SHADOW EMPLOYMENT AND LABOR PRODUCTIVITY DYNAMICS

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Abstract

This paper offers theoretical and empirical insights on the anecdotal "buffer hypothesis", that is the view that the shadow employment functions as an improper tool for increasing the labor market flexibility. Official data for Italy supports the premise. While the contemporaneous correlation between HP-detrended shadow labor and output is positive and significant, as time passes their association looses momentum. The opposite is found for the regular employees. Since their lower productivity level, the cyclical response of the hidden workers affects the short-term profile of the overall labor productivity. It adds new hints on the still puzzling 1990s productivity dynamics.

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1. Introduction

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) and that it is hard to reduce it (Boeri and Garibaldi 2006; Bovi 2005). This implies that the shadow employment dynamics may impact on the cyclical swings of Government revenues (Ihrig and Moe 2004), and on the overall productivity (ISAE 2002). Finally, the study of the dark side of the labor market is crucial for questions dealing with the costs born by firms because of employment protection legislation (EU 2003; Schivardi and Turrini 2004; Dolado *et al.* 2005). I address this topic focusing on a related feature of the undeclared work, the as anecdotal as widespread "buffer hypothesis". According to it, the shadow employment may serve as a macroeconomic buffer for the regular/regulated sector employment over the course of business cycles. My main aim and contribution is i) to develop a simple model rationalizing the buffer hypothesis, and ii) to test its empirical implications in the Italian labor market. This latter is a good case-study since it shows both regular/regulated employment and wage rigidities (Bertola, 2002), while reliable data for its non trivial dark side are available. Some recent papers broadly and sparsely deal with the short term analysis of hidden activities. Ihrig and Moe (2001), Conesa *et al.*, (2001), Carillo and Pugno (2004), Bowler and Morisi (2006) suggest that the irregular sector may be procyclical; Galli and Kucera (2003) and Busato and Chiarini (2004) argued that it could be countercyclical. It is noteworthy that the above mentioned literature does not distinguish between informal and irregular activities. Possibly, this may explain their mixed empirical results[1]. Unlike those works, I take advantage of national account consistent data based on an official and clear-cut definition of underground economy. This is so because I use data from the Italian National Institute of Statistics (Istat).

The study of the buffer hypothesis enlarges another recent strand of the research, too. Motivated by the different performances of European and US labor markets and following the seminal contributions of Nickell (1986) and Bentolila and Bertola (1990), many authors have devoted attention to the effects of labor market frictions, on (un)employment and growth (*inter alia*, Bentolila and Saint-Paul 1995; Bertola and Rogerson 1997). Focusing on the regular side of the labor market they suggest that, while adjustment costs do not entail *per se* a bad employment performance, rigidities tend to smooth the path of the employment over the cycle. The empirical analysis led by Nickell and Nunziata (2000) supports their suggestions - employment adjustment costs are significantly inversely correlated with the speed of labor demand adjustment across the OECD economies. The potential and challenging links between this paper and that literature are easily seen - the shadow employment is by its very nature frictionless.

The proposed theoretical model is in the spirit of the sticky-price settings conceptualized by Bertola and Bentolila (1990), and can be sketched as follows. Given a sufficiently low expected penalty and a rigid regular market, the hidden workers afford to increase all kinds of labor flexibility - occupational (hiring-firing), contractual (part-time, fixed-term, etc...) and wage. That is, 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,

[1] This is claimed even by Galli and Kucera (2003). However, they follow the definition of informality used by the International Labour Organization which associates informality only with employment in small firms (fewer than five or ten workers). Thus, a worker may be considered "formal" even if she is irregular (see section 2). Conesa *et al*., (2001) consider the recorded GDP assumed to be net of hidden production. This is not strictly true because official data on GDP include (a large part of) irregular activities via demand side - it is easier to hide incomes than consumption. The work of Busato and Chiarini (2004) is different from the present paper because it deals with the relationships between regular and irregular GDP.

immediately and free of charge, fire them to overcome adverse economic evolutions. On the other hand, if the shadow employment pool actually works as a pad, during booms firms should refill it. In addition, before hiring "sunk" and costly regular workers, firms may want to wait and see if the recovery is not short-living. Hidden workers afford the opportunity to tailor the overall employment stock to the cycle, while waiting to see. Due to taxation, indeed, firms would prefer to hire only irregular workers even when operating in a frictionless labor market. So, why firms have a regular employment group, as well? The issue with the shadow cluster is that its size may be too limited and/or that its members might not be productive enough (Boeri and Garibaldi 2002; ISAE 2002). Then, an extreme shadowization could imply a prohibitive expected penalty. To the extent this is true, the irregularity ratio (=hidden workers/total workers) keeps small. As for dynamics, the insufficient productivity of the shadow workers implies that the black economy pool may only copy with "ordinary" demand/productivity temporary shocks – its absorptive capacity can become saturated during dramatic slumps/rallies. In these latter episodes, even regular employees are affected by the business cycle, although with some unavoidable delay. Despite its simplicity, the proposed theoretical model raises a number of notable empirical questions. First, underground economy jobs should be more business cycle sensitive than the regular ones (the buffer hypothesis). More precisely, from the statistical standpoint, there should emerge a positive contemporaneous correlation between the detrended series of output and undeclared employment. Instead, the cyclical response of the regular employment should be slower, possibly leading to lagged correlations with the GDP gap. Second, these peculiar cyclical movements of the labor inputs spread out their relative productivity dynamics. According to its sticky-price setting, the model supports the prociclicity of both kinds of labor inputs (Basu *et al.*, 2004). The sole, outstanding, exemption to the rule is that demand-driven shocks induce a counter cyclical behavior in the underground workers' productivity. This allows identifying periods of predominant demand shocks.

