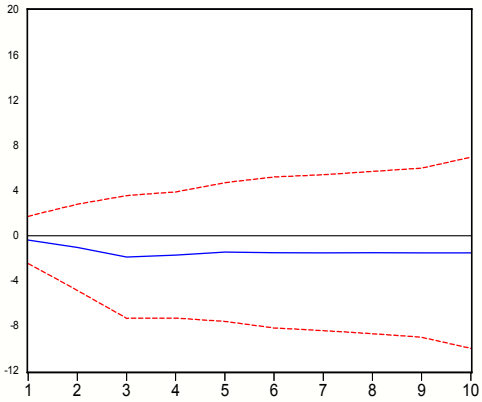


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Employees

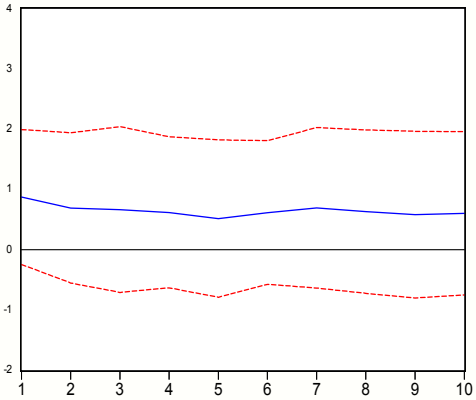


Employees to Output

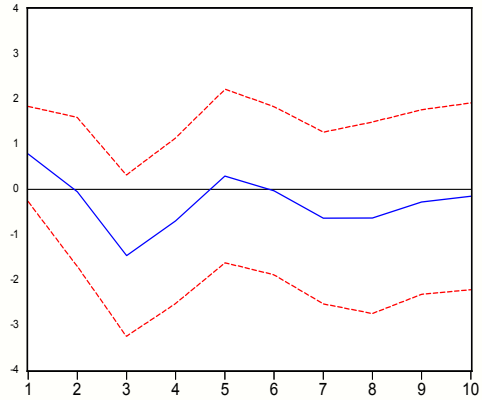


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Self_Employment



Self_Employment to Output



MANUFACTURING

Tab. 2ab **Input: Black Economy Employment**
One lag. Instantaneous Causality: [0.09]

Multivariate tests			
Portmant. Q-Stat 3 lags = 14.6 [0.07][a]	Normality J-B = 3.20 [0.52]	Hetero X^2 No Cross Terms = 10.4 [0.58]	Hetero X^2 Cross Terms = 11.9 [0.68]

a) See table 1a.

Tab. 2bb **Input: Regular Employees**
Two lags. Instantaneous Causality: [0.00]

Multivariate tests			
Portmant. Q-Stat 3 lags = 8.42 [0.11][a]	Normality J-B = 4.29 [0.34]	Hetero X^2 No Cross Terms = 22.4 [0.55]	Hetero X^2 Cross Terms = 42.8 [0.44]

a) See table 1a.

Tab. 2cb **Input: Regular Self-Employed**
One lag. Instantaneous Causality: [0.33]

Multivariate tests			
Portmant. Q-Stat 3 lags = 6.35 [0.61][a]	Normality J-B = 2.64 [0.62]	Hetero X^2 No Cross Terms = 5.49 [0.94]	Hetero X^2 Cross Terms = 5.99 [0.98]

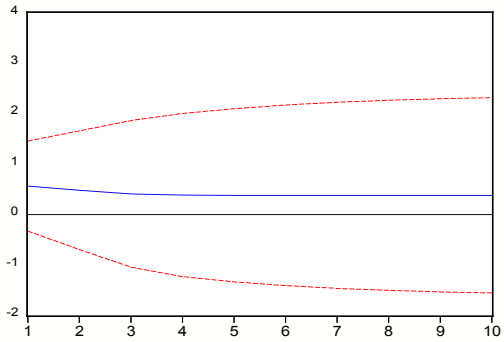
a) See table 1a.

