THE RELATIONSHIP BETWEEN SHADOW ECONOMY AND UNEMPLOYMENT RATE. A ARDL CAUSALITY ANALYSIS FOR THE CASE OF ROMANIA

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Outline

- Goal
- Literature review
- Methodology
- Data
- Empirical results
- Conclusions
Goal

- To estimate the size of Romanian shadow economy as % of official GDP using the currency demand approach.

- To investigate the relationship between unemployment rates and shadow economy (SE) using ARDL cointegration and causality approach.
Defining the shadow economy

*Schneider* (1998): “all currently unregistered economic activity which contributes to the officially calculated (or observed) Gross National Product”.

*Smith* (1994): “market-based production of goods and services, whether legal or illegal that escapes detection in the official estimates of GDP.”

*Schneider* (2010): “all market-based legal production of goods and services that are deliberately concealed from public authorities in order to:

1. to avoid payment of income, value added or other taxes;
2. to avoid payment of social security contributions;
3. to avoid having to meet certain legal labor market standards (minimum wages, maximum working hours, safety standards);
4. to avoid complying with certain administrative procedures (completing statistical questionnaires or other administrative forms)”.

In the definition of shadow economy are not included:
- economic crime activities (burglary, robbery, drug dealing);
- informal household economy which consists of all household services and production.
### The size of Romanian shadow economy (% of official GDP)

<table>
<thead>
<tr>
<th>Authors</th>
<th>Approach</th>
<th>Period</th>
<th>Size of SE (% of official GDP)</th>
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</table>
Estimating the size of shadow economy - Methodology (1/2)


1. Estimation of $\hat{C} = A(1 + \Theta)^\alpha Y^\beta \exp(-\gamma i)$

2. Setting the tax variable equal to zero and re-estimate the equation, keeping all the other coefficients unchanged we obtain $\tilde{C}$. The difference $EC = \hat{C} - \tilde{C}$ is the amount of extra currency that measures the amount of illegal money in the economy.

3. Assuming equal velocity in both formal and informal sector, the size of shadow economy is obtained multiplying EC by the velocity of money (v):

   $EC \times v = Y_{shadow}$

   $\frac{Y}{M_1 - EC} = v$

4. If the income elasticity $\beta \neq 1$ Ahumada et. al (2006) propose a correction of the results:

   $\frac{Y_{shadow}}{Y_{official}} = \left( \frac{C_{shadow}}{C_{official}} \right)^{\frac{1}{\beta}} = \left( \frac{\hat{Y}_{shadow}}{\hat{Y}_{official}} \right)^{\frac{1}{\beta}}$
1. Several models based on Cagan currency demand function:

- M1: \( C_t = \alpha_0 + \alpha_1 \cdot Y_t + \alpha_2 \cdot Tax_t + \alpha_3 \cdot R_{r12t} + \alpha_4 \cdot WS_t + \varepsilon_{1t} \)
- M2: \( C_t = \alpha_0 + \alpha_1 \cdot Y_t + \alpha_2 \cdot Tax_t + \alpha_3 \cdot R_{r3t} + \alpha_4 \cdot WS_t + \varepsilon_{2t} \)
- M3: \( C_t = \beta_0 + \beta_1 \cdot Y_t + \beta_2 \cdot Tax_t + \beta_3 \cdot R_{r12t} + \beta_4 \cdot Gov_t + \varepsilon_{3t} \)
- M4: \( C_t = \theta_0 + \theta_1 \cdot Y_{dt}'' + \theta_2 \cdot Tax_t + \theta_3 \cdot R_{r12t} + \theta_4 \cdot E_t + \varepsilon_{4t} \)
- M5: \( C_t = \varrho_0 + \varrho_1 \cdot Y_{dt}'' + \varrho_2 \cdot Tax_t + \varrho_3 \cdot R_{r12t} + \varepsilon_{5t} \)
- M6: \( \left( C_t \bigg| M_2 \right) = \gamma_0 + \gamma_1 \cdot Tax_t + \gamma_2 \cdot WS_t + \gamma_3 \cdot R_{r12t} + \gamma_4 \cdot Y_{pc1t} + \varepsilon_{6t} \)

2. Unit root tests.


4. VAR model with an error correction mechanism.

5. Granger causality analysis.
Data description

- Quarterly data 2000Q1-2010Q2.
- Seasonally adjusted, first differentiated.

Data source:
- Monthly Bulletins, National Bank of Romania.
- Tempo database, National Institute of Statistics.
- Quarterly National Accounts database, Eurostat.
- Quarterly Interest Rates database, Eurostat.
Results (1/3)

• The best Model is $M_1$.

