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An Empirical Analysis for the Case of Romania**

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ABSTRACT

Nature of the Relationship between Minimum Wage and the Shadow Economy Size: An Empirical Analysis for the Case of Romania

The recent increase in the minimum wage in Romania in early May 2016 represented a popular topic at the national level, which indicated that aggressive increases in the minimum wage could create a competitiveness problem in the context of a relatively high level of informal economic activities. The objective of this paper is to analyse the nature of the relationship between the minimum wage and the size of the Romanian shadow economy using quarterly data for the period 2000-2015. The MIMIC model has been used to estimate the dimension of the shadow economy, and the empirical results revealed that unemployment, self-employment, indirect taxation and a lack of trust in the government are considered the main causes of Romanian informality. The results also indicated that the Romanian shadow economy decreased until 2008 to a value of approximately 27.8% of the official GDP. During the economic crisis, a slow increase in the shadow economy occurred, whereas in recent quarters, a slow decrease was observed. The potential effect of an increase in the minimum wage on the size of the shadow economy has been analysed using the Granger causality approach with vector error correction models. The empirical results indicated that an increase in the minimum wage can be considered a long-term supporting factor for the shadow economy because it increases informal economic activities, as firms will seek alternative methods of circumventing authorities. However, the empirical results do not support any effects of an increase in the minimum wage in the short run.

JEL Classification: J31, C32, C52, O17, P48

Keywords: minimum wage, shadow economy, MIMIC model, Granger causality, Romania

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1. Introduction

The increase in the minimum wage has drawn increasing attention from policymakers in the context of the potential effects of the minimum wage, which is the subject of continued debate in the literature. An increase in the minimum wage will initially cause a loss of jobs primarily among low-skilled employees because of the greater number of individuals seeking employment at a higher salary; thus, the number of jobs will decrease, which directly affects low-skilled workers (Maloney and Mendez, 2004).

Aggressive increases in the minimum wage could create an issue with competition in the context of a relatively high level of informal economic activities. Among the main causes of the shadow economy are the poor quality of institutions, the inefficient application of tax laws, and the bureaucracy and corruption; in these areas, Romania ranks last in the EU (Schneider et al., 2010). In addition, the level of unemployment and self-employment¹ are directly related to a higher level of informality. The level of the official economy is very important in this context because a higher degree of official economic development could be associated with a decreasing level of informality (Schneider, 2005). Moreover, a rapid increase in the minimum wage could lead to the expansion of the unofficial sector.

A vicious cycle is observed in which high tax evasion leads to poor public finances, which is a primary cause of increased taxes, and a higher tax burden will lead individuals to avoid tax payments by moving to the informal sector. The minimum wage has an adverse influence on living standards through its effects on employment, earnings' structure, productivity and social cohesion.

The impact of the minimum wage on employment is mixed. For employees with salaries close to the minimum level, this type of increase will lead to higher wages; however, those with the lowest wage rates will not find jobs and will become unemployed or they will find an alternative in the informal sector. Studies by Neumark and Wascher (1992), Gindling and Terrell (2005, 2007), Neumark, Schweitzer, and Wascher (2000), Currie and Fallick (1996) and

¹ PFA(Authorised Physical Person) or those who work in agriculture.

Abowd, Kramarz, and Margolis (1999) provided empirical evidence for the negative effects of the minimum wage on employment. However, Machin and Manning (1994), Dickens et al. (1999) and Card and Krueger (1995, 2000) found a positive impact of the minimum wage when considering the work-based opportunities offered to employees, such as training and skill development, which help prevent unemployment that could be caused by a potential increase in the minimum wage. For Romania, Andreica et al. (2009) revealed a negative effect of increases in the minimum wage on employment for youth and low-skilled employees.

These controversial results may be based on the accuracy of the methodological approaches used in the analyses (time series models vs. panel data models), which present different results.

The effect of an increase in minimum wage is unclear in countries that have a high proportion of low-wage earners, a high level of informality and relatively modest law enforcement. The empirical evidence associated with the hypothesis that an increase in the minimum wage will encourage people to leave the official sector and move to the unofficial sector is mixed.

The studies by Carneiro (2004), Comola and Mello (2011), and Muravyev and Oshchepkov (2013) confirmed the validity of the previous hypothesis, whereas the research of Magruder (2013) noted that when the minimum wage was introduced in Indonesia, it took on the role of an “efficiency wage” and attracted people to the official economy and thus decreased the informal sector. In their papers, Khamis (2013) and Boeri et al. (2011) noted the effect of wage growth in the informal sector as a consequence of increases in the minimum wage in the official sector as a “lighthouse effect²”.

The main purpose of this paper is to analyse the relationship between the minimum wage³ and the size of the shadow economy in Romania by determining whether the labour market regulations (the impact of minimum wage) could lead to a significantly higher incidence of

² The lighthouse effect means that the official minimum wage is regarded as a benchmark for the entire economy and the uncovered sector.

³ In addition, the minimum wage is defined as the lowest remuneration that employers may legally pay to workers, and it is considered the price floor below which workers may not sell their labour.

informality. This relationship was investigated using vector error correction model (VECM) models, Granger causality analyses and an impulse response function for quarterly data covering the 2000-2015 period. An estimation of the Romanian shadow economy was obtained using the MIMIC model.

The term 'shadow economy' used in this paper is consistent with the definition by Schneider et al. (2010, p.3-4), who defined it as "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 certain legal labour 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." In accordance with the definition, the underground economic activities (i.e., illegal actions) and the informal household economy are not regarded as components of the shadow economy.

This paper is organized as follows. Section two presents a literature review of the main studies on the relationship between minimum wage and informality. Section three offers a short description of the institutional background of the minimum wage at the European and national levels. Section four presents the data and methodology, and section five details the most important empirical results along with the conclusions and a discussion.

