THE USA SHADOW ECONOMY AND THE UNEMPLOYMENT RATE: GRANGER CAUSALITY RESULTS

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Abstract: *Using the time series data for USA shadow economy (SE), we examine the relationship between the size of unreported economy estimated as percentage of official GDP and the unemployment rate (UR). Granger causality tests are conducted, with a proper allowance for the non-stationarity of the data. The results indicate a clearly evidence of such causality from the unemployment rate to shadow economy.*

Key words: *shadow economy; unemployment rate; Granger causality*

Introduction

This paper uses the estimations of the U.S. shadow economy in order to evaluate if a structural relationship exists between the shadow economy and the unemployment rate for the United States. The structural relationship between the two variables is demonstrated by the use of an unrestricted VAR which shows the response of the shadow economy to a shock in the unemployment rate.The shadow economy is one of the causes of the inefficient functioning of the goods and labour markets. It introduces a distortion of competition within countries and among States. It is clear that the SE not only has negative effects on the economic system but also generates positive ones (Dell'Anno, 2007).

Shadow economy creates an extra added value that can be spent in the official economy. Schneider and Enste (2000) state that at least two thirds of the income earned in the SE is immediately spent in the official economy, thus having a positive effect on the latter.

The hidden economy expressed as percentage of measured GDP has been growing over the past of two or three decades. In many empirical and theoretical studies, it has been found that the tax burden is one of the biggest causes of the shadow economy, followed by the increase in government regulations such as through labour market regulations can lead to a huge increase in the cost of labour in the shadow economy.

Also, an increase in the unemployment rate reduces the proportion of workers employed in the formal sector. Consequently this leads to higher labour participation rates in the informal sector.

Data issues

In this context it is interesting to investigate the nature of the relationship between the unreported economy estimated as percentage of official GDP and the level of unemployment rate. The study use quarterly data for the period 1980-2007. Following the earlier work of Giles and Tedds (2000), Dell'Anno (2006) we have used the MIMIC models in order to generate quarterly data for the relative size of the USA shadow economy (Dobre and Alexandru, 2008).

We obtain the dimension of the shadow economy using an econometrical approach, in which we apply the MIMIC model with four causal variables and two indicators. Thus, we have obtained an MIMIC 4-1-2 as the best model, with four causal variables (tax on corporate income, social security contributions, unemployment rate, and self-employment) and two indicators (index of real GDP and civilian labour force participation rate).

For the unemployment rate the data are compiled from official data released by Bureau of Economic Analysis of USA (www.bea.gov).

We test each series for non-stationarity allowing for the possibilities of I (2), I (1) or I (0) data. To discover the unit roots, the Augmented Dickey-Fuller (ADF) test is used; to choose a number of lags sufficient to remove serial correlation in the residuals we have employed the Schwarz information criterion (ADF). In the following table the p-values is reported, while the null hypothesis is the presence of the unit root, and therefore a value greater than 0.05 indicates non-stationary time series.

Table1. Augmented Dickey-Fuller results

Variable		Level	First Difference	Second Difference
SE	None	0.1604	0.0006*	0.0000*
	C	0.7474	0.0056*	0.0000*
	T&C	0.1132	0.0290*	0.0000*
UR	None	0.2130	0.0000*	0.0000*
	C	0.2025	0.0000*	0.0000*
	T&C	0.2185	0.0000*	0.0000*

* means stationary at 0.05 level.

The results from table 1 indicate that both SE and UR are I(1), are hence non-stationary.

Is there a structural link between shadow economy and unemployment rate?

