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Active Ageing and Shadow Economy in Romania. An Empirical Causality Analysis

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Abstract. *The paper aims to analyze the unidirectional relationship from active ageing phenomena to the size of the Romanian shadow economy in order to see if the unofficial sector represents a social buffer for older workers who have lower labor market opportunities. In order to do that, we applied two important causality analyses, Granger and Toda-Yamamoto, based on quarterly data over the period 2000-2010. The size of the Romanian shadow economy was previously estimated using a revised version of the currency demand approach based on autoregressive distributed lag (ARDL) approach. For active ageing, the employment rate for older workers was used as proxy. The cointegration empirical results highlight the existence of a positive long-run relationship between employment rate of elderly and unofficial sector. The empirical causality results conclude that there is a unidirectional Granger causality that runs from employment rate of older workers to shadow economy both on long-run and short-run. The empirical results of Toda-Yamamoto revealed the absence of a short-run causal relationship from employment rate for older workers to the size of shadow economy. One possible explanation for the existence of a positive relationship that runs from employment rate of elderly to unofficial sector can be the low capacity of the economy to generate proper jobs, so this age group of older workers does not have qualifications that meet the needs of formal economy, and therefore shadow economy becomes an alternative to formal work and it may provide a buffer for some workers who have few alternative labor market opportunities. Another alternative could be the fact that this age group of elderly remains occupied in the formal lab our market, but with low earnings and they work in informal activities in order to supplement their income.*

Keywords*: shadow economy, older workers, active ageing, Granger causality, Toda-Yamamoto approach, Romania.*

Introduction

Active ageing has been developed as a strategy to leverage the potential of individuals to improve awareness of what every one of us can do to keep fit and healthy for as long as possible. Physical activity, healthy eating, life-long learning and staying integrated in the work life as a paid employee, as an entrepreneur or as a volunteer – all these are elements of an active life style that should characterize the whole life-course.

The World Health Organization (WHO) and the European Commission for Europe (UNECE) use the term "active ageing" in such a way to include different ageing trajectories and diverse groups of older people. "Active

ageing is the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age" (WHO, 2002, p.12).

Two main characteristics of active ageing are gainful employment and volunteering. While people are living longer (and will have a longer working life in the future), fewer young people are entering the labor market. In the future, people aged between 55 and 64 will comprise a large share of the workforce. From an economic standpoint, it makes sense to encourage older workers to stay active and to utilize their skills and experience. Employers may benefit from employing older workers because this means reduction in recruitment and training costs. For the individual, the extension of working life might be seen positive, as well (e.g. continuous interweavement with society, opportunity for self-fulfillment, and higher income relative to retirement benefits).

The need to increase labor market participation of older workers has grown during the last decade. In 2000, the European Council set a target employment rate for older workers (aged 55-64) of 50% in 2010 and, from 2000 to 2010, both the Lisbon Strategy and the European Employment Strategy highlighted the promotion of employment of older workers as a clear objective. The year 2012 has been proclaimed the *European year for active ageing and solidarity between generations, having as main goal increasing* awareness of the contribution of older workers to society and mobilizes the potential of the rapidly growing population in their late 50s and over.

Shadow economy is a controversial topic that has aroused the interest of specialists from the 60's, when the phenomenon took a great extent. Formed in the literature under various names, the shadow economy exists in a more or less extent in all countries, regardless of their level of development, enjoying an enduring existence, although as area of research it is a new "young" area. This would explain the lack of agreement among experts, even in the name and definition of the phenomenon.

The paper aims to investigate the relationship between the phenomenon of active ageing and the size of the shadow economy (SE) for the case of Romanian, using *two important causality analyses, Granger and Toda-Yamamoto,* for quarterly data covering the period 2000-2010. The size of the Romanian shadow economy was estimated using a revised version of the currency demand approach based on bounds testing approach to cointegration and error correction models, developed within an autoregressive distributed lag (ARDL) framework. A detailed description of the shadow economy estimation is presented in (Davidescu & Dobre, 2013). Thus, the size of the shadow economy as % of official GDP measures

approximately 45% at the end of 2000 and achieving the value of 37.4% in the last quarters of the period.

It is important to mention that this research paper focuses on the uni-directional relationship from employment rate of elderly towards shadow economy and therefore the inverse relationship will not be further discussed.

The paper is structured as follow: first section details both concepts from a theoretical perspective; the second section presents a statistical analysis of active ageing indicators in Romania and EU-27. The third section is dedicated to the presentation of the methodology and data, while the forth one presents the main empirical results for the two causality analyses. The paper ends with the presentation of the main conclusions and policy implications.