Data support the model's prescriptions. While the contemporaneous correlation between shadow jobs and output is positive and significant, as time passes their association looses momentum. The opposite is found for the regular employees, which show significant positive correlations with lagged output gaps only. As for apparent productivity dynamics, data detect an inversion in the short-term profile of the irregular workers' per capita output – it was procyclical in the '80s, counter cyclical afterwards. According to the model, it implies that the last decade was a period of demand shocks which, tentatively, might be due to the dramatic change in the Italian fiscal stance to deal with the European agreements of the 90s.

The paper is organised as follows. In the next section I describe and comment the Istat procedure for estimating the undeclared employment. Theoretical and statistical frameworks are reported, respectively, in section 3 and 4. Section 5 collects empirical results and concluding remarks close the paper.

2. The National Account Framework.

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 the above recalled international agreements the underground sector is part of the so-called "non-observed economy", which includes also illegal and informal activities. The former are defined as productive activities forbidden by law or

productive activities which are usually legal but carried out by unauthorized producers. At the moment, due to the difficulties of estimation, illegal work/production is not included in Italian national account. The informal sector is broadly characterized as consisting of production units with the primary objective of generating employment and incomes to the persons concerned, and as such forms a part of household unincorporated enterprises. Informal workers are considered[2] regular. The underground sector represents the area of legal production activities that are not directly observed due to reasons of an economic nature and/or statistical nature. Falling within the underground production for economic reasons are the activities carried out with the deliberate desire to avoid taxes, social contributions. Forming the statistical underground area are all those production activities that are not registered: a) due to the failure to fill out the administrative forms or statistics questionnaires because of the lack of sensitivity to statistics of those asked to fill them out and/or shortcomings in the statistics system; b) due to the difficulty in grasping the changes of a rapidly evolving productive system, characterized by small productive activities which are often not detectable with the traditional survey techniques.

We are now in a position to say precisely that the main national account object of this paper is the labor input used in the underground economy for economic reasons. Briefly, the Istat method (Calzaroni 2000; OECD 2002; Baldassarini and Pascarella 2003) to estimate it can be summarized in the following way. Firstly, Istat looks for exhaustive estimates on the volume of work. To this end, Istat collects information both from the enterprise's (demand-side) standpoint and from the households (supply-side) perspective. The next step is their comparison at a detailed level of territorial analysis (region) and economic activity (five-digit industry level according to the classification of economic activities ATECO[3] 2002). The assumption is that firms provide a measure of regular jobs (both primary and secondary), *i.e.*, they provide information on employment for which legal provisions and obligations are full filled, while data collected via households measure the number of employed persons, both those who are regularly and irregularly employed. The logic behind is that individuals have less reason than enterprises to conceal the nature of their work. The existence of such a situation has been repeatedly verified by researches carried out by Istat. Then, the following definitions are stated:

- regulars: employed people who equal the number of jobs;
- full-time irregulars: employed people exceeding the number of jobs;
- regulars multiple jobs: jobs exceeding the number of employed people.

The product of this process is the number of jobs, which Istat converts into Full-Time-Equivalent (FTE) units to quantify the volume of work[4] (see Fig. 1). While the use of FTE-units data hampers the connections with unemployment and labor force issues, they have a direct interface with GDP and, therefore, are a convenient device when dealing with apparent labor productivity (see section 5). To the present aim it is important to note that, as for

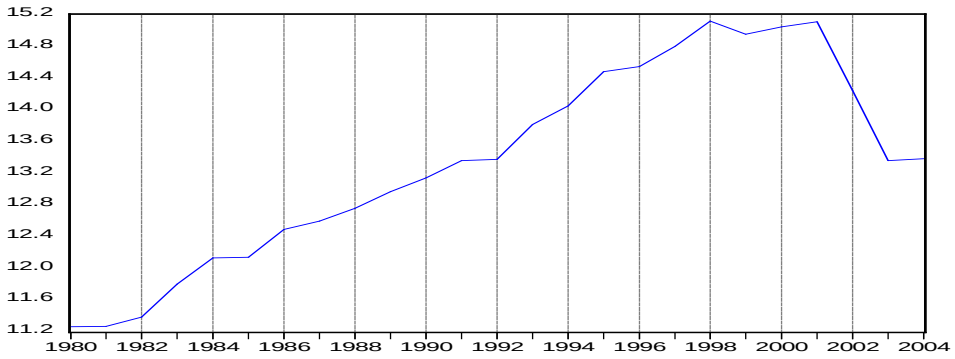
[2] Just to mention the difficulties of the topic, the ILO's International Expert Group on Informal Sector Statistics (Delhi Group), after long discussions, joined data users in concluding that the definition and measurement of "employment in the informal sector" (which includes all jobs in informal sector enterprises) needed to be complemented with a definition and measurement of "informal employment" (which comprises the total number of informal jobs, whether carried out in formal sector enterprises, informal sector enterprises, or households, during a given reference period).

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

[4] Full time equivalent units are equal to the number of jobs corresponding to full time. The total of full time equivalent units is obtained by the sum of (primary and secondary) full-time jobs and part-time jobs transformed into full-time units. Actually, the first best solution would be to quantify how many hours has been performed. However this is not always possible, therefore Istat converts jobs in FTEs, as suggested by the SNA93.

irregular wages, Istat attributes to hidden employees the same gross compensation (net of social contributions) of corresponding (same industry, same firm's size, etc.) regular ones. That is, the overall GDP includes the personal income tax "paid" by black economy workers. This choice is dictated by the privileged goal of exhaustiveness in the presence of lack of information. Is then important to mention that, according to Istat, in the public sector there is no undeclared work. This is why in the empirical experiments I focus on private sector employees.

Fig. 1. Shadow Employment (as % of total) in Italy



Source: Istat.