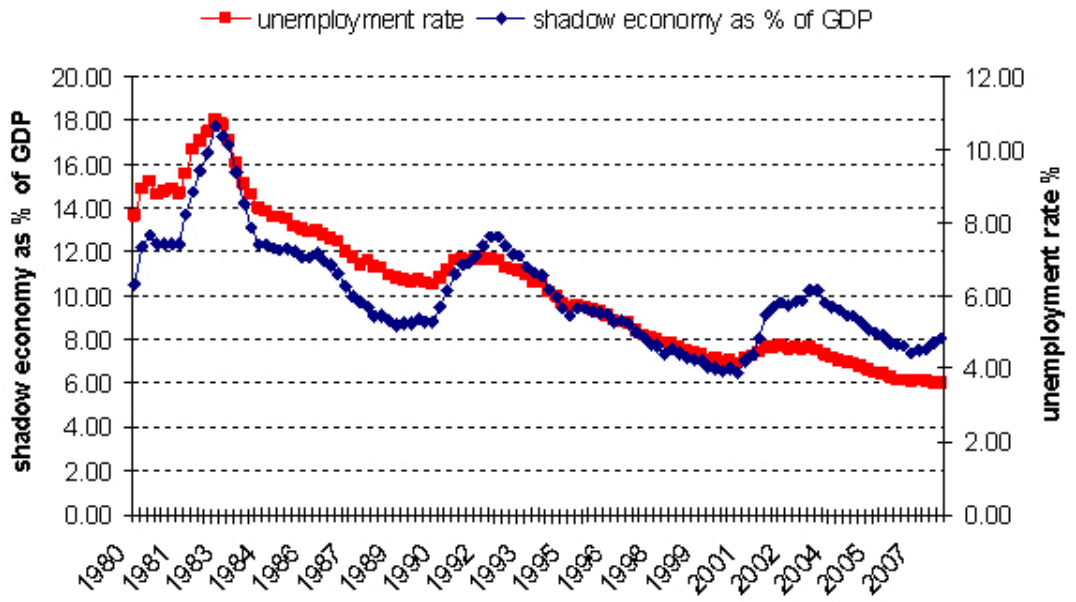

Figure 1. The shadow economy vs unemployment rate

The shadow economy measured as percentage of official GDP records the value of 13.6% in the first trimester of 1980 and follows an ascendant trend reaching the value of 18% in the last trimester of 1982. At the beginning of 1983, the dimension of USA shadow economy begins to decrease in intensity, recording the average value of 6.5% of GDP in 2007. The results of this estimation are not far from the last empirical studies for USA (Schneider and Enste 2001, Schneider 1998, 2000, 2004, 2007,). Schneider estimates in his last study[1], the size of shadow economy of USA as average 2004/05, at the level of 7.9 percentage of official GDP.

Figure 1 compares the trend of the shadow economy estimated by MIMIC model and the unemployment rate (UR) and shows a direct relationship between the two variables. The correlation between the estimated shadow economy and unemployment rate is found to be 0.90, confirming the presence of a strong positive relationship between the shadow economy and UR.

Giles and Tedds (2002) state that the effect of unemployment on the shadow economy is ambiguous. An increase in the number of unemployed increases the number of people who work in the black economy because they have more time. On the other hand, an increase in unemployment implies a decrease in the shadow economy. This is because the unemployment is negatively related to the growth of the official economy (Okun's law) and the shadow economy tends to rise with the growth of the official economy.

A general way of showing the relationship between the shadow economy and UR is to estimate an unrestricted VAR model. The optimal number of lags was chosen based on the Schwartz Bayesian Criterion and Akaike's Information. The optimal lag length was found to be 2, since the Schwartz, Akaike and Hannan Quinn information criterions indicates the same order of lag.

Table 2. The output of VAR model

	UR	SE
UR(-1)	1.346084	0.289852
	(0.15540)	(0.16672)
	[8.66220]	[1.73855]
UR(-2)	-0.427679	-0.378604
	(0.15810)	(0.16962)
	[-2.70510]	[-2.23205]
SE(-1)	0.200389	1.217077
	(0.14766)	(0.15842)
	[1.35713]	[7.68282]
SE(-2)	-0.173276	-0.190219
	(0.14926)	(0.16014)
	[-1.16087]	[-1.18783]
C	0.212894	0.201711
	(0.08841)	(0.09485)
	[2.40804]	[2.12660]
R-squared	0.980858	0.995224
Adj. R-squared	0.980129	0.995042
Sum sq. resids	4.555047	5.243034
S.E. equation	0.208282	0.223458
F-statistic	1345.097	5469.989
Log likelihood	19.05021	11.31366
Akaike AIC	-0.255458	-0.114794
Schwarz SC	-0.132709	0.007955
Mean dependent	6.082424	10.27581
S.D. dependent	1.477550	3.173557
Determinant Residual Covariance		0.000772
Log Likelihood (d.f. adjusted)		82.01566
Akaike Information Criteria		-1.309376
Schwarz Criteria		-1.063877

The estimated VAR is fund to be stable (stationary), because all roots have modulus less than one and lie inside the unit circle. If the VAR is not stable, certain results (such as impulse response standard errors) are not valid.

Because the both variables are found to be integrated of first order, I(1) it is meaningful to test for possible cointegration between the two series and in table 3 we show the results applying the Johansen's likelihood ratio "trace test" to test the null of no cointegration in the context of a bivariate VAR model. Considering the inclusion of drift or trend in the VAR model, the five possibilities suggested by Johansen are considered. Asymptotic critical values are given by Osterwald-Lenum (1992).