Tab. 2db **VAR Granger Causality/Block Exogeneity Wald Tests**

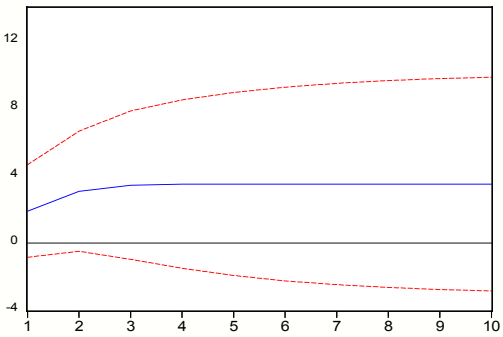
X^2 [P-value]	X^2 [P-value]	X^2 [P-value]
Output => Shadow 0.88 [0.35] Shadow => Output 0.56 [0.45]	Output => Employees 2.58 [0.27] Employees => Output 2.01 [0.37]	Output => Self-Empl. 7.90 [0.00] Self-Empl. => Output 1.96 [0.16]

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Black

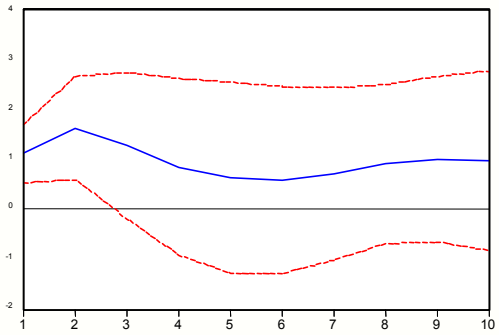


Black to Output

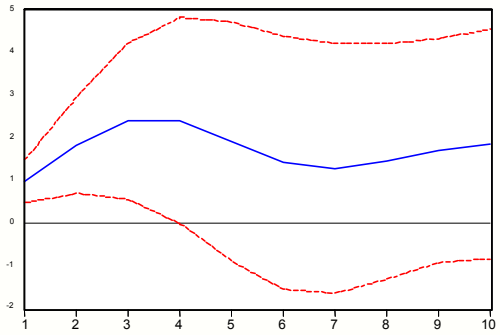


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Employees

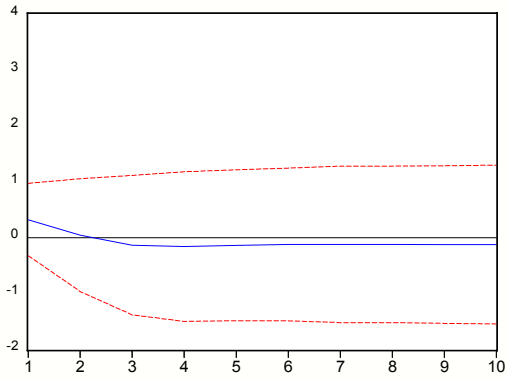


Employees to Output

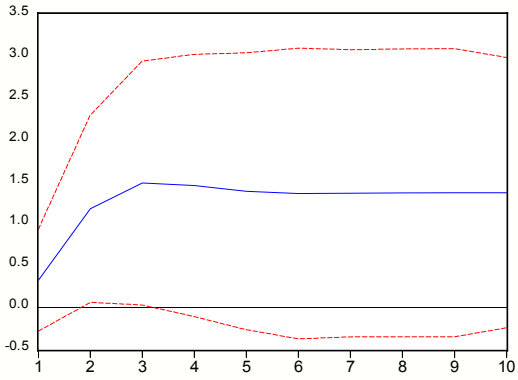


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Self-Employment



Self-Employment to Output



CONSTRUCTION

Tab. 2ac **Input: Black Economy Employment**
One lag. Instantaneous Causality: [0.25]

Multivariate tests			
Portmant. Q-Stat 3 lags = 13.0 [0.11][a]	Normality J-B = 4.47 [0.35]	Hetero X^2 No Cross Terms = 11.6 [0.71]	Hetero X^2 Cross Terms = 13.4 [0.77]

a) See table 1a. Point dummy in 1989.

Tab. 2bc **Input: Regular Employees**
Two lags. Instantaneous Causality: [0.11]

Multivariate tests			
Portmant. Q-Stat 3 lags = 4.49 [0.34][a]	Normality J-B = 2.91 [0.57]	Hetero X^2 No Cross Terms = 29.2[0.21]	Hetero X^2 Cross Terms = 51.9 [0.14]

a) See table 1a.