The relationship between the Romanian shadow economy and active ageing. A theoretical background

According to the definition of the European Commission, active ageing means „helping people stay in charge of their own lives for as long as possible as they age and, where possible, to contribute to the economy and society".

In the future, the proportion of older people is expected to increase fast, due to low birth rates, ageing "baby-boomers" and rising life expectancy. Between 2010 and 2060, the number of people over 65 will grow from 17.4% to 29.5% of the total population. The number of people over 80 will nearly triple to 12%. During the same time, the working age population in the EU is expected to decline by 14.2%. Pensions, health care and long-term care systems risk becoming unsustainable, with a shrinking labor force no longer able to provide for the needs of the growing number of older people.

The EU devoted the European Year 2012 to promoting active ageing as a basis for solidarity between generations. In this context, the Social Protection Committee and the Employment Committee elaborated guiding principles for active ageing. The Active Ageing Index has been developed to assess the untapped potential of older people. The European Innovation Partnership for Active and Healthy Ageing is fostering innovation to raise healthy life expectancy.

The concept of shadow economy is a generic notion including all market-based legal production of goods and services that are deliberately concealed from public authorities for the following reasons: to avoid payment of income, value added or other taxes; to avoid payment of social security contributions; to avoid having to meet certain legal labor market standards,

such as minimum wages, maximum working hours, safety standards; to avoid complying with certain administrative procedures, such as completing statistical questionnaires or other administrative forms. It is important to note that from the multitude of definitions attributed to this phenomenon in the literature, this paper addresses the concept of informal economy as defined by Schneider et al. (2010) and does not trait the informal sector.

From the main methods for assessing and quantifying the size of the shadow economy existing in the literature, the monetary approach was used to estimate the size of the Romanian shadow economy using a revised version of the currency demand approach based on ARDL models.

The monetary approach is the most used methodology to estimate the size of the informal economy and is based on the assumption that cash is the main medium of exchange for transactions in the informal sector because it "leaves no identifiable marks," so that participants in the informal economy will use cash to hide income to tax authorities. So an increase in currency, ceteris paribus, may represent an increase in informal activity. If the amount of cash used for informal transactions can be estimated, it can be multiplied by the speed of rotation of money to get a measure of the size of the informal economy.

The currency demand approach uses currency as the main tool for exchanges, because it does not leave traces for public authorities. The shadow banking complements traditional banking system by expanding the credit access, by providing alternatives to banking deposits and by spreading risks (Barbu, Obreja & Boitan, 2015; Boitan, 2015).

An assessment of the most important national and international studies in the literature regarding the estimates of Romanian informal economy using different estimation methods was presented in Dobre and Davidescu (2013). As Schneider (2007) stated, no approach is exempt from criticism, the empirical results being different. So, if according to National Institute of Statistics, the informal activity represents between 14.5% and 23.5% of official GDP, Schneider et al. (2010) estimates the size of shadow economy in Romania to overcome the threshold of 35% of official GDP.

Analyzing the potential relationship between active ageing quantified by the employment rate of older workers and shadow economy, one possible explanation for the existence of a positive relationship can be the low capacity of the economy to generate proper jobs, so this age group of older workers does not have qualifications that meet the needs of formal economy, and therefore shadow economy becomes an alternative to formal work.

The figures for Romania negate the idea that employment and social insurance coverage can be substantially expanded by "formalizing" informally employed and self-employed workers. While under-declaring the level of income might still be an important phenomenon in Romania, most of the urban population is already "registered" as contributors in the Social Insurance system, while many rural "self-employed" may be mainly outside of the cash economy and cannot be expected to make tax payments or social security contributions even based on the minimum wage.

Analyzing the employment performance and convergence of the European countries and regions, Perugini and Signorelli (2004) emphasized that a significant negative correlation exists between total (regular) employment rate and size of shadow economy (used as aproxy of irregular employment), stating that the countries with the worst employment performances have a higher incidence of "irregular employment".[1] Another explanation for failing the "official" employment participation is the unregistered workforce, as more people get paid "under the table".

In developing countries, where most workers simply cannot afford to be unemployed, underemployment usually takes the form of informal employment. The informal economy often provides the only means of survival for low-skilled workers who need to support their families when formal sector job opportunities are unavailable. As workers laid off from the formal economy turn to the informal economy, their work becomes characterized by lower earnings, lower productivity, more difficult working conditions and the increased risk of poverty.

Older workers who lose their jobs tend to encounter greater difficulty in finding new work than younger workers. In the United Kingdom, out of work men in their 50s only had a one-in-five chance of being in a job two years later; the longer they remained unemployed, the worse were their chances of finding employment.