2. Relationship between minimum wage and shadow economies in the literature

In the research by Tokman (2001) and Rei and Bhattacharya (2008, pp.1), informality can be considered "a form of survival through low quality and low earning occupations for individuals primarily as a result of a lack of productive employment opportunities and lack of access to the market and productive resources".

The theoretical considerations regarding the impact of the minimum wage on formal and informal sectors were captured in the literature by dual sector models, in which the size of the minimum wage fixed above the equilibrium places a limitation on the labour demand. With

increases in the minimum wage, certain workers will lose their jobs and become unemployed; thus, the informal sector can be viewed as a solution for low-skilled marginal-productivity workers at least in the short term. This situation will lead to a decline in wages and a rise in employment in both formal and informal sectors. Thus, the increase in the minimum wage can have a positive effect on the probability of becoming an informal worker (Krstic and Schneider, 2015; Hohberg and Lay, 2015).

Betcherman (2012) noted two perspectives associated with minimum wage. The first perspective relates to a “fair wage” and a social policy instrument, whereas the second implies that a minimum wage could attract employees with low productivity into the informal sector, thus negatively affecting those people who were meant to benefit from the policy. Therefore, the presumed effect of an increase in the minimum wage (at least for developing countries) is a reduction in formal employment followed by an increase in unofficial employment. The main consequence of this increase in the informal labour supply will be a decrease in the wages of this sector.

In the standard models incorporating both sectors, informal workers “were seen as the disadvantaged sector of a labour market affected by the minimum wage increase, and as consequence, some workers were forced into jobs where they earn below what they did before” (Maloney and Mendez, 2004, p.111). Analysing the situation in Brazil, Mexico, Argentina, and Uruguay, Maloney and Mendez found that the influence on minimum wage is significantly higher in the informal sector than the formal sector. In an attempt to explain the role of the informal sector, Maloney (1998, p.9) noted that it can be viewed as “a way of avoiding the inefficiencies of labour market regulations as the regulations themselves”.

Maloney and Mendez (2004) also noted that when it is not imposed by law, the minimum wage had the role of “fair remuneration”, and the absorption of official workers assigned to the informal sector becomes debatable. Such a sentiment is similar to the second hypothesis, which states that the minimum wage leads to job loss and reduces the capacity of the informal sector to absorb unemployed persons.

Although the main focus in the literature was on employment and wage effects, a number of empirical studies focused on the impact of informality. In this context, the optimal level of minimum wage must be determined by considering the negative effects that a very large minimum wage could have on the labour market. Moreover, the extent of the benefit provided by the minimum wage must be determined if it is proposed as a policy measure to help poor people. Relatively few empirical studies have focused on the effects of the minimum wage on the informal sector.

The empirical evidence in the literature related to the potential effects of the minimum wage on wages and employment in the informal sector is mixed and accompanied by a certain amount of ambiguity. Most of the studies have been formalised in Latin America using dual models based mainly on kernel density and cumulative distribution techniques.

Packard, Koettl, Montenegro (2012) and Hazans (2011) noted that the manner in which the minimum wage affects informal work is very different among EU countries. For new member states and southern economies, the effect is positive and leads to an increase in the proportion of workers without contracts. For the older EU countries, the effect is negative, and an increase in the minimum wage leads to a decrease in employment without a contract, with the minimum wage having the role of an “efficiency wage”, which entices employees back to formal jobs.

Studies by Neri (1997), Muravyev and Oshchepkov (2013), Maloney and Mendez (2004) and McIntyre (2002) confirmed that an increase in the minimum wage will augment the incidence of the informal sector. As Carneiro and Henley (2001) previously noted, in a country with a relatively small level of social security, individuals choose to have informal jobs that pay less than official jobs instead of remaining unemployed.

Gindling and Terrell (2002) highlighted that the main reaction to increases in the minimum wage in Costa Rica was an increase in the number of full-time labourers (by increasing the working time of certain part-time employees and dismissing other employees). These dismissed workers may be drawn towards the informal sector, where the increase in the supply leads to a decrease in the wages of the sector.

Studies by Lemos (2004), Fajnzylber (2001), Khamis (2013) and Carneiro (2000) quantified the effects on wages and employment in both official and unofficial sectors and revealed significantly greater effects in the unofficial sector than in the official sector and mixed effects on employment, which was negative for both sectors. This finding was highlighted by the results of Fajnzylber (2001) and Lemos (2004). The negative effects observed for the official sector and the positive effects observed for the unofficial sector were emphasized by the findings of Carneiro (2000) and Khamis (2008).

Muravyev and Oshchepkov (2013) revealed that in Russia, increases in minimum wage can be related to increases in youth unemployment and the proportion of individuals who are trapped in the informal sector. Another interesting result was the relatively quick response of the labour market to a shock in the minimum wage: after only one-quarter, the effects were attenuated. Dinkelman & Ranchhod (2012) analysed the impact of the minimum wage on domestic workers and revealed that in South Africa, domestic workers earn less than the minimum wage. Borat et al. (2013) also analysed other sectors (retail, security and forestry) and observed a positive impact on wages.

The empirical results obtained by Hohberg and Lay (2015) for Indonesia revealed that the minimum wage has a direct impact on formal sector wages and no effect on informal workers.

Fialová and Schneider (2011) found a negative association with informal production, highlighting the role of the fiscal channel of minimum wage; thus, growth in the minimum wage could constrain firms and employees to a higher degree of tax compliance when declaring their revenues.