While it is simple to describe, the practical application of the Istat method is more difficult. In particular, the method depends crucially on the availability of comprehensive estimates of labor inputs (OECD 2004). On that, Istat considers that the results of the household labor force survey, supplemented by demographic data, provide exhaustive estimates (Calzaroni, 2000). Additional occupational segments are then captured through *ad hoc* statistical surveys. There are two notable examples. The first deals with the so-called "collaborazioni coordinate e continuative" (freelance coordinated work), whose source is the Social Security Institute (INPS). The second is that of non resident undocumented foreigners. They can not be directly observed by the usual sources used to uncover other kinds of black economy and are estimated on the basis of information provided by the Ministry of Internal Affairs. Finally, it should be clear that although 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, Boeri and Garibaldi (2002) point out that if employees cooperate in shadow activities they may decide not to declare to be working. 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[5] 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

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

underground sector. In addition, 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). As Tanzi suggests (1981), then, 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). Despite these *caveats*, it is worth recalling that the Istat method 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).

3. The Theoretical Framework

In order to derive testable implications, my theoretical economy is aimed at capturing in the starkest way the main features of the case-study. In the spirit of the literature stemming from Bentolila and Bertola (1990), I conduct a partial equilibrium analysis in which firms bear adjustment costs, face a constant post-tax wage (w) and operate amid unpredictable demand/productivity shocks. As Nickell (1986) noticed, hiring costs are incurred both in the act of hiring and in the consequent introduction of a new employee into the productive force. The former category would include expenditure on advertising and time spent on interviewing, testing and the like. The latter category would include direct expenditure on training and indirect expenditure in the form of lost output while the individual learns the job. Firing costs include payments in lieu of notice, compensation for breach of contracts, loss of output resulting from the lag between separation and subsequent replacement and any costs incurred because it is necessary to fulfill certain legal requirements. As noted by Lazear (1990), wages could potentially adjust to labor demand[6] fluctuations in such a way as to offset the effects of (mandatory) redundancy payments. The constant wage hypothesis implies adjustments on quantity only and, in the present setting, it is also dictated by the fact that Istat does not offer data on irregular wages (see section 2). For simplicity, I set the price that the firm charges equal to one and I assume zero natural turnover and discounting. Labor is the sole factor of production.

I depart from the above mentioned literature in some important respect. In my model only temporary shocks affect labor demand dynamics. In addition, demand and productivity shocks may be generalized or localized but, in the latter case, as large as to produce aggregate effects even in the regular employment. Then, and most importantly, the present model allows the firm to choose among two labor inputs – one regular (L^r), one hidden (L^b), with total employment = $L^T = L^r+L^b$. The former is infinitely supplied at the given wage, is taxed and, in the short-time, totally rigid. The latter is perfectly flexible, untaxed, and always offered at the given wage. The marginal productivity of both inputs is diminishing and the shadow employment has a lower productivity level. In fact, as shown by some works (Isae 2002; Boeri and Garibaldi 2002), underground units are likely to be at the lower end of the skill distribution - first-time workers, young, women, illegal immigrants, etc. I assume that same-job shadow and regular workers have the same (constant and post-tax) wage (w). As mentioned, an equal take-home pay is close to the conjecture made by Istat in estimating national account aggregates. Here it implies that, from the firm's standpoint, the shadow

[6] Under the assumption of exogenous wages and with no firm rationed in the labor market, the level of employment is always equal to the labor demand.

worker costs less than the corresponding regular one (due to taxation and friction costs). So, leaving aside the presence of a positive expected penalty, what prevents a total shadowization [7] (*i.e.* $\frac{L^b}{L_T}$ =1) is the insufficient productivity level of the hidden group. Otherwise stated, firms choose their optimal labor input ratio by adjusting the flexible input until its comparative marginal benefit (tax evasion, zero adjustment costs), equals its comparative marginal cost (lower productivity, expected penalty). More formally, the production function is:

$$Y = A^r \log(L^r) + A^b \log(L^b), \quad (1)$$

where:

Y = output;
L^b = shadow labor input;
L^r = regular labor input;
A^b = shadow productivity level;
A^r = regular productivity level;
$A^b < A^r$.

In equilibrium (for simplicity, period 0), we have:

$$w L^b_0/(1-p) = A^b_0 \quad (2)$$

$$[w(1+c)]L^r_0 = A^r_0 \quad (3)$$

$$(L_0/L^r_0) = (A^b_0/A^r_0)(1+c)(1-p). \quad (4)$$

c=constant rate capturing the taxation/flexibility gains of using L^b instead of L^r;
p=constant[8] probability to be detected.

As well known, the presence of adjustment costs makes it costly for firms to undo previous choices. So, when firms decide how much to hire they need to look forward to anticipate their future input of labor. It implies that the optimal static labor demand may be different from the dynamic one. Another consequence of positive friction costs is that, as suggested by the literature, they create an "inaction zone" demarcated by hiring/firing marginal costs. The logic behind is that the optimal hiring/firing decisions are based on a wage that is respectively higher/lower than the actual one. Thus, firms optimally prefer to respond less then fully to fluctuations in (regular) labor demand. Against this backdrop, the availability of shadow workers may induce even more stability in the regulated input demand and may impact on the forward-looking considerations. If, starting from the steady-state equilibrium stated in equation (4), all the future business cycles could be addressed via the black economy pool, the regular employment would be totally stable and, obviously, hiring/firing issues would have no short-term impact. At the margin, the economy would be frictionless and firms do not need to form expectations about the future - equation (4) would be optimal from both the static and the dynamic point of view. I suppose that there is only one event which can surprise the firm and, consequently, generate a gap between optimal and actual labor demand

[7] The actual degree of shadowization in the case-study, which the model wants to replicate, is reported in Fig. 1 (section 2) and it is congruent with a light shadowization.

[8] The probability to be detected could be easily (and better) modeled assuming that, *e.g.*, p increases with L^b. I assume that it is so small that I can focus on productivity issues only.