According to Lehmann and Pignatti (2008), young workers enter informal salaried employment to gain some training, which in turns enables them to enter at a later stage formal salaried employment. Having acquired physical and additional human capital as formal salaried employees, as they get older they might leave for informal self-employment or informal entrepreneurship. If their activities or businesses are successful they will finally enter formal self-employment or entrepreneurship. But this point of view contradicts the hypothesis that young workers work in the informal

[1] If official employment rates were corrected to allow for irregular employment, a general convergence and upward shift of "corrected" employment levels would result. Employment in illegal activities is, of course, excluded from the definition of "irregular employment".

sector queuing for a formal sector job and once they have achieved a formal employment relationship they try to remain formally employed until retirement.

According to Maloney (1999), workers start their working life choosing informal salaried employment for training, and then they enter its formal counterpart to gain human and physical capital. When older, some of them will flow into informal self-employment and eventually into formal self-employment.

Pignatti and Lehmann (2008) found that while workers try to enter formal employment at any stage of their working life, some are forced to take up informal salaried jobs in an involuntary fashion, while a minority is engaged in informal jobs voluntarily.

OCDE (2008) considers that informal employment may provide a buffer for some workers who have few alternative labor market opportunities. Their empirical results revealed that one of the key groups affected by informal employment in Korea is older workers. They are more likely to work in informal jobs or as own-account workers than those of prime working age, even after controlling for their lower average levels of education.

Other possibility of activating older workers in the field of labor market is that financial companies to receive incentives for employing elderly acting in the direction of promoting sustainable development and decreasing the size of unofficial sector (Moldovan, 2015a; Moldovan, 2015b).

Foreign direct investment might be seen also as an alternative in this direction, due to the fact that they might be incentivized to employ elderly workers, and also contributing to the decrease of the informal activities (Danciu & Strat, 2015).

Also taking into consideration the empirical results obtained by Saafi et al. (2015a, 2015b) stating that high levels of unemployment lead to high levels of shadow economy and vice versa it is very important to draw policy measures that will tackle the problem of unemployment activating vulnerable groups on the labor market such as elderly in order to reduce the size of informal sector.

The analysis of active ageing indicators in Romania and at EU-27 level during the period 2000-2014

Analyzing the evolution of employment rate for older workers, it can be revealed a 15 percentage points increase in the proportion of 55 to 64 year olds in employment in the EU between 2000 and 2014. This positive trend has persisted over the years for both men and women. In Romania compared with the EU-27 level, we have an oscillated evolution, the employment rate for older workers decreasing to 37.3% in 2002 and then having a slowly increasing evolution reaching the value of 43.1% in 2014.

Despite a significant increase, the employment rate of older workers in 2014 remained well below other groups. Increasing employment rates of older workers is a focus of policy actions, and for the phenomena of active ageing.

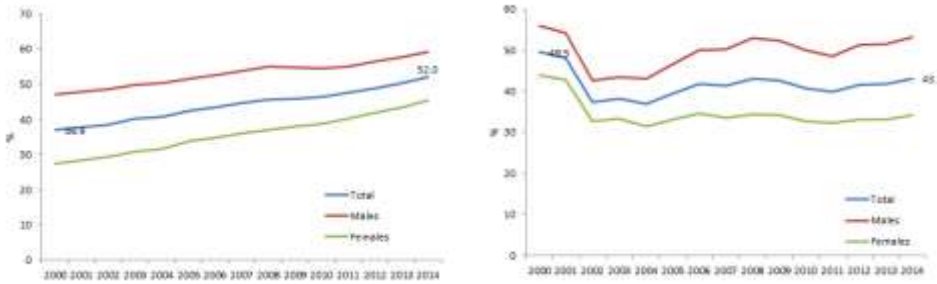

Figure 1. Employment rates for older workers in EU-27 (%, left side) and in Romania (%, right side)
Source: Eurostat (tsdde100)

At the EU-27 level, the recession has not yet affected the proportion of older people in employment. An increase in the share of older workers in employment stopped temporarily during the period following the crisis. While the year-on-year increase was one percentage point or above between 2005 and 2008, it was only 0.4 percentage points in 2009 and 2010. In 2012, 2013 and 2014 the rate of older workers increased again at a higher level of 1.5 percentage points per year.

In Romania, the crisis has affected the employment rate of older workers, who has decreased with 0.5 percentage point in 2009, 1.9 percentage points in 2010 and 0.8 percentage point in 2011. In 2012-2014, the rate increased by 1.3 percentage points per year.

