Busting the Myth: 
The Impact of Increasing the Minimum Wage

The Experience of Romania

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Abstract

This paper discusses the impact of a gradual, pre-announced significant increase of the minimum wage during 2013–16 in Romania. The main finding is that the positive effects prevail when the starting level of increase in the minimum wage is very low and the economy is in a negative output gap. Evidence shows that employment has increased, mainly at the minimum wage level, therefore making a shift toward a more balanced wage distribution. This measure might have contributed to a decrease of the shadow economy and a decrease in the share of people at risk of poverty. The impact on inflation was very limited, and the impact on the public budget was positive. Moreover, firms’ profits were not affected, as the negative impact of the measure on unit labor costs and exports was limited.

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Busting the Myth: The Impact of Increasing the Minimum Wage: The Experience of Romania¹

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1. Introduction

The prevalent view in the mainstream literature regarding the role of minimum wage and the impact of minimum wage increases has followed for decades the view expressed by Friedman (1962): “it increases poverty and it makes unemployment higher than it would normally be”. The main arguments, as summarized by Agenor (2004), are that the minimum wage represents an “implicit tax on employers in the formal economy, leading to labor reallocation and unemployment”; moreover, “a high minimum wage level raises the relative cost of employing unskilled workers, thus accelerating the substitution of unskilled labor and reducing profits, which in turn reduces firms’ investment capacity”.

The theoretical support for the minimum wage, on the other hand, is rather shy and based on inconclusive empirical analysis on the impact of the minimum wage on unemployment or profits. In the Keynesian paradigm, there is no direct link between wages and unemployment. Keynes’ argument (1936) is that a change in some wages primarily affects the distribution of the aggregate real wage between different labor groups, and not its average amount per unit of employment. Piero Sraffa’s argument (1960) in the academic Cambridge-Cambridge debate on the minimum wage was that a new structure of relative prices would lead to new technology choices of firms, which cannot be predicted.

In recent years, more empirical analysis added to the debate, with mixed results. This paper contributes to this debate, providing evidence from Romania, an emerging economy member of the European Union. While we make no attempt to extrapolate the results for other economies, we are able to bust the myths regarding the negative impact of minimum wage raises, in particular when the starting level is very low and when the economy is in the negative output gap cycle.

Our research is focused on a specific episode of minimum wage increase: the period 2013-2016. This period has three specificities: 1. the minimum wage doubled in only four years; 2. the minimum wage increases were pre-announced and gradual, part of the government’s program; 3. the minimum wage increases in the first years of the above-mentioned period were agreed with the international financial institutions (IMF, World Bank) and the European Commission, as the country was in a financing agreement with them (which ended in the fall of 2015). Therefore, the gradual, pre-announced minimum wage increases were part of the Letter of Intent and Memorandum of Understanding with the IFIs in the period 2013-2014 (June 2013 – Letter of Intent, March 2014 – Letter of Intent). Further minimum wage increases, in particular after 2016,
are not the subject of this paper. However, a word of caution is needed, since the minimum wage increases between 2013 and 2016 were large enough to shift the wage distribution (as we will show in this paper). In particular after the negative output gap was closed in 2016, further minimum wage increases need to be carefully tailored.

The remaining of the paper is structured as followed. Section 2 provides a brief literature overview. Sections 3-9 analyze the impact of minimum wage increases on average wage and wage distribution, growth and inflation, employment, shadow economy, firms’ competitiveness, and the general budget. The last section concludes.
2. Literature review

There is an extensive body of literature investigating the impact of the minimum wage on the economy. The opinions about its effects are usually seen either as a necessity to prevent exploitation of the low skilled labor and address income inequality, or as an artificially imposed price that creates excess labor supply and hence unemployment.

Most of these studies were conducted especially for the labor markets of advanced economies, such as the United States, the United Kingdom, Germany or Canada. New Zealand and Australia are the pioneers of the minimum wage policy. The literature on the impact of the minimum wage policy has significantly improved in the past years even for developing countries, where labor markets are more heterogeneous and conclusions about the positive and/or negative effects of such measures are even more difficult to be drawn.