Tab. 2cc **Input: Regular Self-Employed**
Three lags. Instantaneous Causality: [0.04]

Multivariate tests			
Portmant. Q-Stat 4 lags = 8.45 [0.08][a]	Normality J-B = 7.21 [0.12]	Hetero X^2 No Cross Terms = 32.0[0.66]	Hetero X^2 Cross Terms = NA

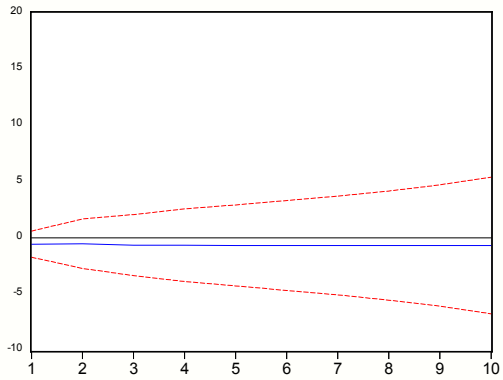
a) See table 1a.

Tab. 2dc **VAR Granger Causality/Block Exogeneity Wald Tests**

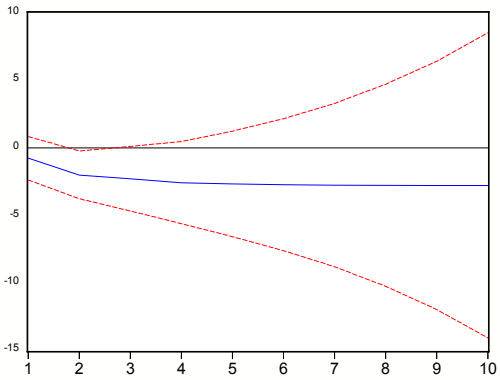
X^2 [P-value]	X^2 [P-value]	X^2 [P-value]
Output => Shadow 7.07 [0.01]	Output => Employees 7.05 [0.03]	Output => Self-Empl. 8.73 [0.03]
Shadow => Output 0.73 [0.39]	Employees => Output 0.32 [0.85]	Self-Empl. => Output 0.83 [0.84]

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Black

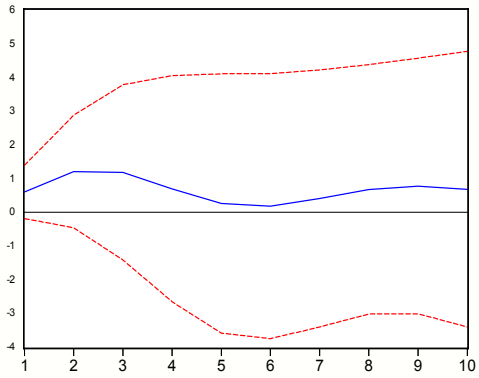


Black to Output

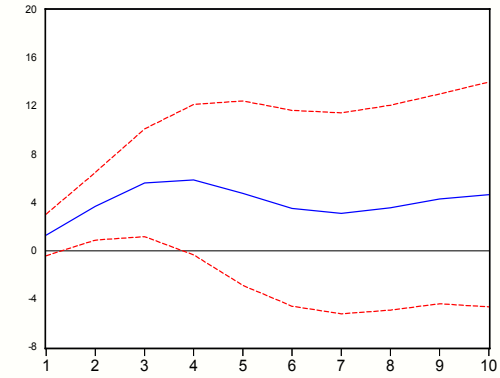


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Employees

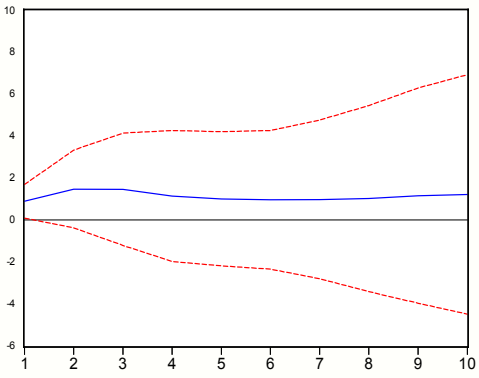


Employees to Output

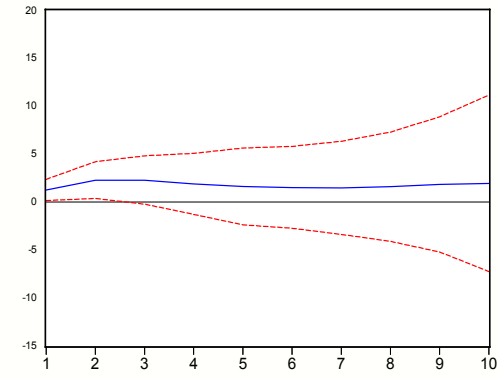


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Self Employment



Self Employment to Output



TRANSPORT AND COMMUNICATIONS

Tab. 2ad **Input: Black Economy Employment**
One lag. Instantaneous Causality: [0.72]