In short, most studies emphasized negative effects of the minimum wage on formal employment and found that the influence of the minimum wage on the informal sector varied considerably between EU countries. An increase in the minimum wage most likely leads to an increase in the informal sector, at least for new EU member states and southern countries. A legislated minimum wage increases the labour costs for companies; in addition, the most affected group will be workers with low productivity, who are mainly young and low-skilled

workers who will encounter difficulties finding a formal job. These individuals will either become unemployed or will move into the informal sector.

For the longer-tenured EU countries, the potential impact is the opposite, with the minimum wage playing the role of an “efficiency wage” and attracting workers into formal jobs.

3. Minimum wage at the European level and national level

Nearly all EU countries have a form of minimum wage that was established by the authorities or through a bargaining process between employers and trade unions. According to ILO (2004), “the national minimum wage applies to all employees, without taking into account the self-employed and unpaid family members.”

On 1 January 2016, 22 EU countries and five⁴ candidate states had a national minimum wage, whereas only five countries did not have such a labour regulation (Denmark, Sweden, Finland, Austria and Italy). Significant variations are observed between member states regarding the amount of the minimum wage, which ranges from 215 EUR for Bulgaria to 1923 EUR for Luxembourg.

An analysis of the values at the 2016 level shows that the countries can be classified as follows: countries with minimum wages lower than 500 EUR per month (Albania, Republic of Macedonia, Montenegro and Serbia as candidate countries and Bulgaria, Romania, Lithuania, Hungary, the Czech Republic, Latvia, Slovakia, Croatia, Estonia and Poland as members), with Romania occupying fourth place in this low minimum wage group at a value of 233 euro per month (Figure 1); countries with minimum wages below 800 EUR per month (Turkey, Portugal, Greece, Malta, Spain and Slovenia); and minimum wages above 1000 EUR per month (France, Germany, Belgium, the Netherlands, the United Kingdom, Ireland and Luxembourg).

Considering the price levels, the differences between countries are much more salient. The group of countries with low minimum wages tends to have higher wages expressed in PPS

⁴ Turkey, Serbia, Montenegro, Albania and Former Yugoslav Republic of Macedonia.

because of low price levels, whereas the countries with high minimum wages tend to have lower minimum wages expressed in PPS⁵. The monthly minimum wages range from 445 PPS in Romania to 1597 PPS in Luxembourg. As previously stated, Romania is within the low minimum wage country group, with the value of 445 PPS (appendix C).

Figure 1 [insert here]

An analysis of the ratio of minimum wage as a percentage of the average gross monthly earnings in 2014⁶ across the EU member states shows that the highest values occur for Slovenia (51.3%), Greece (50.1% in 2011) and Turkey (50% in 2010). In contrast, the Czech Republic and Spain reduced the level of their minimum wage to below the threshold of 35% of average earnings. Romania is much closer to these countries and presented a proportion of mean gross monthly earnings of 38.5% in 2014. In terms of increases, Romania exhibited the largest increase in the percentage during the period 2008-2015 (95%) and was followed by Bulgaria (64%), Slovakia (58%) and Lithuania (57%). However, with all this growth, Romania had the second lowest wages in the EU in 2016 after Bulgaria. After the government-implemented increase in the minimum wage from 1050 to 1250 lei starting on 1 May, Romania will remain second from the bottom of the table after Lithuania, which has a level of 300 euros (appendix D).

At the national level, the minimum wage level was established by Government Decision no. 1017/2015 after consultation with trade unions and employers. Government decisions and minimum wage fluctuations are presented in appendix B.

According to a Romania Country Report (2015, p.20-21), “wage growth has been moderate but uneven, with the wage distribution becoming increasingly compressed at the bottom due to strong increases in minimum wages. It has been increasing sharply since 2012 and is expected to reach close to 48% of average gross earnings at the end of 2016.”

⁵ Main source is the Earnings Database of Eurostat.

⁶ The main reason for selecting this year was the lack of available data for the last two years 2015 and 2016.

Approximately 2.4 million Romanian workers representing 40% of total active employees received the minimum wage or less in 2015. Of these workers, 1.6 million were full-time workers, and 0.8 million were part-time workers. If the wage achieves 46% of the gross average earnings, it will not have the capacity to guarantee the minimum standard of living for employees. A portion of these workers is paid at the minimum wage or less to avoid a tax payment to authorities.

Figure 2 [insert here]

Since 2000, the minimum wage has increased constantly yearly or several times per year. Figure 2 shows the evolution of the nominal and real minimum wages for the period 2000-2016. Both the nominal and real minimum wages have followed a consistent upward trend with short periods of stagnation in real terms (the period 2009-2010 highlighting the impact of the economic crisis).

An analysis of the evolution of the real and nominal minimum wages for the period 2000-2016 shows that in nominal terms, the minimum wage increased by twenty times in 2016 compared with 2000. In real terms, the wage increased by nearly 5 times.

To clarify the growth of the minimum wage during the analysed period, it worth examining the ratio of the minimum wage to the average gross earnings.

A steady increase was observed in the average gross earnings to a value of 39.6% in the first quarter of 2003, and it declined sharply to 24.7% at the end of 2007. Starting from 2008, the ratio of the minimum wage begins to increase slowly, registering a value of 38.6% at the end of 2015, with a value of 48% the average earnings expected at the end of 2016. The government has proposed to increase the minimum wage to 1400 RON at 1 January 2017. Currently, the introduction of an adjustment mechanism for the minimum wage that relates the value to productivity or economic growth has been discussed. However, the unions claim that in such a mode, any increase will be relatively small because the minimum wage amount does not have the capacity to guarantee a minimum standard of living of employees. Conversely, employers highlighted that these increases will lead to employment loss.

Policymakers are concerned about this negative effect associated with raising the minimum wage because it is likely to affect the competitiveness level, business environment, taxation and, informal sector.