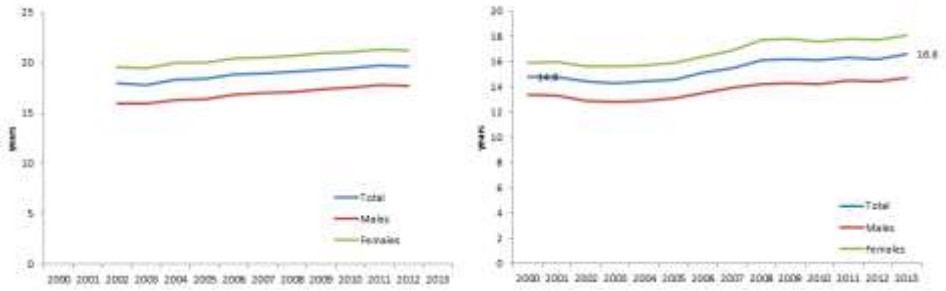

Figure 2. Life expectancy at age 65 in EU-27 (years, left side) and in Romania (years, right side)
Source: Eurostat (tsdde100)

The expected number of years left to live at the age of 65 increased for men and women between 2000 and 2013. Analyzing the Romanian figures, women life expectancy at age 65 increased only slightly, but continuously, from 15.9 to 18.1 years. Life expectancy for men started from a lower level of 13.4 years in 2000 and reached 14.7 in 2013.

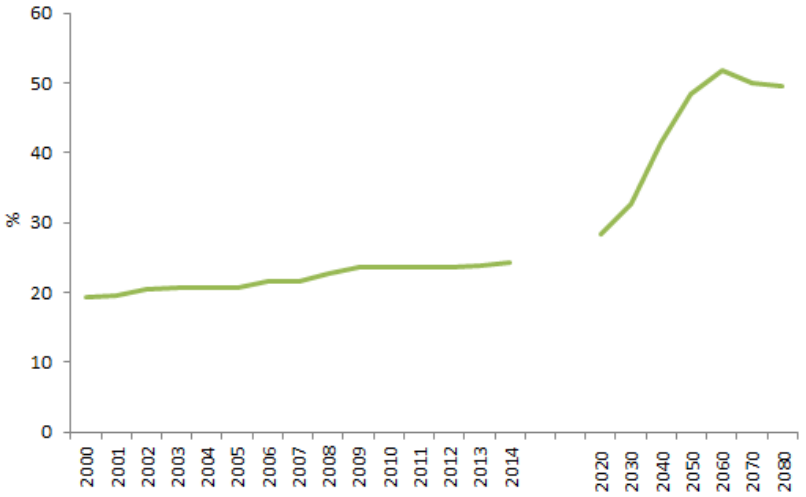

Figure 3.Old-age-dependency ratio, RO (1000 persons)
Source: Eurostat (tsdde100, tsdde511)

Old-age dependency expected to keep rising until 2050. The trend towards a growing share of older people aged 65 and above in the population and a shrinking working-age population (15 to 64 years) has long been observed, and is expected to accelerate in the future. The ratio of elderly people to the working age population in the EU has steadily increased from 24.5 % in 2000

to 28.2 % in 2014. Projections indicate that the old-age dependency ratio will continue to increase, reaching 51.8 % in 2055, or about double the level of 2012. The share of people aged 65 and above in the total population increased in Romanian from 19.3% in 2000 to 24.3% in 2014 and is projected to increase to 51.9 % by 2060.

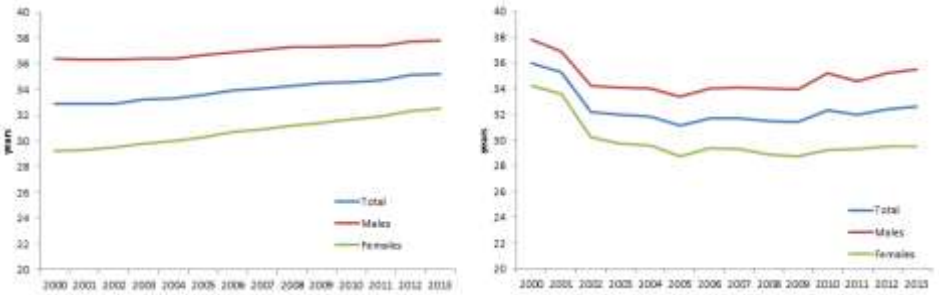

Figure 4. Duration of working life, by sex, in EU-27 (years, left side), and Romania (years, right side)
Source: Eurostat (tsdde420)

At the European level, there is a 2.3 years increase in duration of working life between 2000 and 2013. The number of years a person is expected to be active in the labor market throughout their life slightly increased between 2000 and 2013 for men with 1.4 years and for women with 3.3 years. In Romania, the duration of working life is increasing with only 0.4 years in 2013 compared with 2002. For men, the number of years a man is active in the labor market increased with 1.3 years in 2013 compared with 2002, instead of women for which the duration of working life decreased with 0.7 years.