Multivariate tests			
Portmant. Q-Stat 3 lags = 6.98 [0.54][a]	Normality J-B = 3.05 [0.55]	Hetero X^2 No Cross Terms = 9.52 [0.85]	Hetero X^2 Cross Terms = 14.5 [0.70]

a) See table 1a. Point dummy in 1983.

Tab. 2bd **Input: Regular Employees**
One lag. Instantaneous Causality: [0.84]

Multivariate tests			
Portmant. Q-Stat 3 lags = 9.42 [0.31][a]	Normality J-B = 3.84 [0.43]	Hetero X^2 No Cross Terms = 12.9[0.38]	Hetero X^2 Cross Terms = 18.7 [0.23]

a) See table 1a.

Tab. 2cd **Input: Regular Self-Employed**
One lag. Instantaneous Causality: [0.49]

Multivariate tests			
Portmant. Q-Stat 3 lags = 4.94 [0.76][a]	Normality J-B = 2.48 [0.65]	Hetero X^2 No Cross Terms = 9.26[0.68]	Hetero X^2 Cross Terms = 10.7[0.77]

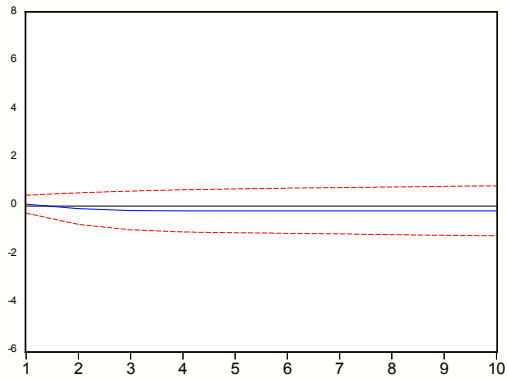
a) See table 1a.

Tab. 2dd **VAR Granger Causality/Block Exogeneity Wald Tests**

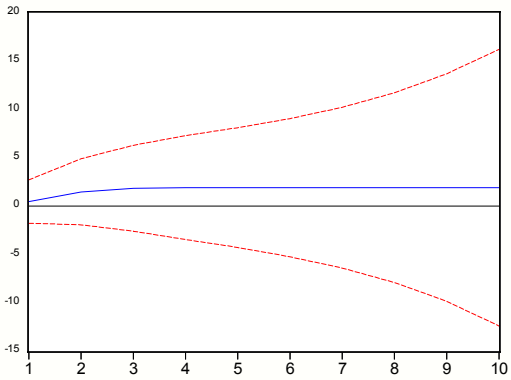
X^2 [P-value]	X^2 [P-value]	X^2 [P-value]
Output => Shadow 1.00 [0.32]	Output => Employees 0.00 [0.96]	Output => Self-Empl. 3.06 [0.08]
Shadow => Output 1.57 [0.21]	Employees => Output 1.04 [0.31]	Self-Empl. => Output 0.05 [0.82]