• The coefficients for output, tax burden and wages have a positive long-run effect, while interest rate take the pressure off on currency demand.

• All coefficients are strongly significant and assign relevant weight to GDP with a coefficient of 1.80.

Note: All variables are in natural logs. All series used are I(1). The number of lags in the model was determined using SBC and HQ criterions. The models were estimated using SBC criterion (lag 1) and it assume one cointegrating equation. [ ] denote the prob. levels. * indicates significance at the 5% level.
Results (2/3)

- a general downward trend in the size of the shadow economy as % of official GDP for the period 2000-2010 with an highlight on two low periods, 2003Q1 and 2008Q4.

- the size of the shadow economy as % of official GDP measures about 36.6% in 2000Q1 and follows a downward trend registering the value of 31% by 2008.

- for the past few quarters, there is a slightly upward trend in the size of Romanian shadow economy.

- the results are consistent with studies of Schneider (2007) and Albu (2007, 2010, 2011) which show a mainly downward trend of shadow economy in Romania.
Results (3/3)

- It is important to note that because of its undetectable nature and character, it is nearly impossible to measure precisely the size of economic activities taking place in the shadow economy of any country in the world, whether developed or less developed.

- Given this, any theoretical or empirical inference derived from these results should always be regarded as an approximation.

- In the face of these difficulties, the results drawn from these estimates should be interpreted with due reserve, given the limitations of the method.
• Giles și Tedds (2002);

• Buehn și Schneider (2008);

• Tanzi (1999) considers that the relationship between unemployment and the shadow economy is ambiguous.

• The greater the number of unemployed, the more individuals will seek a job in the shadow economy;

• However, it is likely that opportunities to work in the shadow economy should be limited when unemployment is high; fewer businesses offering jobs whether they are official or underground.

• Dell’Anno și Solomon (2007) found a positive relationship on the short-run between unemployment rate and U.S. shadow economy for the period 1970-2004, showing that a positive aggregate supply shock causes the shadow economy to rise by about 8% above the baseline.
Assessing the relationship between Romanian shadow economy and unemployment rates (2/2)

Note:
\[ \text{correl (ILO_{UR}, SE)} = 0.22 \]
\[ \text{correl (R}_{UR}, SE) = 0.67 \]
The impact of unemployment rates on the size of Romanian shadow economy. A ARDL causality analysis (1/5)

- The size of shadow economy (% of off. GDP);
- Registered unemployment rate (%);
- ILO unemployment rate (%);

- Quarterly data 2000Q1-2010Q2;
- seasonally adjusted, first differentiated.

- Monthly Bulletins, National Bank of Romania;
- Tempo database, National Institute of Statistics.
Bounds test approach for cointegration and causality (2/5)

- Bounds test approach for cointegration within ARDL (the autoregressive distributed lag).

- Developed by Pesaran, Shin & Smith (2001)

- The ARDL modeling approach involves estimating the following error correction models (Katircioglu, 2009):

\[
\Delta SE_t = a_0 + \sum_{i=1}^{m} a_{1i} \Delta SE_{t-i} + \sum_{i=0}^{m} a_{2i} \Delta R\_UR_{t-i} + a_3 \cdot SE_{t-1} + a_4 \cdot R\_UR_{t-1} + \varepsilon_{1t}
\]

\[
\Delta SE_t = b_0 + \sum_{i=1}^{m} b_{1i} \Delta SE_{t-i} + \sum_{i=0}^{m} b_{2i} \Delta ILO\_UR_{t-i} + b_3 \cdot SE_{t-1} + b_4 \cdot ILO\_UR_{t-1} + \varepsilon_{2t}
\]

where: \(\Delta\) is the difference operator; \(SE_t\) is the size of Romanian shadow economy as % of official GDP; \(R\_UR_t\) is the registered unemployment rate, \(ILO\_UR_t\) is the ILO unemployment rate; \(\varepsilon_{1t}\) and \(\varepsilon_{2t}\) are serially independent random errors with a mean value of zero and a finite covariance matrix; “\(m\)” represents number of lags.
The F-test is used for investigating the long-run relationship.