Methodology and data

In the econometrical demarche of the investigation of the relationship between active ageing and shadow economy, the size of Romanian shadow economy as % of official GDP has been obtained using a revised version of the currency demand approach based on bounds testing approach to cointegration and error correction models, developed within an autoregressive distributed lag (ARDL) framework.

The method of currency demand approach assumes the econometrical estimation of an equation for currency demand over time depending on real gross domestic product, total tax revenues normalized by GDP, 1 year real saving deposit interest rate and the ratio of wages and salaries in national income. The time span covered by the series is from 2000:Q1 to 2010:Q2.

Apart from the real interest rates and the real currency outside banks, the data were seasonally adjusted by means of TRAMO/SEATS method.

Estimating this equation we identify the amount of currency $\hat{C}$. Setting the tax rate (which is supposed to be the incentive variable that gives incentives to make hidden transactions) equal to zero and leaving the coefficients of the other variables unchanged, we obtain the amount of currency $\tilde{C}$. The difference between $\hat{C}$ and $\tilde{C}$ is the amount of extra currency. In other words, the difference measures the amount of illegal money in the economy. Forth more, assuming that the velocity of money is the same in both official and shadow sectors[2], we obtain an estimate of the size of shadow economy multiplying illegal money ($EC = \hat{C} - \tilde{C}$) by the velocity of money ($v = \frac{Y}{C}$).

The empirical results pointed out that the size of the shadow economy as % of official GDP measures approximately 45% at the end of 2000 and achieving the value of 37.4% in the last quarters of the period. A detailed description of the shadow economy estimation is presented in Davidescu and Dobre (2013). The phenomenon of active ageing was quantified using a more comprehensive indicator: the employment rate for older workers (50 years and over), expressed in %. The data source was LFS database of Eurostat.

The aim of the paper is to investigate the nature of the relationship between active ageing and the size of the Romanian shadow economy and to identify the direction of causality between them for quarterly data covering the period 2000-2010. In order to quantify the relationship between active ageing and shadow economy, we employed the following econometrical techniques: non-stationarity tests (ADF and PP tests), Johansen cointegration test, estimation of VAR or VECM models, Granger causality method, Toda-Yamamoto approach, together with two short-run analyses impulse response function and variance decomposition.

The Johansen procedure provides a framework for the estimation of multivariate cointegrating systems based on the error correction mechanism of the VAR (p) model, with the mention that if the variables are cointegrated, then error-correction terms must be included in the VAR model.

The first step in this econometric assignment is to estimate an Unrestricted Vector Autoregression Model (VAR) and to determine the optimal lag length,

[2] This assumption has been criticized and, as Ahumada et al. (2007) claim, even if the velocity is the same, previous works that find $\beta \neq 1$ (i.e. income elasticity different from 1) are incorrect. Therefore, they propose an alternative way of correcting the estimates.

k, taking into account the absence of serial correlation in the residuals. In order to verify the cointegration of the variables we applied Johansen test under the two tests *maximal eigenvalue* and the *trace* tests. If the variables are not cointegrated under Johansen approach, a VAR model should be run under first difference (we will have only short-run results) and the F-test should be statistically significant. If instead, both variables are cointegrated, a VECM should be run, corresponding to a restricted VAR of order *p-1* for the first differenced series, with the inclusion of error-correction terms for the cointegrating vectors.

The vector error correction model (VECM) restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. In this case, the cointegration terms are the correction terms since a series of partial short-run adjustments correct gradually the deviation from long-run equilibrium.

The cointegration term is known as the correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments.

The ECM estimated can be defined as follows:

$$\Delta X_t = \mu + \Gamma_1 \cdot \Delta X_{t-1} + ... + \Gamma_{p-1} \Delta X_{t-p+1} + \Pi \cdot X_{t-1} + \varepsilon_t \quad (1)$$

where: Δ is the difference operator, X is the set of I(1) variables; μ is a drift parameter; $\varepsilon_t \approx niid(0, \Sigma)$; Π is an $(n \times n)$ coefficient matrix decomposed as $\Pi = \gamma \cdot \beta'$, γ, β are both $n \times r$ matrices of full rank, where γ represents the adjustment coefficients and β containing the r cointegrating vectors; Γ denotes an $(n \times n)$ matrix of coefficients and contains information regarding the short-run relationships among the variables.