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Black

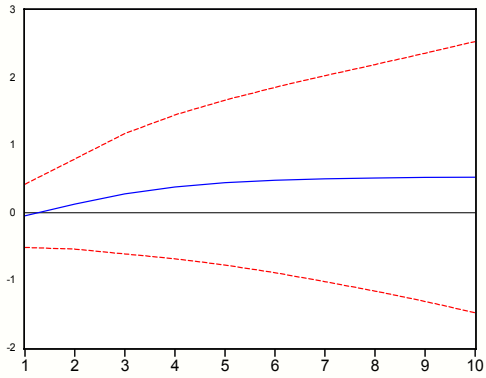


Black to Output

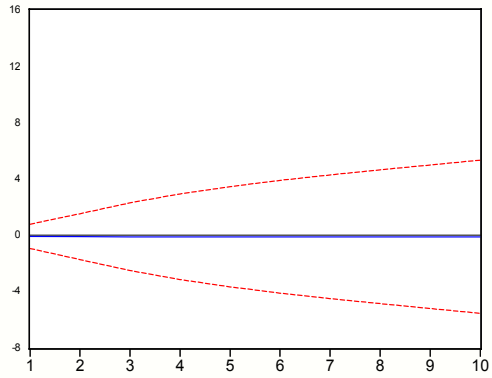


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Employees

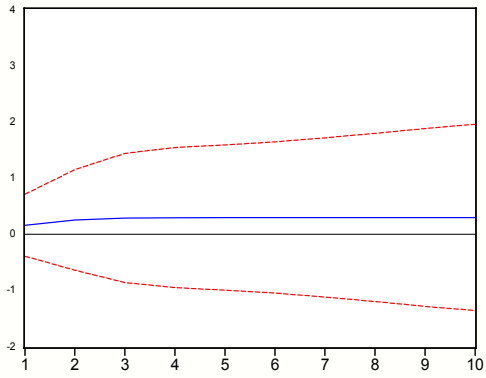


Employees to Output

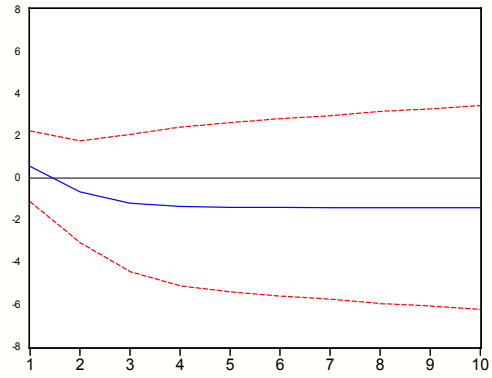


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Self Employment



Self Employment to Output



HOTELS AND RESTAURANTS

Tab. 2ae **Input: Black Economy Employment**
One lag. Instantaneous Causality: [0.07]

Multivariate tests			
Portmant. Q-Stat 3 lags = 8.27 [0.41][a]	Normality J-B = 1.91 [0.75]	Hetero X^2 No Cross Terms = 5.93 [0.92]	Hetero X^2 Cross Terms = 6.59 [0.97]

a) See table 1a.

Tab. 2be **Input: Regular Employees**
One lag. Instantaneous Causality: [0.72]

Multivariate tests			
Portmant. Q-Stat 3 lags = 10.3 [0.24][a]	Normality J-B = 5.44 [0.24]	Hetero X^2 No Cross Terms = 3.84[0.99]	Hetero X^2 Cross Terms = 10.2 [0.80]

a) See table 1a.

Tab. 2ce **Input: Regular Self-Employed**
One lag. Instantaneous Causality: [0.33]

Multivariate tests			
Portmant. Q-Stat 3 lags = 7.89 [0.44][a]	Normality J-B = 3.50 [0.48]	Hetero X^2 No Cross Terms = 12.2[0.43]	Hetero X^2 Cross Terms = 14.8[0.46]

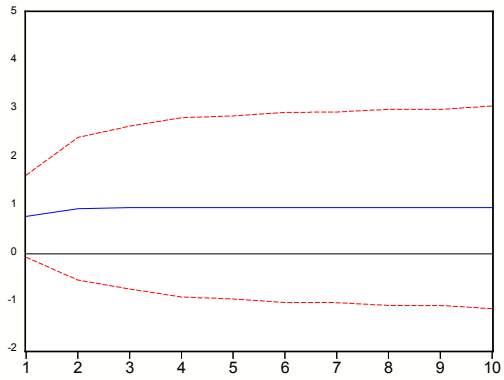
a) See table 1a.