The minimum wage does not follow a transparent mechanism and is based more on hidden interests (electoral interests). Furthermore, increases in the minimum wage that are not connected to economic growth and labour market performance have created additional pressure on wage distribution by pushing low-skilled and youth workers into unemployment or informality.

4. Data and methodology

To estimate the effect of the minimum wage on informality, quarterly data for the period 2000Q1-2015Q2 have been used. The MIMIC structural equation model has been used to determine the size of the Romanian shadow economy (SE). Using this model, the SE is considered “a latent variable, related on the one hand to a number of observable indicators (reflecting changes in the size of the SE) (the measurement model) and on the other hand to a set of observed causal variables considered the main determinants of shadow activity (the structural model)” (Dell’Anno, 2003; Dell’Anno and Solomon, 2007; Dell’Anno, Gomez and Pardo, 2007).

In an estimation of the Portugal SE, Dell’Anno (2007) noted the following the mathematical specification of the MIMIC model:

$$Y = \lambda\eta + \varepsilon \tag{1.1}$$

$$\eta = \gamma X + \xi \tag{1.2}$$

where η is the size of the SE; $Y' = (Y_1, \dots, Y_p)$ is the vector of indicators; $X' = (X_1, \dots, X_q)$ is the vector of causes; $\lambda_{(p \times 1)}$ and $\gamma_{(q \times 1)}$ are vectors of parameters; and $\varepsilon_{(p \times 1)}$ and $\xi_{(p \times 1)}$ are vectors of scalar random errors.

For Romania, in the process of estimating the size of the SE, we have considered the following: fiscal regime and its components (direct taxes, indirect taxes and social

contributions), government consumption as a % of GDP, government employment as the ratio of labour force, part-time employment as a ratio of total employment, unemployment rate, self-employment and perception indices⁷ (particularly, regulatory quality and rule of law).

We used three indicator variables: the real gross domestic product index (2005=100), the currency ratio C/M_1 and the labour force participation rate. The data sources are Eurostat databases, monthly bulletins of the National Bank of Romania and the Tempo database of the National Institute of Statistics.

The series exhibiting seasonality have been seasonally adjusted using the Census X-13 method. The non-stationarity of the series has been tested using unit-root tests (ADF and PP tests). The empirical results revealed that the series are $I(1)$, and they have been differenced to achieve stationarity.

Several specifications of the model were estimated in STATA 13 because certain causal variables cannot be simultaneously included in the model, as they are highly correlated.

As the estimation method, we used the robust maximum likelihood⁸ method because the results of Mardia (1970), Doornik–Hansen (2008) and Henze–Zirkler’s (1990) revealed a rejection of the hypothesis of multivariate normality.

To estimate the model, in accordance with Giles and Tedds’ (2000) perspective, we normalized the index of the real GDP to -1, which implied that an inverse relationship occurs between the official economy and the SE.

The optimal model is a 4-1-2 MIMIC model in which the main drivers of SE are the unemployment rate, self-employment, indirect taxation and regulatory quality, and the presence of SE is best reflected by increases in currency reported to the monetary aggregate M1.

⁷ In the model, we have also included other perception indices (economic freedom, freedom from corruption, fiscal freedom, labour freedom, rule of law, government effectiveness, and control of corruption); however, their coefficients were not statistically significant.

⁸ The main advantage is that it offers the same parameters as the ML estimates, although the standard errors are corrected.

Indirect taxation has a significant influence on the size of the SE, and the significant positive sign of the unemployment rate highlighted that the SE is considered a “buffer” for the official economy. As a portion of the ‘officially’ unemployed move to the informal sector to supplement their earnings, Dell’Anno and Solomon (2007) stated that “there is a flow of resources from the official sector to the SE in recession cycles”. The sign reveals the significant impact of self-employment on the SE because these individuals have various opportunities to avoid paying taxes.

The regulatory quality index has an expected negative sign, which revealed that a high level of the official economy was associated with a higher quality of regulations.

According to Razmi et al. (2013, p.5), “institutional instability, lack of transparency and rule of law undermine the willingness of frustrated citizens to be active in the formal economy. Citizens will feel cheated if they believe that corruption is widespread, their tax burden is not spent well, their government lacks accountability and that they are not protected by the rules of law, increasing the probability to enter the informal sector.”

The empirical results revealed that at the beginning of 2000, the size of the SE was 36.5% and followed a declining trend, with a value of 27.8% at the end of 2008, which is considered the beginning of the economic crisis in Romania. From this point forward, the size of the SE followed a slow increase at nearly 30.2% of the official GDP in the third quarter of 2010. Until the beginning of 2011, the size of the SE decreased slowly, whereas from 2011 to the end of 2013, we noted a slowly increasing trend. For recent quarters, a slowly decreasing trend can be highlighted, and the ratio of the unofficial economy was 29% of the official GDP in 2015.

A detailed presentation of the estimation process can be found in the working paper by Davidescu and Schneider (2016).

Furthermore, we expressed the SE as the natural logarithm of the real SE activity per capita⁹ divided by CPI (2005=100) for the first model and SE activity per capita % of GDP per capita for the last two.

⁹ by dividing it to the total population (15 years and over).

For the minimum wage, we used three proxies: the log of the real monthly minimum wage¹⁰ (RON per capita), the minimum wage as a ratio of average gross earnings (%) and the minimum wage as a ratio of GDP per capita (%).