For the case when both variables are integrated on the same order and they are also co integrated, the Granger causality test was run under VECM:

$$\Delta Y_t = C_0 + \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{i=1}^{p} \alpha_i X_{t-i} + p\ ECT_{t-1} + u_t \quad (2)$$

$$\Delta X_t = C_0 + \sum_{i=1}^{p} \gamma_i X_{t-i} + \sum_{i=1}^{p} \zeta_i Y_{t-i} + \eta\ ECT_{t-1} + \varepsilon_t \quad (3)$$

where: Y, X are the variables, p, η are the adjustment coefficients while ECT_{t-1} expresses the error correction term. In eq.(2), X Granger causes Y if α_i, p are significantly different from zero. In eq.(3) Y Granger causes X

if ζ_i, η are significantly different from zero. In order to identify such a relation, the t-ratio of the ECT should also be negative and statistically significant and accompanied by a significant value for the F value of the model. Therefore, the significance of the error correction term signals the presence of the causality in at least one direction.

If the Granger causality analysis requires that the lagged coefficients of the independent variable in each equation are jointly statistically significant, using Wald statistics, Toda-Yamamoto has the advantage of no pre-testing the integration order of variables and also of the co integration rank in the VAR system. Still, we have to mention the main disadvantage of the Toda-Yamamoto procedure, which is represented by the fact that only the short-run causality relationship can be investigated.

A noteworthy aspect is the fact that the Toda-Yamamoto procedure involves estimating the augmented VAR [dmax + k] model using the Seemingly Unrelated Regression technique [28]. In the case of a bivariate (*Y*, *X*) relationship, Toda and Yamamoto causality test is represented as follows (Esso, 2010):

$$Y_t = a_0 + \sum_{i=1}^{k} b_{1i} \cdot Y_{t-i} + \sum_{i=k+1}^{k+d_{\max}} b_{2i} \cdot Y_{t-i} + \sum_{i=1}^{k} c_{1i} \cdot X_{t-i} + \sum_{i=k+1}^{k+d_{\max}} c_{2i} \cdot X_{t-i} + e_{1t} \quad (4)$$

$$X_t = d_0 + \sum_{i=1}^{k} e_{1i} \cdot X_{t-i} + \sum_{i=k+1}^{k+d_{\max}} e_{2i} \cdot X_{t-i} + \sum_{i=1}^{k} f_{1i} \cdot Y_{t-i} + \sum_{i=k+1}^{k+d_{\max}} f_{2i} \cdot Y_{t-i} + e_{2t} \quad (5)$$

where: $Y_t = SE_t$, $X_t = EMPLROW_t$, e_{1t}, e_{2t} are the residuals of the models.

A detailed presentation of these techniques is offered by the articles Alexandru and Dobre (2011), Alexandru and Dobre (2013), Davidescu (2014) and Davidescu (2013).

Empirical results

The correlation analysis of variables revealed the existence of a strong positive relationship between shadow economy and employment rate for older people (50 years and over) quantified by a value of 0.63 of correlation coefficient.

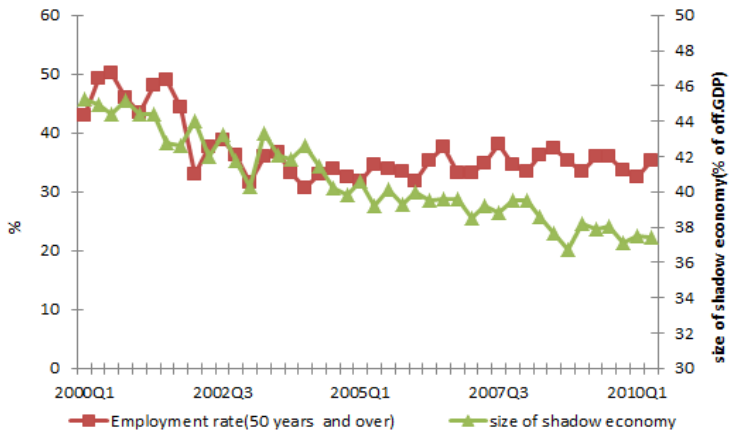

Figure 5. The size of the shadow economy vs. employment rates for older workers in Romania.
Source: LFS Eurostat Database

The analysis of non-stationarity using ADF and PP unit root tests revealed that the variables are non-stationary at their levels but stationary at their first differences, being integrated of order one, I(1).