Tab. 2de **VAR Granger Causality/Block Exogeneity Wald Tests**

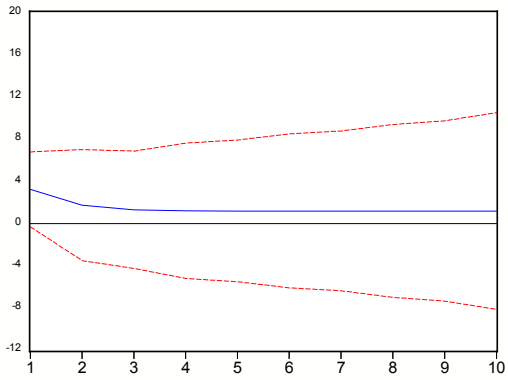
X^2 [P-value]	X^2 [P-value]	X^2 [P-value]
Output => Shadow 0.98 [0.32]	Output => Employees 0.11 [0.74]	Output => Self-Empl. 0.39 [0.53]
Shadow => Output 0.01 [0.93]	Employees => Output 0.00 [0.97]	Self-Empl. => Output 0.12 [0.73]

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Black

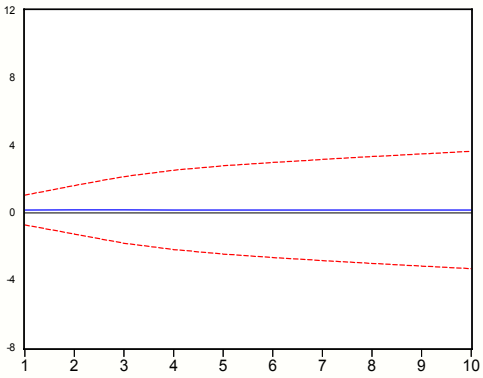


Black to Output

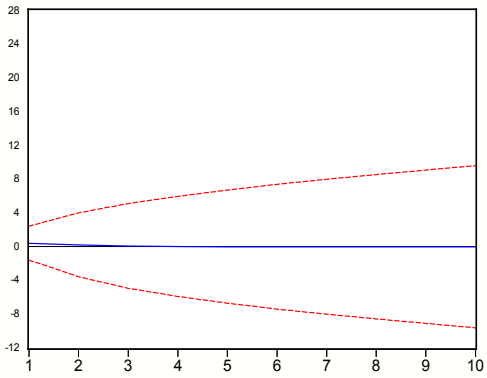


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Employees

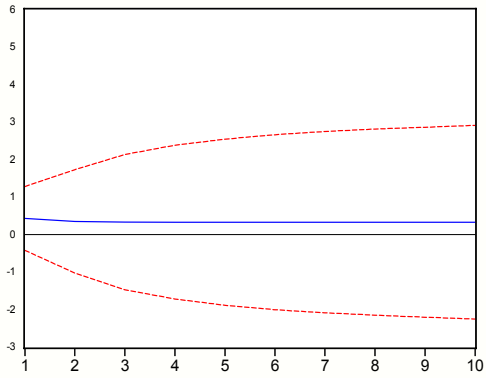


Employees to Output

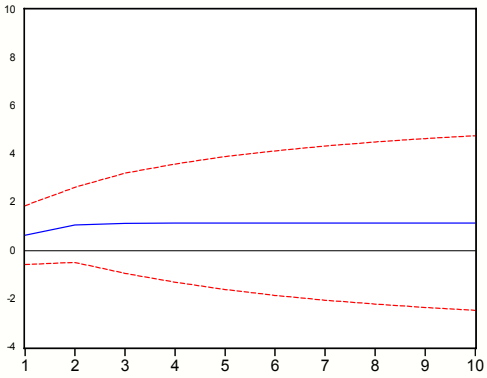


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Self Employment



Self Employment to Output



TRADE

Tab. 2af **Input: Black Economy Employment**
Two lags. Instantaneous Causality: [0.58]

Multivariate tests			
Portmant. Q-Stat 3 lags = 2.52 [0.64][a]	Normality J-B = 6.01 [0.20]	Hetero X^2 No Cross Terms = 21.6 [0.60]	Hetero X^2 Cross Terms = 35.3 [0.76]

a) See table 1a.

Tab. 2bf **Input: Regular Employees**
One lag. Instantaneous Causality: [0.04]

Multivariate tests			
Portmant. Q-Stat 3 lags = 10.2 [0.25][a]	Normality J-B = 2.95 [0.57]	Hetero X^2 No Cross Terms = 7.81[0.80]	Hetero X^2 Cross Terms = 7.97 [0.92]

a) See table 1a.