- an "oversized" temporary idiosyncratic[9] shock. As mentioned, the problem is that the hidden sector's absorptive capacity becomes saturated in the aftermath of dramatic changes in market conditions. So, when the demand for the products of some firms suddenly collapses below $A^r\log(L^r)$, they fire their entire hidden workforce and, due to the shadow employment shortage, they must start the slow-motion bargained agreements for firing regular workers. Alike, when an extra-large demand boom materializes, the involved firms quickly record difficulties in finding underground workers with the required skill. Therefore these firms need to hire, with the usual sluggishness, even regular workers. Clearly, the same limitations to hire/fire hidden workers operate in the big-localized productivity shock scenario. In Italy, indeed, instruments such as the Cassa Integrazione Guadagni (wages guarantee fund) and government interventions (*e.g.*, by financing early retirements or by acting as the employer of last resort) have been largely used as slow-motion[10] shock absorbers in the last decades[11] (Bertola and Garibaldi 2003; Pacelli 2006). Once the shock is over, the regulated input gradually returns to the steady state. As for permanent shocks, I rule out the demand driven ones because it is hard to think about permanent demand shocks in a sticky-price environment. Then, I assume that permanent productivity shocks evolve according to a HP-trend (see section 4), known by firms, such as they have no observable short-term effects. Otherwise stated, only temporary shocks impinge on labor demand fluctuations.

Even in this highly stylized world, intriguing relationships between inputs, output and labor productivity emerge. I have already outlined the effects of oversized idiosyncratic shocks. What about ordinary episodes? Suppose a temporary positive shock proportionally[12] increasing the period 1 productivity level of both labor inputs such that, with no friction, the optimal labor mix (4) would remain unchanged (A^b_n/A^r_n constant for any n=0,1,…with $A^b_0=A^b_n<A^b_1$; $A^r_0=A^r_n<A^r_1$). As usual in a sticky price setting (Basu *et al*. 2004), employment falls in response to a positive productivity shock. The logic is that firms, after observing the new productivity level, fire labor units because fixed prices imply unchanged real sales so that less labor is required to meet a given level of demand. Since, by assumption, only L^b can be cyclically fine-tuned (*i.e.* $L^b_0>L^b_1$; $L^r_0=L^r_1$), the shocked labor input ratio[13] will be lower than the steady-state one. Alike, *mutatis mutandis*, in the case of negative shocks.

What happens after a temporary demand shock? As before, firms adjust only their shadow labor pool[14]. However, following a demand-driven shock, the shadow workers' apparent productivity (Y/L^b) contour shows a counter cyclical pattern. This is so because the impact of

[9] I do not consider permanent oversized idiosyncratic shocks because they are unlikely.

[10] According to the Italian employment protection legislation, very strong regulation against individual dismissal are in place. Workers can appeal in court against dismissal and firms may want to pay some form of compensation to the dismissed workers in order to avoid litigation. This is especially true in collective and negotiated dismissals, when lump-sum payments are sometimes explicitly bargained with the unions. Clearly, all that induces short-term rigidity.

[11] While there are different regulation environment according to the size of the firm (the threshold is 15 employees), recent studies suggests that the differential effects of EPL on small and large firms might be overstated (Garibaldi, Pacelli and Borgarello 2004; Schivardi and Torrini 2004). Possibly, this paper could rationalize why. According to Istat, the shadow employment accumulates exclusively in small firms – thus, to the extent these latter conform with the buffer hypothesis, they correspondly resort less to regular devices.

[12] At the moment I exclude idiosyncratic shocks on productivity. However, corresponding regular and irregular employees work side-by-side and the shock would quickly (data are annual) "contaminate" everyone. I speculate that the difference in the productivity level is maintained because the shadow worker is so frequently fired that she simply has not the time to catch up her regular collegue's productivity (*e.g.*, via learning by doing). Alike we may think that as soon as a shadow worker becames (more than) as productive as her regular counterpart, such as to be able to "produce" even (more than) her gross wage and adjustment costs, the firm regularizes her. Thus, only low productive units remains in the black economy pool. As mentioned in the main text, there is some evidence on that.

[13] Therefore, the regular input is inefficiently used because, in period 1, $(A^r_1/L^r_0)>w(1+c)$.

[14] Thus now, contrary to what happen after a productivity shock, the input used inefficiently is the shadow employment - thanks to its flexibility, it will be demanded over/under the desired level (see the previous note).

the shock on output is less than the irregular labor demand - due to the dimishing marginal productivity, undeclared labor must be hired/fired more than proportionally to meet the new level of the demand. Clearly, the quasi fixed-input's productivity outline is procyclical. It turns out that, to the extent that shadow employees are less numerous than the regular ones, the overall apparent productivity (Y/L^T) should be procyclical.
We are now in a position to point out some important empirical implications of the model. Focusing on the effects of shocks on labor demand and on per capita output dynamics[15]:

1. The shadow employment is more volatile than the regular one (the buffer hypothesis).
2. In some case the regular employment reacts to GDP, but always with some delay.
3. Demand shocks induce a procyclical profile in the apparent regular labor's productivity, while the response of the underground workers' productivity is counter cyclical.
4. A sufficiently mild shadowization implies that the overall productivity follows a procyclical pattern.

4. The Statistical Framework

My main aim is to verify the validity of the buffer hypothesis. An easy and usual way to perform a statistical analysis involving cyclical behaviors is to deal with growth rates (*e.g.*, Basu, Fernald and Kimball 2004). However, growth-rate correlations are subject to some bias due to first-differencing, which 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. 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[16]. 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 authors claim that this kind of filter can improve two practical problems encountered when using the Hodrick-Prescott (HP) filter: unusual behavior of cyclical components at the sample's beginning and end, and the choice of a smoothing parameter (λ) 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

[15] In fact, the model also highlights inefficiency issues (see the previous note). Moreover, since the two inputs are differently taxed, variation in their levels affect government revenues.
[16] 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).

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[17]. Finally, the HP-detrended series will not lose any observations. Since the Istat data are transformed as the difference between the log of variables and the HP trend of the log of variables, the time series I use henceforth represent short-term fluctuations around the trend.