Some empirical evidence based on US data suggests that an increase of the minimum wage leads to a decrease in employment. Brown, Gilroy and Kohen (1982) identified large negative effects for teenage workers, and still negative, but much smaller effects for young adult workers. Deere, Murphy, and Welch (1995) found that the 1990-91 increase of minimum wage by 27% reduced employment for all teenagers by 7.3% and for black teenagers by 10%. Burkhauser, Couch, and Wittenberg (2000) documented a decline in employment of 2% to 6% for each 10% increase in the minimum wage. Even the United States Joint Economic Committee surveyed all empirical research on the employment effects of minimum wage available in 1995 and concluded that a 10% increase in the minimum wage reduced teenage employment by 1% to 3%. Later on, these conclusions were shared by Neumark and Wascher (2013), but with a smaller effect for the young workers.

Some other studies did not find any negative effects on employment or even documented slightly positive effects. There is the well-known study by Card and Krueger (1994), based on survey data for New Jersey and Pennsylvania. Michl (2000) and later Allegretto et al. (2011) also confirmed these conclusions.

A World Bank study from 2001 (Maloney et all) provides an empirical model based on the Colombian economy which shows that such a measure can have an important impact on wage distribution in the neighborhood of the minimum wage and that the effect is much stronger in Latin America than in the United States. The results were that the minimum wage policy affects
the labor market in a substantial way by increasing rigidities, but it also influences the informal sector, by strong lighthouse effects (the “Efeito Farol”). This last remark was also noted by Neri, Gonzaga and Camargo (2000).

Carpio and Pabon (2014) found that the evidence of the effects of the minimum wage on employment, poverty and inequality is mixed. In some cases, the measure leads to layoffs of low productivity workers, but in some others, the effects were minimal due to “low compliance with the law and because large segments of people work outside the reach of labor law”. They also mention that “moderate changes in the minimum wage level, aligned with key economic variable, can limit the negative impacts and lead to positive impacts from minimum wages” and that when setting minimum wage “it is best to have a clear formula that avoids excessive rigidity (…) and it is easy for all stakeholders to understand and apply”. Using a transparent adjustment process (with a pre-set formula) in the Republic of Korea is found not to have any negative employment effects, since the absence of discretion the policy makers have in setting minimum wages allowed for better planning of future labor costs for the firms.

The literature on the minimum wage policy implies that the impact depends on many aspects, such as the degree of competition in labor and product markets, the methodological evaluations used (Card and Krueger, 1994; Neumark, 2013), the time span, the category of people affected (teens, women), the sectors where the employees work, the magnitude by which the minimum wage increased (de Linde Leonard et al, 2014) or the workers’ and firms’ policy expectations (Pinoli, 2010) and whether or not minimum wages are indexed to inflation (Strain and Brummund 2016; Tilly, 2017).

On the methodological evaluations, Card and Kruger (1994) found that cross sectional studies comparing regions are more likely to have negligible or positive effects of the minimum wage increase on the employment side than the time series studies or the panel data studies. More recently, Neumark et al. (2013) showed however that adding state specific time trends to data will no longer show negative effects on employment. Improvements in this regard have been seen in recent years also for panel data studies, when appropriate controls are put in place.

As for Romania, an IMF study (2016) made a preliminary assessment of the minimum wage increases that started in 2013. The findings were mixed. On the one hand, the study finds that minimum wage increases reduced inequality, narrowed the gap between low and high pay, and boosted consumer spending. On the other hand, the impact on reducing poverty was inconclusive,
negative impact on employment of youth and low-skilled could be expected, and firms’ external competitiveness could have been undermined. As for overall employment, “(…) benign impacts of minimum wage hikes on the employment in Romania may be due to the fact that minimum wage hikes emerged from low wage base and growing economy in recent years had helped to absorb the negative impact on employment.”

Now we can analyze the minimum wage increase that took place in Romania with the benefit of time and additional data. However, we share the IMF concern expressed in that study that, after a certain minimum wage floor has been reached, further significant minimum wage increases may be counterproductive.