The relationship between active ageing and the shadow economy in Romania, a Granger causality analysis

In order to investigate if we have a long run relationship between variables, we use the Johansen co integration test. Prior to performing the co-integration tests, we need to determine the optimal lag length estimating a VAR model using un-differenced data (variables in levels) and choosing the lag for which the residuals pass the diagnostic tests of non-autocorrelation, homoscedasticity and normality of the residuals and, additionally, the model fulfills the stability condition.

Since the total number of observations is only 42, we used a maximum number of 4 lags, eliminating the serial autocorrelation of residuals. Also VAR model verifies the stability condition and the hypothesis concerning non-autocorrelation, homoscedasticity and normality of the residuals. According to LR, FPE, AIC SBC and HQ criterions the optimal number of lags was chosen to be 3.

In order to determine de optimal model for for the deterministic components in the system, we have applied Pantula's (1989) principle. Cheung and Lai (1993) mention that the trace test is more robust than the maximum eigenvalue test for cointegration. The results suggest the choice of model 4

(intercept and trend in cointegrating equation and no intercept in VAR) and empirical results point out the existence of a unique cointegrating relationship (a long run relationship) between the variables with both eigenvalue and trace tests. Because a long run equilibrium relationship is found between the variables, a VECM model is constructed to determine the direction of causality.

Table 1. Empirical results of VECM model

Cointegrating Eq:	CointEq1
SE(-1)	1.000000
EMPL_RATE_50(-1)	0.051072
	(0.02343)
	[2.18001]
@TREND(00Q1)	0.168720
	(0.00964)
	[17.5008]
C	-42.41616
Error Correction:	D(SE)
CointEq1	-1.355096
	(0.29938)
	[-4.52640]
D(SE(-1))	0.369785
	(0.25575)
	[1.44587]
D(SE(-2))	0.315808
	(0.21077)
	[1.49836]
D(SE(-3))	0.394952
	(0.15266)
	[2.58720]
D(EMPL_RATE_50(-1))	-0.039181
	(0.04971)
	[-0.78816]
D(EMPL_RATE_50(-2))	-0.095411
	(0.03721)
	[-2.56414]
D(EMPL_RATE_50(-3))	0.057931
	(0.04537)
	[1.27672]
C	-0.043870
	(0.15198)
	[-0.28865]
R-squared	0.657349
Adj. R-squared	0.577397
Sum sq. resids	14.00017
S.E. equation	0.683134
F-statistic	8.221799
Log likelihood	-34.94784

Akaike AIC	2.260413
Schwarz SC	2.605168
Mean dependent	-0.204179
S.D. dependent	1.050847

The long-run coefficient is positive and strongly significant inferring that a 1% increase in the employment rate of older workers would imply in the long-run an estimated increase of almost 0.05% in the size of the shadow economy.

The significance of the error correction term shows causality in at least one direction. The lagged error correction term (EC_{t-1}) is negative and highly significant, revealing the existence of a long-run causality that will run from employment rate of older workers to shadow economy.

The short-run coefficients are unclusive and statistically not significant, revealing that short-term relationship between employment rate of older workers and the unofficial sector is ambigous.

Table 2. Granger Causality test results

	Lag level 3	
Null hypothesis	Wald test	$t_{ECT_{t-1}}$
Employment rate of older workers does not Granger cause SE	**12.44****	**-1.35***

*Notes: ** and * denote significance for 1% and 5% levels.*

The empirical results of Granger causality under VECM model conclude that there is a unidirectional Granger causality that runs from employment rate of older workers to shadow economy both on long-run and short-run (t-ratio of ECT is statistically significant at 1% level, ECT is negative, and Wald-tests for the short-run coefficients of employment rate of older workers are statistically significant).

Analyzing the short-run causality running from employment rate of older workers to shadow economy, we applied the impulse response function in order to quantify the effects of a positive shock in the employment rate of older workers on the size of unofficial sector. The empirical results state that the shadow economy (informal employment) will increase by 0.5% at the horizon of the 8th quarter after the initial shock, as a consequence of a positive shock in employment rate of elderly.