One common way to properly analyze the empirical relationships between time series is the vector autoregression (VAR) approach (Sims 1980). In the present context, the VAR environment offers three useful statistical devices. The first one is the impulse response function (IRF), which 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 of the VAR is diagonal, the shocks will not occur independent from each other. The non-zero residual correlations reported in Appendix 1 suggest following Pesaran and Shin (1998), which construct an orthogonal set of innovations that does not depend on the VAR ordering. 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. This leads to the second VAR-nested device, the block/exogeneity Granger causality tests (Granger 1963, 1969). In the present bivariate VAR models, 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 noted, 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:

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

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

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[Var(ε_{1t})/Var(ε_{2t})]*n~ χ^2. This is the third statistical tool I will use to assess the empirical validity of the buffer hypothesis. It is worth remarking that, despite its attractiveness, this test is seldom used in the empirical analysis of labor markets. I collect main VAR diagnostics and outcomes in Appendix 1.

[17] 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.

5. Empirical Results

According to Istat estimates, the irregularity ratio (L^b/L^T) has varied between 11.3% and 15.1% over the last twenty-five years (see Fig. 1). These figures are coherent with the environment conceptualized by the model, which rules out zero and "too big" irregularity ratios. Then, the theoretical setting postulates that the wage and the C-factor should be constant or, at least, that they should be less volatile than the FTE-hidden units. As for these latter, one of the model's implications is that the dark side of the labor market is less rigid than the regular one. Although not modeled, in order to have some indirect confirmation of the model's predictions, I examine also data for regular self-employed. The logic behind is that, due to their mid-range flexibility, this third kind of labor input should show a mid-range proficiency to adapt to changing business conditions – better than that of protected regular employees, worse than that of underground workers. Altogether, it means that firms absorb economic fluctuations especially via hidden quantities. Data collected in table 2 are acceptably coherent[18] with my *a priori.*

Table 2. Volatility in the Italian labor market (1980-2004).

	W(1+SSC)	W	(1+SSC)	L^b	L^s	L^e
Std. Dev.	0.0061	0.0088	0.0072	0.0143	0.0093	0.0072

Source: Istat. HP-detrended data. W=real per capita wage (private[19] sector); L^i=FTE-units (i=b,s,e; b=shadow; s= regular self-employed; e=regular employees); (1+SSC)=Irap-adjusted[20] social security contribution (SSC) factor.

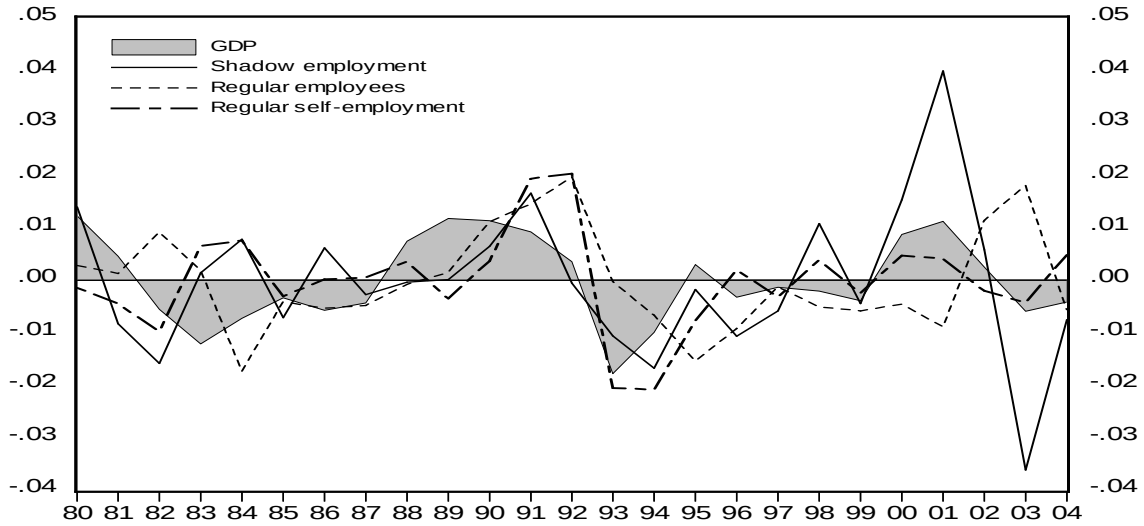
Figure 2 reports the cyclical behavior of the three FTE-units.

[18] A recent theoretical paper supporting wage stickiness over the cycle is Hall (2005). Other empirical evidence on wage stikiness in Italy may be found in OECD (2007).

[19] According to Istat, shadow employment is exclusively allocated in the private sector (see Section 2).

[20] In Italy a new tax (IRAP) was introduced in 1998. At the same time employers' social contributions (SSC) were substantially reduced, bringing the overall employers' social contribution rate down substantially. For reasons of comparability, the part of the revenues stemming from this new tax has been allocated to SSC, although it is not actually levied on wages and salaries as such.

Fig. 2. The Cyclical Behavior of Employment in Italy (1980-2004).



Source: author's elaboration on Istat data. Variables (real GDP and labor inputs) are computed as log(X/*X*), where *X* is the HP-smoothed version of X.