Overall, the academic literature did not reach a unitary consensus regarding the effects of the minimum wage policy on macroeconomic variables, with empirical results varying depending on the specific country-data used, sample and methodology.

Recent studies have tried to focus more on some other implications of the minimum wage. This is also the case for the present paper, which tries to assess a large variety of effects of the minimum wage, having in mind different areas and different models.
3. Impact on average gross wage and gross wage distribution

February 2013 through December 2016, the economy-wide minimum gross wage was raised on 7 preannounced occasions, by a cumulative 79 percent (Figure 1). This was the biggest increase registered by an EU Member State within the mentioned period.

The impact of the increases in the minimum gross wage on average wage was determined based on the economy-wide wage distribution. In particular, the direct effects were estimated by assuming that the minimum wage increase had been applied to all eligible employees (i.e. those with labor earnings below the new statutory gross minimum wage), while the above-minimum wage earners were not affected. The direct impact ranges from 0.5 percentage points in 2013, when the minimum gross wage increase directly affected only around 6 percent of the employees,5 to 1.5 percentage points in 2016, when the number of full-time employees earning the minimum wage reached 31 percent of total registered employees (Figure 2). If indirect effects are also taken into consideration, i.e. wage increases for above-minimum wage earners in order to

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5 According to National Institute of Statistics (NIS) data, at the end of 2012 there were 3.6 million full-time employees, out of which 0.23 million were earning the minimum wage.
preserve relative wages within a business, the overall impact is likely to have been larger, yet still contained (see also Annex 3).

As a result, whereas at the end of 2012 the minimum-to-average gross wage ratio was among the lowest in the EU, by the end of 2016 the indicator slightly exceeded the mean value across EU countries (Figure 3). However, the minimum wage level remained among the lowest in the EU (Figure 4). Calculated in net terms, at the end of 2016 the minimum wage was around 42 percent of the average wage, below the Council of Europe definition of a “decent” wage.

**Figure 3. Minimum gross wage as a percentage of the average gross wage in EU countries**

![Graph showing minimum-to-average gross wage ratio in EU countries from 2012 to 2016, with data points for France, Slovenia, Malta, Luxembourg, Poland, Lithuania, Bulgaria, Belgium, Portugal, Germany, Romania, United Kingdom, Latvia, Croatia, Hungary, Slovak Republic, Ireland, Netherlands, Estonia, Czech Republic, and Greece.]

Source: OECD, Eurostat

Note: For Bulgaria, Croatia and Malta the ratio is determined based on the statistics corresponding to industry, construction and services sectors. For Germany, only data for 2016 is presented (the minimum wage policy was introduced in 2015). The EU countries that are missing (i.e. Austria, Cyprus, Denmark, Finland, Italy and Sweden) do not have an official minimum wage policy.

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6 Iordache, Militaru and Pandioniu (2016) use the results of a National of Bank of Romania (NBR) survey conducted in 2014 on firms’ behavior in the labor market to document that there were companies that had also granted raises to above-minimum wage earners as a response to an increase in the minimum gross wage.

7 For the analyzed period, the empirical evidence (see Box 2 entitled “Wage-productivity relationship and implications for inflation” in the November 2017 NBR Inflation Report) points to a significant importance of labor productivity in explaining the path of wages. Although during 2016 an increasing influence came from the gradual tightening of the labor market and certain institutional factors, such as the rise in public sector wages and the hike in the minimum gross wage, labor productivity remained the main determinant of wage dynamics.

8 The value was determined considering that the minimum-wage earner has no dependents.

9 See European Committee of Social Rights, Activity Report 2015, p.144: “It is the Committee’s case-law that, in order to ensure a decent standard of living, the lowest net wages paid must be above a minimum threshold, set at 50% of the net average wage.”
Over the 2012-2016 period, there was a significant expansion in the share of minimum wage workers, a development supported by the successive increases in statutory gross minimum wage by the government. These increases, particularly in 2015-2016, reduced significantly the gap between minimum wages and average wages, leading to more compressed and equal wage distribution (Figure 5).
In comparable terms – expressed as the ratio of employees’ wage to average wage – there was a pronounced rightward shift in wage distribution over the 2012-2016 period, including a significant increase in the share of middle-income workers (with wages between 45% and 100% of the average wage) (Figure 6).
As a result of successive minimum wage hikes, the number of employees earning the minimum wage increased significantly, from 0.23 million persons in 2012 (representing 6% of the total
number of employees) to 1.27 million persons in 2016 (31% of the total number of employees). At the same time, the concentration of the share of workers earning the minimum wage in the private sector increased from 89% in 2012 to 97% in 2016 (Figures 7 and 8). This finding is in line with the public sector employment premium described by Voinea and Mihaescu (2012).