- In the first equation:
  \[ H_0 : a_3 = a_4 = 0 \quad \text{(no cointegration)} \]
  \[ H_1 : a_3 \neq a_4 \neq 0 \quad \text{(cointegration)} \]

- In the second equation:
  \[ H_0 : b_3 = b_4 = 0 \quad \text{(no cointegration)} \]
  \[ H_1 : b_3 \neq b_4 \neq 0 \quad \text{(cointegration)} \]

- Comparing the F-ratios with critical values of Pesaran (2001) or Narayan (2005) for limited samples (40-45 observations), we can reject or accept the null hypothesis.
Bounds test approach for cointegration and causality (4/5)

- Conditional ECM under ARDL approach with distributive lags:
  Level Relationships models:

\[ SE_t = \alpha_1 + \beta_1 \cdot R_{UR_t} + \varepsilon_{1t} \]

\[ SE_t = \alpha_2 + \beta_2 \cdot ILO_{UR_t} + \varepsilon_{2t} \]

ECM models:

\[ \Delta SE_t = \gamma_0 + \sum_{i=1}^{m} \gamma_{1i} \Delta SE_{t-i} + \sum_{i=0}^{n} \gamma_{2i} \Delta R_{UR_{t-i}} + \gamma_3 ECT_{t-1} + \varepsilon_{1t} \]

\[ \Delta SE_t = \lambda_0 + \sum_{i=1}^{m} \lambda_{1i} \Delta SE_{t-i} + \sum_{i=0}^{n} \lambda_{2i} \Delta ILO_{UR_{t-i}} + \lambda_3 ECT_{t-1} + \varepsilon_{2t} \]

- \( \gamma_{1i}, \gamma_{2i}, \lambda_{1i}, \lambda_{2i} \) are the coefficients for the short-run dynamics of the model`s convergence to equilibrium.

- ECT\(_{t-1}\) is the one period lagged error correction term who shows how speed the disequilibrium between the short-run and the long-run values of dependent variable is eliminated each period. The expected sign of ECT is negative.

- \( \varepsilon_t \) is the error term.
If we identify cointegration using bounds test, conditional Granger causality tests under the ARDL approach:

\[
\begin{bmatrix}
\Delta SE_t \\
\Delta R_{UR_t}
\end{bmatrix} =
\begin{bmatrix}
c_1 \\
c_2
\end{bmatrix} + 
\sum_{i=1}^{p} 
\begin{bmatrix}
\phi_{11}^p & \phi_{12}^p \\
\phi_{21}^p & \phi_{22}^p
\end{bmatrix} 
\begin{bmatrix}
\Delta SE_{t-i} \\
\Delta R_{UR_{t-i}}
\end{bmatrix} 
+ 
\begin{bmatrix}
\delta_1 ECT_{t-1} \\
\delta_2 ECT_{t-1}
\end{bmatrix} 
+ 
\begin{bmatrix}
\varepsilon_{1t} \\
\varepsilon_{2t}
\end{bmatrix}
\]

ECT_{t-1} is the lagged error correction term derived from the long-run co-integration model.

where: \(\Delta\) is a difference operator, ECT representing the error-correction term derived from long-run co-integrating friendship via ARDL model, \((i = 1, 2)\) is constant and \((i = 1, 2)\) are serially uncorrelated random disturbance term with zero mean. The optimal lag length \(p\) is based on the Akaike Information Criterion.
The bounds test results supported:

-the existence of a mutual long-run relationship between the SE and unemployment rates when a sufficiently high lag order is selected and when the statistically insignificant deterministic trend is excluded from the conditional ECM.
According to the results in Panel A, a short term negative and statistically significant relationship has been detected between the shadow economy and lagged unemployment rates.

The table presents the conditional ECM regression associated with the above level relationship.

The equilibrium correction coefficient has the expected sign (negative) and statistically significant in both models indicating another confirmation of the existence of the long-run relationship.
The empirical results revealed:

- the existence of a unidirectional causality that runs from the UR to SE

- in short-run both ILO and registered unemployment rates have a **negative** and statistically significant effect on shadow economy;

- in the long-run both unemployment rates have a **positive** effect on shadow economy.
Conclusions(1/2)

- Estimate the size of Romanian shadow economy as % of official GDP, using the currency demand approach.

- The size of the shadow economy is estimated to be decreasing over the period reaching the value of 31.5% of official GDP at the middle of 2010.

- Thus, estimating the size of the shadow economy remains a controversial topic since its clandestine nature. The results should be interpreted with due reserve, given the method limitations.

- Examine the impact of registered and ILO unemployment rates on the Romanian shadow economy using ARDL cointegration and causality approach.
The empirical results point out:

- The existence of a unidirectional Granger causality that runs from both unemployment rates to the shadow economy.

- Support the existence of a negative short-run relationship and of a positive long-run relationship between both unemployment rates (registered and ILO) and the size of the Romanian shadow economy.

- The negative impact of both unemployment rates on the shadow economy can be explained by the inability of the labor market to provide more jobs whether they are official or 'hidden' / unregistered in the event of rising unemployment, underlining a limitation of opportunities to work in the shadow economy.

- But on the long run, an increase in unemployment leads to an expansion of the activities in the shadow economy, underlining a positive impact on the size of the Romanian shadow economy.
Thank you!