At first glance, it seems that all the inputs by and large follow a procyclical behavior. Correlation coefficients are positive, confirming the impression. There is some quantitative difference, supporting the presumed effects linked to the qualitative peculiarities of the production factors. The correlation between GDP and shadow employment is 57%, self-employment scores 44%, and private sector regular employees records a "rigid" 21%. The reduction in the volatility of self-employment may be tentatively associated with the introduction, in the course of the 1996, of freelance coordinated workers ("collaborazione coordinata e continuativa", CoCoCo). In fact, CoCoCo are classified as self-employment in the national accounts and, since their favorable fiscal treatment and flexibility, they become quickly widespread. According to INPS, the number of persons working as CoCoCo promptly becomes 720,000 to pass one-million in 1999 (last available estimate). Policymakers hoped that CoCoCo could offer a temporary regular *status* to otherwise hidden workers, while giving firms the wanted flexibility. Indeed, not surprisingly, CoCoCo can be thought of as one of the possible flex-security tool (EU 2003). Instead, firms exploited this opportunity not to reduce shadow employment, but to hire workers repeatedly as CoCoCo. In practice firms use them as a sort of low-cost permanent employment[21]. As a result, since 1996, a significant share of self-employed is made up by this kind of "quasi-fixed" workers, which may have hampered the overall flexibility of the professional cluster. As for the shadow employment, cyclical movements have been strongly affected by the legalization[22] of many illegal immigrants in 2002.

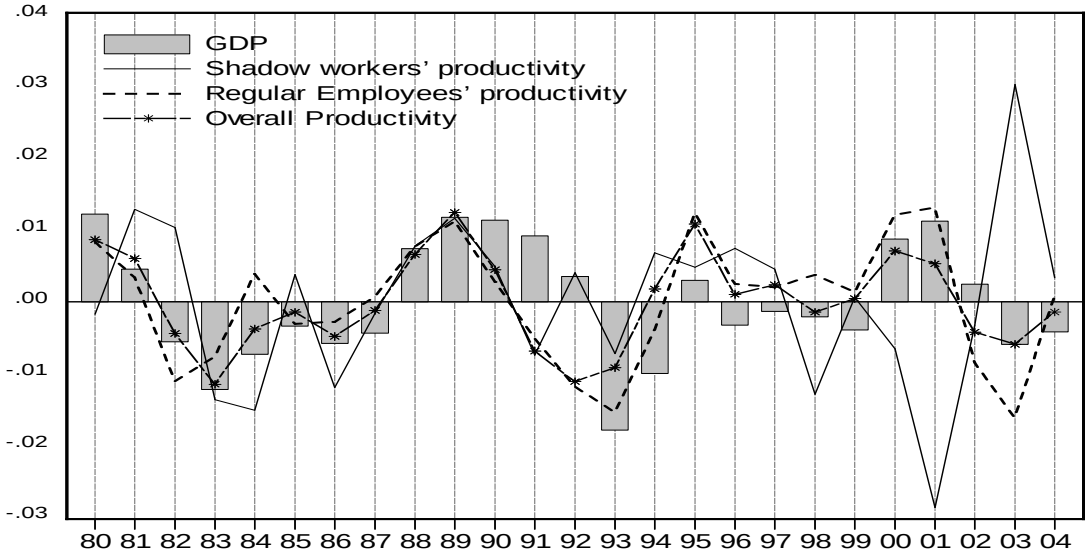
The final preliminary empirical check I run, deals with apparent productivity dynamics. The model suggests that, while the overall productivity pattern is conjectured to be procyclical, the shadow workers' productivity should behave counter cyclically during periods of

[21] According to Istat, more than 90% of CoCoCo works exclusively for a single firm and more than 60% of them is less than 35 and does not decide his/her working time. Actually, since 2004, this kind of contract was heavily modified. A lesson to be kept in mind for future flex-securitisations.

[22] In the last years there were four legalizations: 1990, 1995, 1998, 2002. In this latter, the largest one, 274,000 FTE units switched their status from irregular to regular employees (Istat, 2004). Due to administrative reasons (the bill was approved at the end of 2002), some of them impinged on 2003 data.

predominant demand shocks. In figure 3, I compare the HP-detrended versions of real GDP and employees' productivity (GDP per FTE unit).

Figure 3. The Cyclical Behavior of Labor Productivity in Italy (1980-2004).



Source: author's elaboration on Istat data. Variables (real GDP and apparent labor productivities) are computed as log(X/*X*), where *X* is the HP-smoothed version of X.

Confirming existing results (Basu *et al*. 2004; Galì and Rabanal 2004) and in line with the model's prescriptions, the picture strongly supports the positive comovements between output gap and overall apparent productivity - their correlation is as high as 64%. Breaking down the labor productivity growth into its dark-clear determinants reveals further interesting details. As expected, an evident procyclical nature of the quasi-fixed input productivity emerges. Its correlation with output amounts to 63%, a value that remains practically fixed over the two sub-periods 1980-1991 and 1992-2004. As for the shadow cluster's productivity[23], in the first sub-period the correlation with GDP is 51% while, in the more recent decade, it is -40%. The full-sample statistic curiously records a perfect orthogonality. According to the model, all that means that the recent period is one of predominant demand shocks. This is consistent with the dramatic change in the fiscal policy stance due to the European agreements – the first period shows a (HP-detrended) deficit-GDP average ratio eight times greater than that recorded in the second one. The relative behavior of regular and black economy workers' productivity may shed some light on one of the most debated issue in the recent years – Italy's (and Europe's) 1990s productivity slowdown (Estevão 2004). Indeed, Figure 3 seems to suggest that in Italy the most part of the reduction (*rectius*, of the "below-trend position") was initially due to the dark side of the labor market, while the more recent data indicate the opposite. In addition, the evolution of the irregularity ratio (see Fig. 1), greater in the 90s than in the 80s, is congruent with the poor performance of the average per capita output – "garbage-in garbage-out". Finally, it is consistent with Basu *et al*. (2004), which argue that the productivity slowdown may be due to a fall in the equilibrium marginal cost of labor.

[23] Due to the "tail issues" of the HP procedure (see section 4), I do not comment the very last years of the sample.