Figure 8. Number of employees paid with minimum wage (thousands of full-time workers in October; left) and their sectoral distribution (%; right)

Source: NIS, NBR calculations

The gradual transition of individuals from the left tail of wage distribution towards its center is also reflected in the reduction of the share of people at risk of poverty or social exclusion (Figure 9).

Figure 9. Share of people at risk of poverty or social exclusion by activity status, 18 years and older

Source: Eurostat
This finding is relevant across all employed and unemployed groups, as well as for total population.

In general, Central and Eastern European countries that increased the ratio of minimum wage to average wage the most between 2010 and 2016 also saw a larger reduction in the share of employees at risk of poverty or social exclusion (Figure 10).

*Figure 10. Change in minimum to average wage ratio and change in poverty rate (share of people at risk of poverty or social exclusion) for employees, 2010-2016*

The inverse relationship between changes in poverty rate and changes in minimum to average wage ratio appears evident, for a wider cross-country panel over 7-years’ time. While the coefficients are not statistically significant, still a 0.17 coefficient is not far from the 0.1 coefficient which had statistical significance. Moreover, the explanatory power is strong: an increase in the minimum to average wage ratio explains 20% of the reduction in the poverty rate.
4. Impact on economic growth

After assessing the impact of the increase in the minimum gross wage on average wage (using the economy-wide wage distributions), the impact of the latter on economic growth was determined using a vector autoregressive (VAR) approach (for more technical details, see Annex 1).

The estimated threshold VAR model indicated the existence of an asymmetry related to the economy’s position within the business cycle: the estimated pass-through of average wage increases to economic growth was higher during the periods characterized by excess demand (positive output gap) as opposed to the ones with demand deficit (negative output gap). During the contraction phase of the business cycle, economic agents tend to save more of the extra income in detriment of consumption, in the context of unfavorable employment prospects and, implicitly, uncertain future incomes. The opposite is true during the expansion phase of the business cycle.

Figure 11 shows the distributions of the pass-through coefficients across the two regimes. These are computed as the ratio of the impact impulse response of output to an unexpected average wage shock and the impact impulse response of average wage to the same shock. In the case of the negative output gap regime, average pass-through amounts to about 0.01, meaning that a 10 percentage point increase in average gross wages leads to 0.1 percentage point higher economic growth. The distribution covers a significant range of negative values, suggesting the impact of wage dynamics on economic growth during demand deficit periods is very limited. In the case of the positive output gap, however, the average pass-through coefficient is significantly higher, of about 0.12. Accordingly, a 10 percentage point rise in average wage growth increases economic growth by 1.2 percentage points. In addition, the probability of the pass-through effects to be negative is very low in this case.
The effect of minimum wage increases on economic growth was assessed indirectly by applying the average pass-through coefficients documented above to the estimated contribution of minimum wage dynamics to average wage dynamics (presented in the previous section), while also controlling for the cyclical position of the economy. The cyclical position of the Romanian economy is estimated to have shifted in 2016 from a negative output gap, which emerged during the crisis years, to a positive one. In this context, during the analyzed period (2013-2016), the cumulated impact on economic growth of the average gross wage increase as a result of the minimum wage raises was evaluated to be relatively contained, at around 0.2 percentage points.

Table 1. The average impact of an increase of one percentage point in the average gross wage on economic growth

| Economy’s position within the business cycle | Impact on economic growth |
|--------------------------------------------|---------------------------|
| positive output gap                        | 0.1                       |
| negative output gap                        | 0.01                      |

Source: authors, based on NBR’s estimations

Note: The impact corresponds to the response of output gap to a wage inflation shock in the first period.