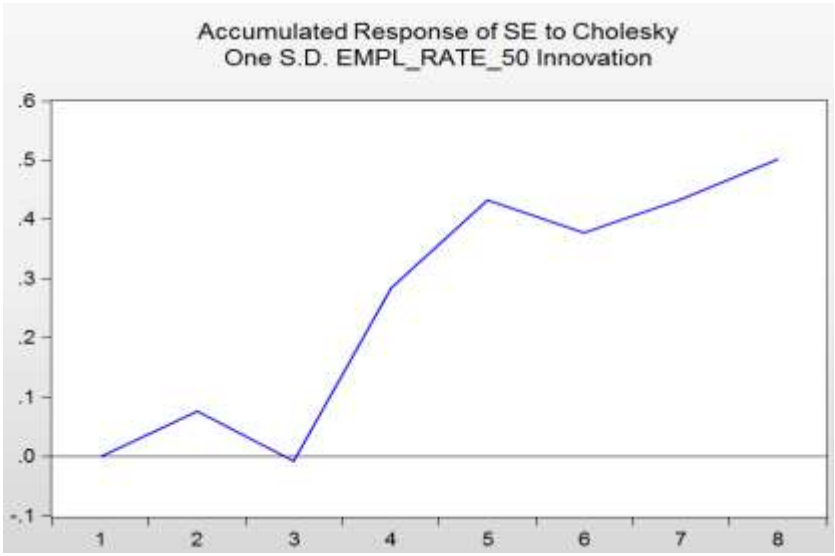

Figure 6. The effect of a shock in employment rate of older workers on the size of the shadow economy

In conclusion, we assert that there is a unidirectional positive causality relation that runs from employment rate of elderly to shadow economy, stating that the shadow economy will increase with about 0.5% at the level of the 8th quarter due to a positive shock in employment rate of elderly.

One possible explanation for the existence of a positive relationship that runs from employment rate of elderly to unofficial sector can be the low capacity of the economy to generate proper jobs, so this age group of older workers does not have qualifications that meet the needs of formal economy, and therefore shadow economy becomes an alternative to formal work and it may provide a buffer for some workers who have few alternative labor market opportunities.

Another alternative could be the fact that this age group of elderly remains occupied in the formal labor market, but with low earnings and they work in informal activities in order to supplement their income.

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Due to the fact that previously both variables were identified to be I(1), we select the maximum order of integration in the VAR system as being 1 (

$d_{\max} = 1$). Going further, due to the fact that the optimal lag was chosen to be p=3, we will further estimate an augmented VAR (4) model in order to investigate the relationship between shadow economy and employment rate for older workers.

Table 3. The Toda-Yamamoto causality results

Null hypothesis	p	MWald statistics	p-values	Decision
$k = 3$				
H_0 : Employment rate of older workers does not Granger cause shadow economy	4	4.69	0.19	Do not Reject H_0

** 1% level, respectively ** 5% level.*

The empirical results (presented synthetically in Table 3) revealed the absence of a short-run causal relationship from employment rate for older workers to the size of shadow economy, suggesting that we can't say anything about the nature of this relationship on short-run.

Conclusions and policy implications

The paper investigated the nature of the relationship between the phenomena of active ageing and the size of Romanian shadow economy expressed as % of official GDP in order to see if the shadow economy represents a social buffer for active ageing phenomena using two important causality analyses, Granger and Toda-Yamamoto, based on quarterly data over the period 2000-2010. It is important to mention that this research paper focuses on the unidirectional relationship from employment rate of elderly towards shadow economy and therefore the inverse relationship will not be further discussed.

The size of the Romanian shadow economy was previously estimated using a revised version of the currency demand approach based on autoregressive distributed lag (ARDL) approach to cointegration analysis. The size of the shadow economy was estimated to be decreasing over the analyzed period from 45% at the end of 2000 to the value of 37.4% in the last quarters of the period. The active ageing was quantified by the employment rate of older workers (50 years and over).

The cointegration empirical results highlited the existence of a positive long-run relationship between employment rate of elderly and unofficial sector, inferring that a 1% increase in the employment rate of older workers would

imply in the long-run an estimated increase of almost 0.05% in the size of the shadow economy.

The empirical causality results conclude that there is a unidirectional Granger causality that runs from employment rate of older workers to shadow economy both on long-run and short-run stating that the shadow economy will increase with about 0.5% at the level of the 8th quarter due to a positive shock in employment rate of elderly. The empirical results of Toda-Yamamoto revealed the absence of a short-run causal relationship from employment rate for older workers to the size of shadow economy.

One possible explanation for the existence of a positive relationship that runs from employment rate of elderly to unofficial sector can be the low capacity of the economy to generate proper jobs, so this age group of older workers does not have qualifications that meet the needs of formal economy, and therefore shadow economy becomes an alternative to formal work and it may provide a buffer for some workers who have few alternative labor market opportunities. Another alternative could be the fact that this age group of elderly remains occupied in the formal labor market, but with low earnings and they work in informal activities in order to supplement their income.

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