We also considered the potential impact of the unemployment rate, the employment rate, the proportion of people having second jobs (% of total employment), the part-time employment as a ratio of total employment, the proportion of workers with temporary contracts (% of employment), the inflation rate, the real labour productivity per hour worked, the index 2010=100 and a series of dummy variables: d1, the introduction from the second quarter of 2011 of a Labour Code amendment (a collective labour agreement was eliminated, and undeclared work was criminalized); and d2, the impact of the economic crisis (from 2010Q3-2013Q1, salaries in the public sector decreased by 25%; from 2010Q3, the VAT increased from 19% to 24% until 1st January 2016, when the VAT decreased to 20%). The series has been seasonally adjusted using the Census X13 method.

The Tempo database of the NIS and quarterly databases¹¹ of Eurostat have been used as data sources.

To quantify the potential effect of the minimum wage increase on the size of the SE, we used the Granger causality under VECM models, and the following econometrical techniques analysis of non-stationarity tests, Johansen cointegration test, VECM models, and Granger causality method with the impulse response function.

The unit-root tests ADF and PP were used to identify the order of integration of the variables. Furthermore, the occurrence of long-run relationship has been tested using a VAR model in level to determine the optimal lag length using informational criteria such as the AIC or SCH to assure the absence of a serial correlation in the residuals. If the variables are not cointegrated, a VAR model in difference must be estimated, and the Granger causality will be tested under the results of this model.

¹⁰ It was obtained by dividing the nominal monthly minimum wage (RON) to CPI (2005=100).

¹¹ Employment and unemployment and consumer price index

If the variables have the same order of integration and are cointegrated, then a cointegrated VAR model incorporating an error correction mechanism must be estimated.

According to Johansen (1991) and Lütkepohl (2007), “the vector error correction model (VECM) restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The cointegration term is known as the error correction term because the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments and indicates the speed of adjustment of the model from the short run to the long run.”

The estimated VECM can be defined as follows¹²:

$$\Delta X_t = \mu + \Gamma_1 \cdot \Delta X_{t-1} + \dots + \Gamma_{p-1} \Delta X_{t-p+1} + \Pi \cdot X_{t-1} + \varepsilon_t \quad (1.3)$$

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 a $(n \times n)$ 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 contains the r cointegrating vectors; and Γ denotes a $(n \times n)$ matrix of coefficients and contains information regarding the short-run relationships among the variables. The Granger causality has the following form:

$$\Delta Y_t = C_0 + \sum_{i=1}^p \beta_i Y_{t-i} + \sum_{i=1}^p \alpha_i X_{t-i} + p_i ECT_{t-1} + u_t \quad (1.4)$$

$$\Delta X_t = C_0 + \sum_{i=1}^p \gamma_i X_{t-i} + \sum_{i=1}^p \zeta_i Y_{t-i} + \eta_i ECT_{t-1} + \varepsilon_t \quad (1.5)$$

where p_i, η_i is the adjustment coefficient, and ECT_{t-1} is the error correction term.

¹² Adam, Tweneboah (2009), Samimi, Tehranchian, Roshan (2010), Chimobi and Uche (2009), Anastassiou, Dritsaki (2005).

Within a VECM model, both long-run and short-run causalities can be observed. To confirm whether long-run Granger causality occurs, the ECM coefficients must be negative and statistically significant in terms of the t-test. The short-run Granger causality is confirmed when the lagged coefficients are jointly statistically significant in terms of the Wald Test or the F-test. We can state that in eq. (1.4), X Granger causes Y if α_i is significantly different from zero, and Y Granger causes X in eq. (1.5) if ζ_i is significantly different from zero. After the Granger causality has been confirmed, Pesaran and Shin (1998) generalized impulse response functions have been used to measure the effect and the time lag of a shock in the minimum wage on the Romanian informality.

5. Empirical results

An analysis of the changes of the indicators during the period 2000-2015 shows that a co-movement relationship occurs between the real minimum wage and real SE per capita and between the minimum wage as a % of GDP per capita and SE as a % of GDP per capita (Figure 3).

Figure 3 [insert here]

Figure 4 [insert here]

To analyse the potential impact of the minimum wage on informality, the first step is to analyse non-stationarity according to the ADF and PP tests, which revealed that the variables are non-stationary at their levels and integrated to order one, $I(1)$.

Then, we investigated whether a long-run relationship occurred between these variables using the multivariate Johansen cointegration test under a VAR model at level. We selected the optimal lag length using the informational criteria AIC and SBC and considering the stability condition and the hypotheses of residuals (non-autocorrelation, homoscedasticity and

normality). According to the information criteria, for all three models, the optimal lag length was 1.

The empirical results of the cointegration test revealed the presence of a long-run equilibrium relationship between the real minimum wage and the real SE per capita (model 1) and between the minimum wage as a % of average gross earnings and the minimum wage as a % of GDP per capita and the SE as a % of GDP per capita (model 2 and model 3), respectively.

Based on the occurrence of a cointegration relationship, we estimated three VECM models for each proxy of the minimum wage.

Several specifications for each model have been tested, with the optimal specification quantifying the impact of the minimum wage on informality in the presence of the official economy.

Table 1 [insert here]

In the first model, the long-run coefficient of minimum wage is positive and statistically significant at 1%, which indicates that if the minimum wage increased by 1%, the size of the informality per capita will increase by 0.14% in the long run, ceteris paribus. The negative long-run relationship between the official and unofficial economies quantified by the coefficient -0.61 indicates that both sectors are substitutes in the long run and the SE can be considered a buffer or a safety valve for the official sector. When the official economy decreases, the activity in the informal sector should increase.

Most short-run coefficients do not reveal statistical evidence because the minimum wage does not impact informality in the short run. However, in the short run, both economies are more likely to represent complements rather than substitutes with a positive relationship.

The error correction term is negative and highly significant, which indicates that causality occurs in at least one direction. The term's value of -0.36 indicates that deviation from the

long-term equilibrium is restored by 36% each quarter. The model is well-specified in terms of the F-test, and the degree of determination is 29.9%.