Table 3. Johansen's "trace" likelihood ratio tests

	Drift/Trend Case[2]				
	M1	M2	M3	M4	M5
	Trace Test Statistic(Ho:zero cointegrating vectors)				
Johansen's tests	19.53	27.22	9.40	15.82	15.69
Crit.value 5%	12.53	19.96	15.41	25.32	18.17
Crit.value 1%	16.31	24.6	20.04	30.45	23.46
	Trace Test Statistic(Ho:no more than one cointegrating vector)				
Johansen's tests	1.95	9.20	0.19	6.41	6.37
Crit.value 5%	3.84	9.24	3.76	12.25	3.74
Crit.value 1%	6.51	12.97	6.65	16.26	6.40

Assuming that we don't have deterministic trend in data, we see that we clearly reject the null of zero cointegrating, but cannot reject the null of one cointegrating vector.

In order to find the direction of any causality between UR and SE, we apply the Granger causality to the VAR estimated model. We estimate the system and than we can apply the usual Wald test to see if the coefficients of lagged SE variables are jointly zero in the UR equation. Similarly, we test if the coefficients of the lagged UR variables are jointly zero in the SE equation. In each case, the Wald test will be asymptotically Chi Square, with degrees of freedom equal to the number of "zero restrictions".

The results of applying the Wald tests for Granger non-causality to the VAR model appear in table 4.

Table 4: The Wald values of VAR Granger causality

Dependent variable: UR

Exclude	Chi-sq	df	Prob.
SE	5.465254	2	0.0650
All	5.465254	2	0.0650

Dependent variable: SE

Exclude	Chi-sq	df	Prob.
UR	9.793764	2	0.0075
All	9.793764	2	0.0075

The null hypothesis in each case is that the variable under consideration does not "Granger cause" the other variable. These results suggest that the direction of causality is from unemployment rate to shadow economy since the estimated Chi-square is significant at the 5 percent level; the critical Chi-sq=5.99(for 2 df). On the other hand, there is no "reverse causation" from shadow economy to unemployment rate, since the *Chi-sq* value is statistically insignificant.

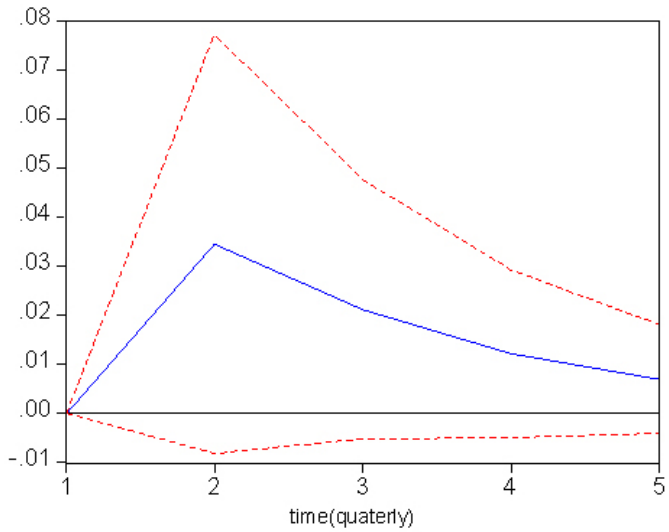

Figure 2. The response of shadow economy to a shock in the unemployment rate

Figure 2 shows that the shadow economy increases by about 3.5% above the baseline in response to a shock in UR. This is followed by a gradual decline towards the baseline. This occurs at the second quarter following the initial shock. This observation concurs with the theory that, an increase in the unemployment rate in the formal sector, fuels an increase in the number of people who work in the shadow economy. Consequently, there is an expansion in the size of the shadow economy.

Given that the estimation of the shadow economy, whose nature is unobservable, is very complicated, any theoretical and empirical inference derived by these figures should be considered always as an approximation.

Conclusions

In this paper we have used time-series data for the USA hidden economy and unemployment rate in order to explore the linkages between unemployment rate and the size of shadow economy in this country from 1980's to 2007. The size of the shadow economy was estimated using the 4-1-2 MIMIC model.

We find that the both series are cointegrated and there is a strong evidence of Granger causality from unemployment rate to shadow economy. On the other hand, there is no "reverse causation" from shadow economy to unemployment rate, since the *Chi-sq* value is statistically insignificant.

The impulse response function shows the response of shadow economy to a shock in the unemployment rate. Accordingly, shadow economy increases by about 3.5% above the baseline in response to a shock in UR. This is followed by a gradual decline towards the baseline. This occurs at the second quarter following the initial shock.

An increase in the unemployment rate in the formal sector, fuels an increase in the number of people who work in the shadow economy. Consequently, there is an expansion in the size of the shadow economy.

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[2] M1-no drift/no trend in cointegrating equation or fitted VAR.
M2-drift/no trend in both cointegrating equation, no drift in fitted VAR.
M3-drift/no trend in both cointegrating equation and fitted VAR.
M4-drift and trend in cointegration equation, no trend in fitted VAR.
M5-drift and trend in cointegration equation and fitted VAR.