Tab. 2cf **Input: Regular Self-Employed**
One lag. Instantaneous Causality: [0.11]

Multivariate tests			
Portmant. Q-Stat 3 lags = 10.2 [0.25][a]	Normality J-B = 5.32 [0.26]	Hetero X^2 No Cross Terms = 7.28 [0.84]	Hetero X^2 Cross Terms = 7.66[0.94]

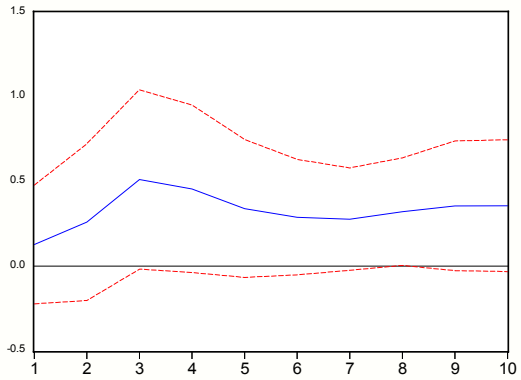
a) See table 1a.

Tab. 2df **VAR Granger Causality/Block Exogeneity Wald Tests**

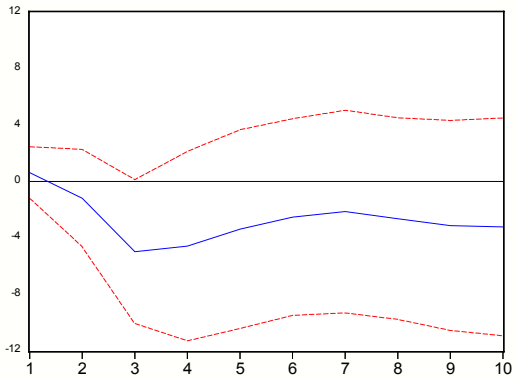
X^2 [P-value]	X^2 [P-value]	X^2 [P-value]
Output => Shadow 18.4 [0.00]	Output => Employees 0.54 [0.47]	Output => Self-Empl. 0.01 [0.95]
Shadow => Output 5.50 [0.07]	Employees => Output 1.22 [0.27]	Self-Empl. => Output 1.99 [0.16]

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Black

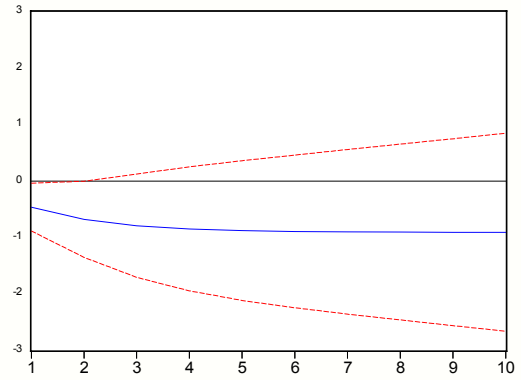


Black to Output

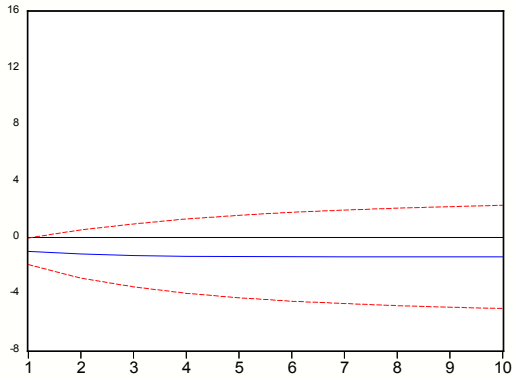


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Employees

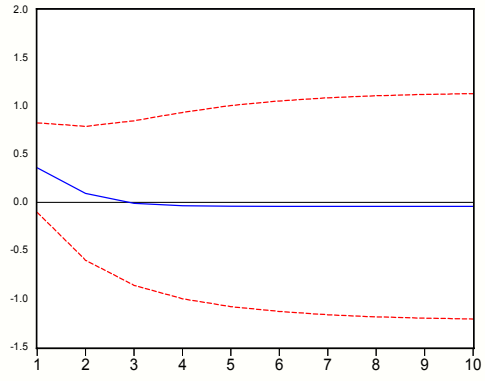


Employees to Output

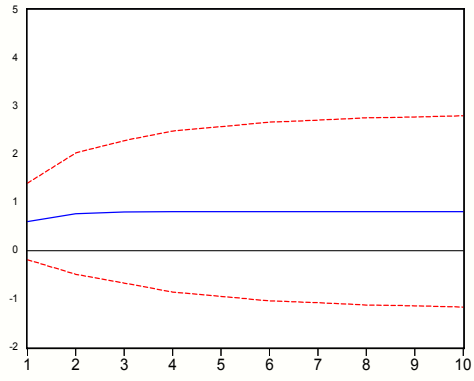


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Self-Employed



Self-Employed to Output



PERSONAL SERVICES

Tab. 2ag **Input: Black Economy Employment**
One lag. Instantaneous Causality: [0.00]