The Granger causality analysis was tested using the VECM model. For model 1, we only identified a long-run unidirectional Granger causality that runs from the real minimum wage to the shadow activity per capita (t-ratio of the ECT is statistically significant at 1% and negative). The short-run causality has been infirmed because of the lack of significance of the F-test.

In the second model, the long-run coefficient of the minimum wage is positive and statistically significant at 1%, which reveals that if the ratio of the minimum wage in average gross earnings increases by 1%, the size of informality as a % of GDP per capita would increase by 0.15% in the long run, ceteris paribus. The negative long-run relationship between the official and unofficial economies shows that both sectors are substitutes in the long run.

The short-run estimates indicate a potential relationship between the minimum wage and SE as well as between both sectors. The long-run causality was confirmed by the negative sign and the significance of the error correction term, meaning that the SE converged to its long-run level by the contribution of the minimum wage and the official economy at 50% of the speed of adjustment.

The model is well-specified in terms of the F-test, and the degree of determination is 24.6%. A long-run Granger causality was identified from the minimum wage as an average gross earnings ratio to the SE as a % of GDP per capita because the error correction term is negative and statistically significant. The short-run causality was disproven because of the lack of significance of the F-test.

In the last model, the long-run coefficient of minimum wage is positive and statistically significant at 1%, which indicates that an increase in the minimum wage by 1% of GDP per capita will increase the size of informality as a % of GDP per capita by 0.56% in the long run, ceteris paribus. The negative long-run relationship between the official and unofficial economies shows that both sectors are substitutes in the long run.

The short-run estimates indicate a potential relationship between the minimum wage and SE as well as between both sectors. The long-run causality was also confirmed for this last model, with the SE converging to its long-run level by 47% of the speed of adjustment.

The model is well-specified in terms of the F-test, and the degree of determination is 26.6%. The negative sign and the significance of ECT confirm the presence of a long-run Granger causality running from the minimum wage to the SE as a % of GDP per capita. The short-run causality has been disproven because of the lack of significance of the F-test. In all models, the hypotheses on the residuals have been validated. The dummy variables do not present any impact on the size of the informality in Romania.

Table 2 [insert here]

We applied the generalized impulse response functions of Pesaran to measure the effects on informality of a shock in the minimum wage. The empirical evidence is presented in Figure 5. The results presented in the first line suggest that the real SE per capita will increase by approximately 0.86% with a 1% increase in the real minimum wage shock, and the shock will achieve its full potential at the level of the fourth quarter; thereafter, the trend flattens. The second figure presents the effects on the SE of a one S.D. shock increase in the minimum wage as a % of the average gross earnings, and the results also reveal that the SE will increase by 0.18% in the third quarter level under a 1% shock in the minimum wage. Subsequently, the trend flattens.

A positive shock in the minimum wage as a % of the official GDP per capita leads to an increase of 0.31% in the size of the SE as a % of GDP per capita manifested in the fifth quarter; then, the trend flattens.

Overall, the empirical results showed that in the long run, the minimum wage has a positive and statistically significant impact on the size of the SE; however, in the short run, the empirical results do not support an effect of the minimum wage.

The empirical results revealed that a negative relationship occurs between official and unofficial economies for all three models, thus highlighting that the informal economy could

represent a buffer for certain periods of time and certain categories of individuals (young or low-skilled workers).