This somewhat reassuring introductory evidence calls for the bivariate VAR analysis outlined in section 4. The visual inspection of the results (see Appendix 1) shows that all the proposed VARs meet the necessary and sufficient condition to give a reasonable statistical description of the data. The scene emerging from the experiments highlights some interesting stylized fact. The instantaneous linear feedback between output gap and black economy employment gap supports the buffer hypothesis. Actually, as indicated by the Granger and the Pesaran-Shin tests, the shadow employment seems to work as a flash buffer only. In contrast, HP-detrended regular employees and GDP are significantly correlated only after some lag, with information flows running from output to input. It suggests that in the last two decades even regular employees were fired/hired according to the cycle, although with a delay of more than one year. Outcomes for the self-employed show that they show no feedbacks and that, perhaps, they are another cyclical pad – side-by-side with the shadow employment - available for firms. All in all, these findings are in line with the model's prescriptions, adding another, more refined, empirical support to it.

6. Concluding Remarks

This paper has dealt with the buffer hypothesis, namely, the use of black economy workers to tackle cyclical fluctuations. In doing that, it extends the literature dealing with the short term analysis of the hidden sector (Ihrig and Moe 2001; Conesa *et al.*, 2001; Busato and Chiarini 2004). It also adds new insights on the literature examining the effects of labor market frictions on (un)employment and growth (Nickel 1986; Bentolila and Bertola 1990). In particular, this paper has conceptualized a framework where the buffer hypothesis is likely to be verified - one with quantity adjustments and a labor market partly regular/regulated, partly undeclared. Firms prefer underground employees for both their superior flexibility and their lower gross wage. Beyond the presence of the expected penalty, what prevents a complete shadowization is the insufficient productivity/number of hidden workers. In this respect, this paper complements also the "marginal shadow employment" framed by Boeri and Garibaldi (2002 and 2006), offering another setting where shadow employment can emerge in equilibrium. The theoretical model suggests further fascinating empirical implications beyond the buffer hypothesis. Due to their different flexibility degree, while demand shocks induce a procyclical shape in the apparent regular labor's productivity, the response of the underground workers' productivity is counter cyclical. It allows identifying the nature of the shocks. Then, due to their dissimilar skill levels, the peculiar cyclical responses of the two labor inputs affect the overall productivity profile. Thus, the analysis of the dark side of the labor market may shed some light on the widely debated issue of the productivity dynamics in Europe.

Data for Italy, confirms the model's prescriptions. In particular, a VAR analysis detects the presence of a significant contemporaneous positive correlation between HP-detrended shadow labor and output (*i.e.*, the buffer hypothesis is verified). As time passes, their association looses momentum. Only lagged correlations link GDP and regular employees, with information flows running from the former to the latter.

While FTE-units data hampers the connections with unemployment and labor force issues, they have a direct interface with GDP and, therefore, are a convenient device when dealing with aggregate labor productivity. Then, data are from the Italian National Institute of Statistics. That is to say, they are "official", national account consistent and built on a precise and internationally accepted definition. In addition, data clearly separate hidden activities from contiguous ones, such as illegal and informal productions. Since the very different nature of these phenomena, it is important to separate them. However, this is hardly done in

the literature. As argued in this paper, approaching the data carefully reduces, but does not eliminate, biased results due to measurement errors stemming from black economy workers with wrongly assigned labor status or from the use of non-exhaustive surveys. On the positive side, the Istat method 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).

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APPENDIX 1. VAR Analysis (GDP ⇔ Labor Input). Sample 1980-2004[24].

Residual Tests

Table 1a. Input: Shadow Employment. Two lags. Resid. Corr. = 0.43. Instantaneous Causality: [0.00]

Multivariate tests			
Portmant. Q-Stat (3 lags) = [0.36]a	Normality J-B = [0.65]	Hetero X^2 No Cross Terms = [0.83]	Hetero X^2 Cross Terms = [0.56]

All the variables (source: Italian Institute of Statistics) are "gaps", *i.e.* short term fluctuations around (HP) trend. Lag order selected by AIC and SBIC. a=adjusted version. P-values in squared brackets.

Table 1b. Input: Regular Employees. Two lags. Resid. Corr. = 0.02. Instantaneous Causality: [0.92]

Multivariate tests			
Portmant. Q-Stat (3 lags) = [0.11]a	Normality J-B = [0.43]	Hetero X^2 No Cross Terms = [0.94]	Hetero X^2 Cross Terms = [0.84]

See table 1a. Point dummy in 1993.

Table 1c. Input: Regular Self-Employed. One lag. Resid. Corr. = 0.51. Instantaneous Causality: [0.06]

Multivariate tests			
Portmant. Q-Stat (3 lags) = [0.25]a	Normality J-B = [0.36]	Hetero X^2 No Cross Terms = [0.05]	Hetero X^2 Cross Terms = [0.08]

See table 1a.