Multivariate tests			
Portmant. Q-Stat 3 lags = 6.66 [0.57][a]	Normality J-B = 1.94 [0.75]	Hetero X^2 No Cross Terms = 12.1 [0.44]	Hetero X^2 Cross Terms = 17.5 [0.29]

a) See table 1a.

Tab. 2bg **Input: Regular Employees**
One lag. Instantaneous Causality: [0.42]

Multivariate tests			
Portmant. Q-Stat 3 lags = 15.0 [0.06][a]	Normality J-B = 3.68 [0.45]	Hetero X^2 No Cross Terms = 20.2[0.16]	Hetero X^2 Cross Terms = 23.9 [0.16]

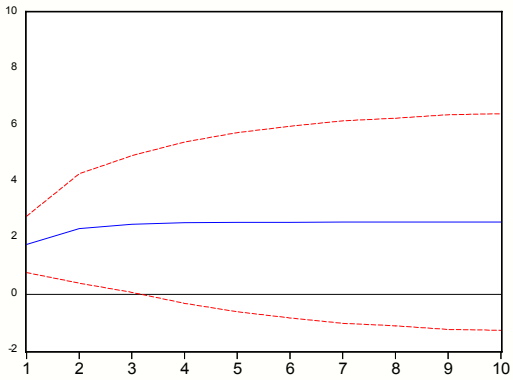
a) See table 1a. Point dummy in 2001.

Tab. 2dg **VAR Granger Causality/Block Exogeneity Wald Tests**

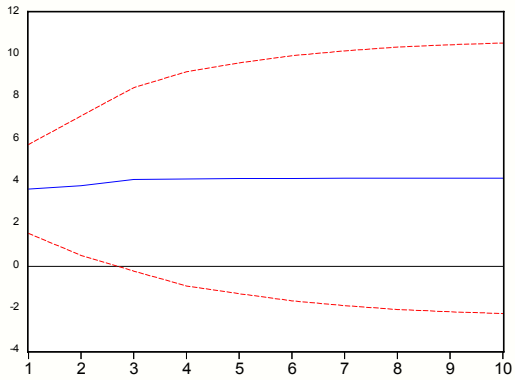
X^2 [P-value]	X^2 [P-value]
Output => Shadow 0.44 [0.51]	Output => Employees 4.04 [0.04]
Shadow => Output 0.00 [0.96]	Employees => Output 1.28 [0.26]

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Black

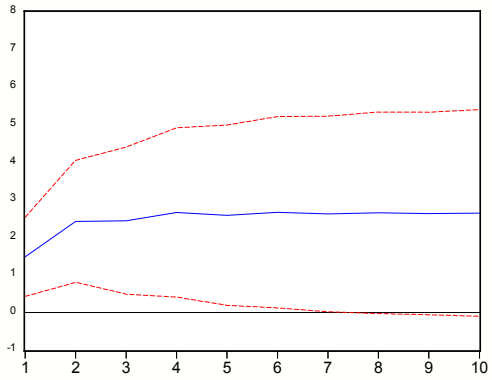


Black to Output

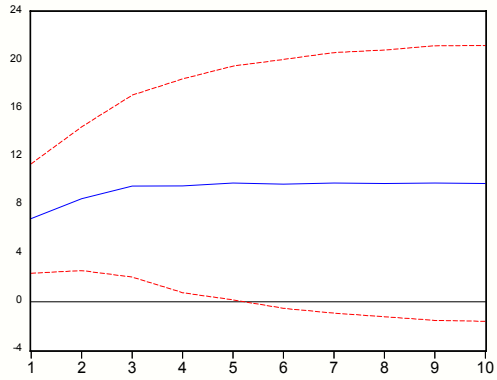


Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Output to Employees



Employees to Output



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