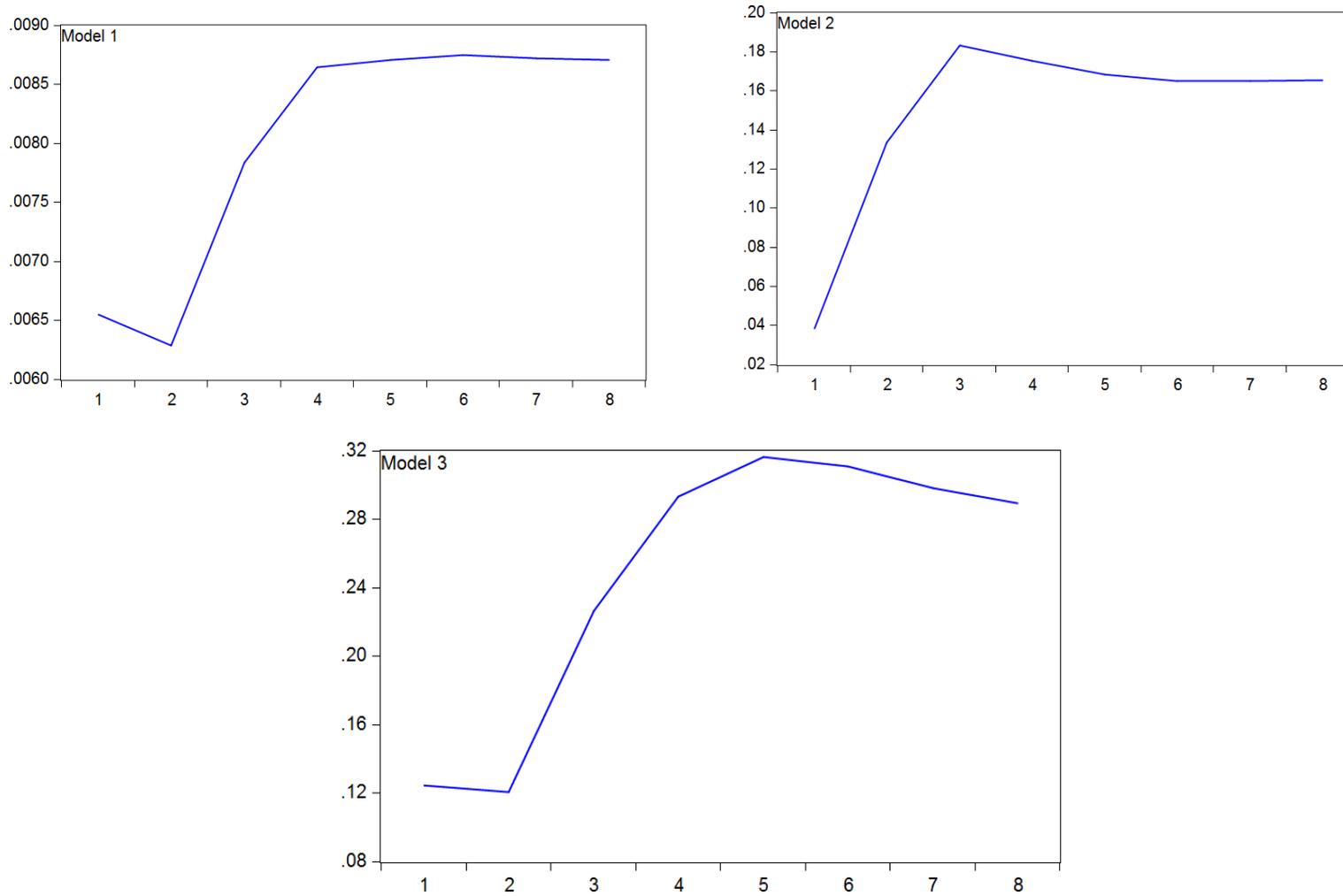


Figure 5. Generalized impulse responses of informality to one S.D. shock in the minimum wage

6. Discussion and conclusions

The main objective of this paper was to measure the effects of the minimum wage on Romanian informal activities based on the sharp increases in the minimum wage observed in the recent periods and the new increase planned by the government for January 2017. In this context, the impact of an increase in the minimum wage must be determined because although it is proposed a social policy instrument, such an increase will create additional pressure on wage distribution and push low-skilled and youth workers into unemployment or informality.

The size of the SE was estimated using the MIMIC model, and the empirical results reveal that unemployment, self-employment, indirect taxation and lack of trust in government can be considered causes of Romanian informality. The figures mainly show a decreasing trend over the period, with a slight reverse trend.

The empirical results of the effect of the minimum wage on informality show that an increase in the minimum wage can be regarded as a long-term supporting factor for the SE; i.e., an increase in the minimum wage will lead to an increase in informal economic activities because firms will seek alternative methods of circumventing authorities. However, in the short run, the empirical results do not indicate an effect of increasing the minimum wage.

The results of this study are consistent with the results of most similar studies in the literature, which emphasized the role of minimum wage as a supporting factor of shadow activities.

The empirical results also revealed a negative relationship between official and unofficial economies, highlighting that the informal economy could act as a buffer for certain periods of time and certain categories of individuals (young or low-skilled workers). Furthermore, the main focus should be on encouraging economic growth and increasing the attractiveness of the official economy for individuals who will return to the formal sector.

Policy recommendations for reducing the incidence of informal activities include refining the taxation structure and labour regulations, improving incentives offered to low-wage earners, establishing and strengthening the trust of people in government and increasing tax

compliance. These types of measures could help authorities improve the formalization of the SE in countries like Romania.

Formulating labour market policy guidance to create a balance between the degree of regulations (minimum wage) and the size of shadow activities could be very risky, and the risk increases when minimum wage increases do not follow a transparent mechanism and are inconsistent with the evolution of the labour market.

Nevertheless, the following recommendations provide a mix of incentives for both firms and workers:

- introduce a lower minimum wage for young people that considers the risk of reducing the attractiveness of the work but also the advantage of stimulating their employment;
- maintain the minimum wage for low-skill jobs at a low level relative to average wages to assure the social role of the minimum wage;
- improve and increase the amount of subsidies received by employers who engage unemployed persons; and
- introduce a tax exemption for those employees who are at or near the minimum wage and reduce labour costs for those employers who have workers who earn at levels close to the minimum wage.

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*** Stata 13 software

APPENDIX A.The description of minimum wage in Romania

Romania	
<i>Method of fixing the national minimum wage</i>	The national minimum wage is set by law at national level, after the government had consultations and negotiations with social partners.
<i>Year of introduction</i>	1949 according to the Ministry of Labour, Family and Social Protection statistics (http://www.mmuncii.ro)
<i>Coverage</i>	<p>All sectors.</p> <p>All employees (monthly rate applied to full-time employees).</p> <p>The monthly rate is set for a full-time working program representing an average of 168.667 hours worked per month (for year 2015, months January - June representing 5.781 lei/hour and months July - December representing 6.225 lei/hour).</p> <p>The working hours depend on the contractual working time (full-time or part-time), but a minimum of hours per day or month is not stipulated by law.</p> <p>According to the national labour law the employees working full-time have a normal working time of 8 hours/day and 40 hours/week. In the case of employees under 18 years old, the normal working time is 6 hours/day and 30 hours/week.</p> <p>There are no differentiations for sub-groups.</p> <p>There is no Minimum threshold of hours paid per month for part-time employees.</p> <p>Gross wages are reported.</p>
<i>Exceptions</i>	No
<i>Methods for updating</i>	The frequency is usually annual. The updating mechanism is through government decisions, after consultations and negotiations with social partners.
<i>Taxes, social contributions</i>	Social contributions are deducted from the gross minimum wage (individual contributions for unemployment, social-security and health care schemes) and also taxes.
<i>Type of rate</i>	Monthly
<i>Conversion rule</i>	None
<i>Latest rate shown in force since</i>	1.7.2015
<i>National website</i>	http://www.mmuncii.ro/j33/images/Date_lunare/s1-15.pdf