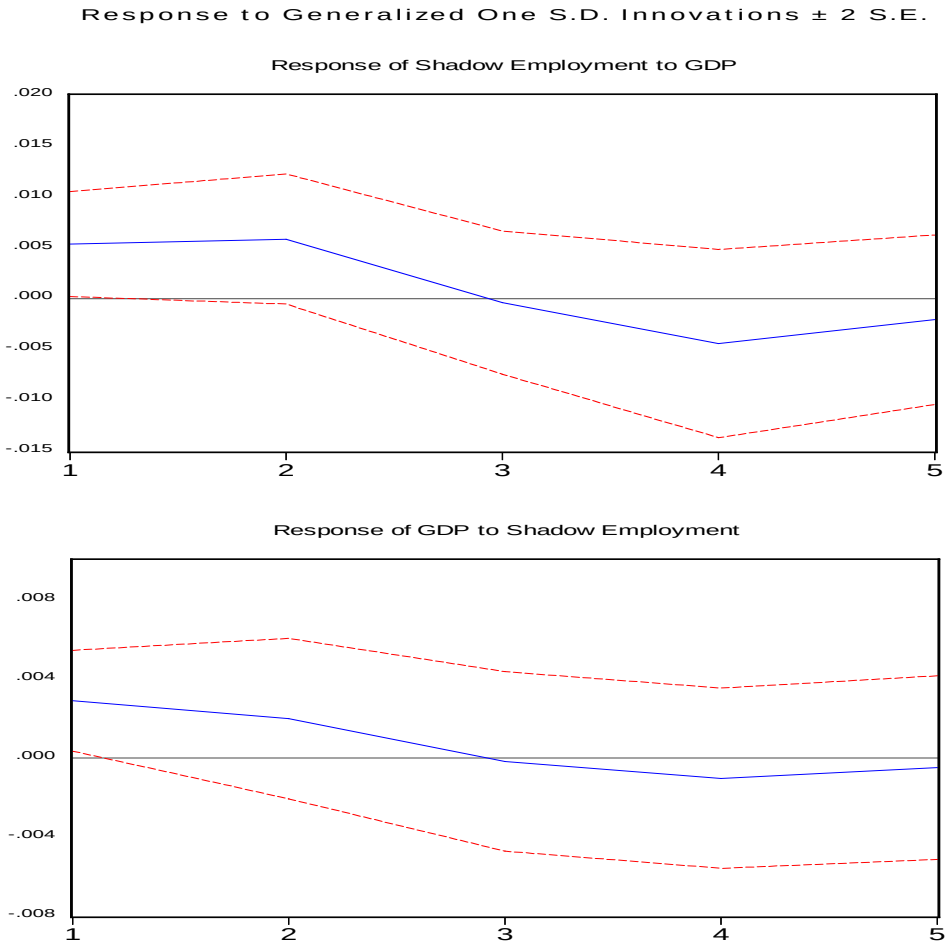
Lag structure

Table 2. VAR Granger Causality/Block Exogeneity Wald Tests.

X^2 [P-value]	X^2 [P-value]	X^2 [P-value]
GDP => Shadow [0.23]	GDP => Employees [0.00]	GDP => Self-Empl. [0.53]
Shadow => GDP [0.97]	Employees => GDP [0.70]	Self-Empl. => GDP [0.51]

[24] To take into account the problem of unusual behavior of cyclical components at the sample's end (see section 4), I performed 1980-2002 experiments as well (results are available upon request). Outcomes are not affected.

Impulse Response Functions[25]



[25] ± 2 S.E bands are drawn from 1000 Monte Carlo replications.


Response of Regular Employees to GDP
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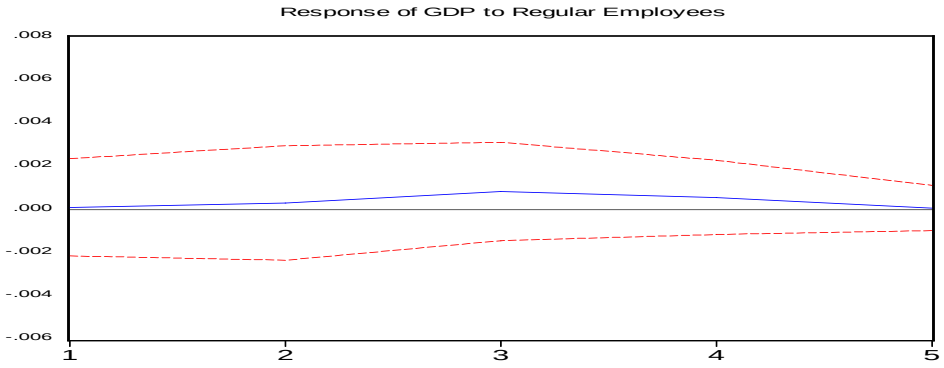
.002
.000
-.002
-.004
-.006
1
2
3
4
5


Response of GDP to Regular Employees
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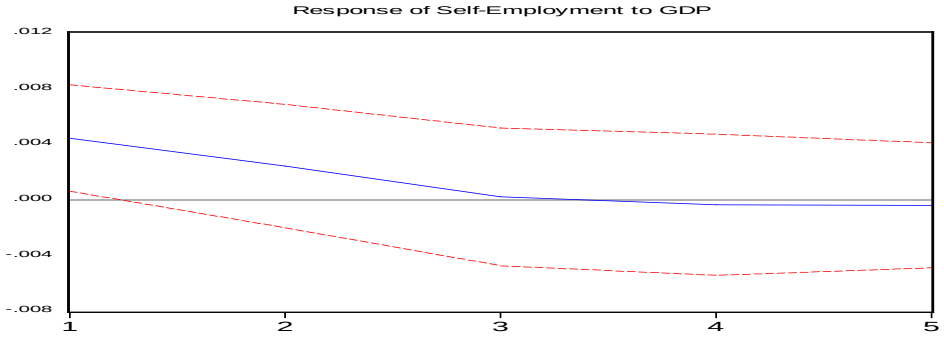
Response of Self-Employment to GDP
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-.004
-.008
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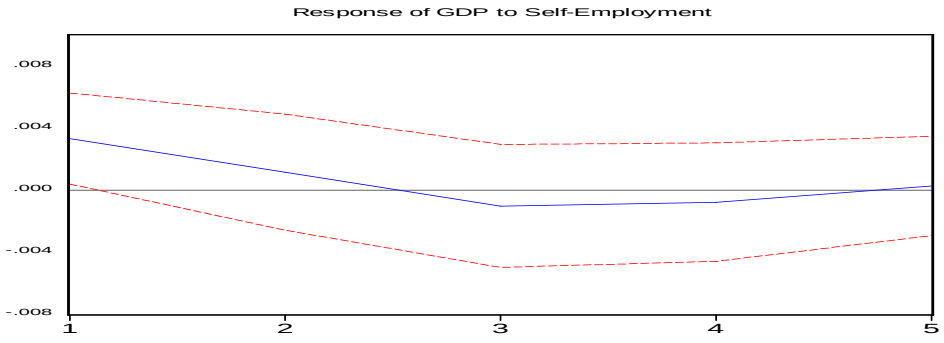
Response of GDP to Self-Employment
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