Source: Eurostat, Minimum wage statistics

APPENDIX B. NATIONAL MINIMUM GROSS GUARANTEED WAGE, 2000-2016

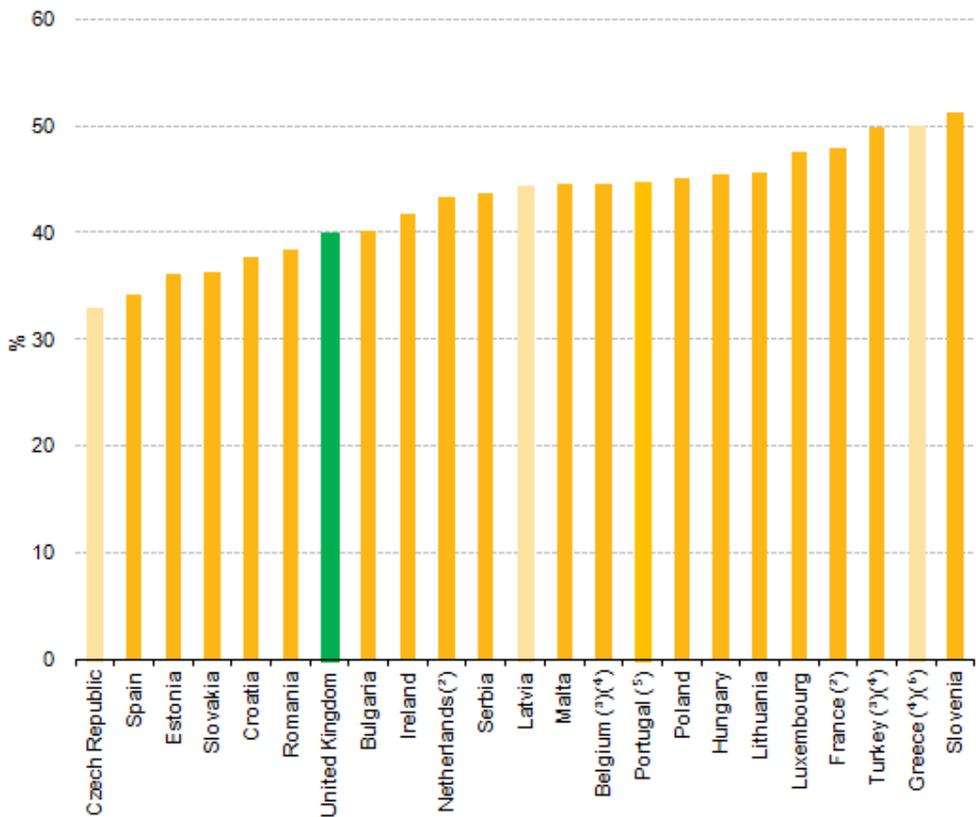
Starting date	Value in lei	Value in EUR/ECU	Legislation
1 May 2016	1250 RON	275€	HG 1017/2015  ^[1]
1 July 2015	1050 RON	236€	HG 1091/2014  ^[2]
1 January 2015	975 RON	216€	
1 July 2014	900 RON	205€	HG 871/2013 ^[3]
1 January 2014	850 RON	189€	
1 July 2013	800 RON	179€	HG 23/2013 ^[4]
1 February 2013	750 RON	171€	
1 January 2012	700 RON	155€	HG 1225/2011 ^[5]
1 January 2011	670 RON	159€	HG 1193/2010 ^[5]
1 January 2009	600 RON	142€	HG 1051/2008 ^[6]
1 October 2008	540 RON	142€	HG 1051/2008 ^[7]
1 January 2008	500 RON	140€	HG 1507/2007 ^[8]
1 January 2007	390 RON	114€	HG 1825/2006 ^[9]
1 January 2006	330 RON	90€	HG 1766/2005 ^[9] ^[10]
1 January 2005	310 RON	85€	HG 2346/2004 ^[10]
1 January 2004	2,800,000 ROL	70€	HG 1515/2003 ^[11]
1 January 2003	2,500,000 ROL	65€	HG 1105/2002 ^[11]
1 March 2002	1,750,000 ROL	62€	HG 1037/2001 ^[12]
1 March 2001	1,400,000 ROL	56€	HG 231/2001 ^[13]
1 December 2000	1,000,000 ROL	45€	HG 1166/2000 ^[14]
1 February 2000	700,000 ROL	39€	HG 101/2000 ^[15]
1 May 1999	450,000 ROL	28€	HG 296/1999 ^[16]

APPENDIX C. Minimum wages, January 2016(PPS per month)

		(PPS per month)
GROUP 1	Albania	329
	Romania	445
	Bulgaria	449
	FYR of Macedonia (²)	458
	Serbia	480
GROUP 2	Montenegro (³)	519
	Latvia	528
	Lithuania	557
	Czech Republic	564
	Estonia	569
	Slovakia	597
	Croatia	618
	Hungary	625
	Portugal	756
	Poland	792
	Greece	800
	Spain	828
	Malta	900
	Turkey	947
	Slovenia (³)	968
GROUP 3	United States	1,028
	United Kingdom	1,133
	Ireland	1,265
	France	1,361
	Netherlands	1,373
	Belgium	1,382
	Germany	1,451
	Luxembourg	1,597

(1) Estimates. Denmark, Italy, Cyprus, Austria, Finland and Sweden: no national minimum wage.
(2) January 2015
(3) July 2015.
Source: Eurostat (online data code: earn_mw_cur)

APPENDIX.D.



Source: Eurostat, Earnings Database

Fig.1.The distribution of proportion of minimum wages by EU countries in 2014