Among the Central and Eastern European countries, a higher minimum wage (in PPS terms) is associated, on average, with a higher labor productivity (computed as GDP in PPS terms divided by the number of persons employed), as Figure 12 shows.
Figure 12. Monthly minimum wage and labor productivity (GDP at PPS per person employed)

![Figure 12. Monthly minimum wage and labor productivity (GDP at PPS per person employed)](image)

Source: authors, based on Eurostat data and NBR

Note: p-values in square brackets; ** denotes significance at 5% level; *** denotes significance at 1% level.

The positive relationship between labor productivity and minimum wage, for a cross-country panel (one year only) is statistically significant at 5% and 1%, and very strong - as it has a large explanatory power (45%).

5. Impact on inflation

In order to take into account possible shifts in the relation between average wage growth and price dynamics, we estimated single equations with time varying coefficients. The specifications resemble the hybrid Phillips curve framework, with core inflation rate (at constant value added tax rate) as dependent variable and a series of independent determinants, including the growth rate of the average gross wage. The various estimations differ in the specifications of exogenous determinants. In Figure 13 we present the estimated time series for the wage dynamics time varying coefficient in a model with the following determinants: a lag of core inflation, survey-based CPI inflation expectations, NBR estimated output gap as a measure of slack, effective external price index as a measure of imported inflation, and the growth rate of the average gross wage. The 68% confidence interval approximates the +/-1 standard deviation distance from the
mean under normally distributed series. Time-varying estimates of the impact response of changes in average gross wage on core inflation seem to be relatively stable over time.

Figure 13. Time varying wage growth coefficient

The effect of gross minimum wage increases on total CPI inflation rate was estimated by multiplying: (1) the contribution of minimum wage hikes to average wage dynamics (as estimated in Section 3); (2) the coefficient of average wage growth in core inflation rate equation (as estimated in this section and described in Annex 2); (3) the share of core items in the total consumer basket. Overall results across different specifications and econometric methods (for more technical details, see Annex 2) point to a relatively low impact on the CPI inflation rate of the average gross wage increase as a result of the minimum wage raises. The passthrough effect of one percentage point increase in average gross wage on CPI inflation was estimated to be in the range of 0.03 to 0.1 percentage points. Accordingly, the cumulated contribution of minimum wage raises to CPI inflation rate was estimated in the range of 0.1 to 0.4 percentage points during the analyzed period (2013-2016).

Table 2. The average impact of an increase of one percentage point in the average gross wage on inflation, single equation framework

| Impact on core inflation | Impact on CPI inflation |
|--------------------------|-------------------------|
| 0.05-0.15                | 0.03-0.1                |

Source: authors, based on NBR estimations

Note: The impact on CPI inflation was determined by multiplying the impact on core inflation with the core index weight in the CPI basket.
Table 3. The average impact of an increase of one percentage point in the average gross wage on inflation, semi-structural model

| Impact on core inflation | Impact on CPI inflation |
|--------------------------|-------------------------|
| 0.05-0.12                | 0.03-0.07               |

Source: authors, based on NBR estimations

Note: The impact on CPI inflation was determined by multiplying the impact on core inflation with the core index weight in the CPI basket.

The results may be counter-intuitive at first sight, as a large increase in minimum wage, over a relatively short time period, has a very small impact on inflation. There are a number of possible explanations for this small impact. First and probably foremost, the whitening of the labor market (the “Efeito Farol”) which means that the same amount of money was exchanged between employers and employees before and after the increase of the minimum wage, but in the latter case more is shown and subject to taxation. This explanation is supported by our finding regarding the impact on the shadow economy. Second, the very low starting point means that people earning the minimum wage probably used some of the higher income to repay their debt or to cover for essential needs for which they should have paid anyway, therefore not creating inflation. Nevertheless, we do not have sufficient data to validate this hypothesis, but it cannot be ruled out. Third, the minimum wage earners may have increased the demand for low-cost, locally-produced goods and services, some of which are being produced by the companies they work for. Therefore, the relationship between domestic demand and domestic supply is reinforced.
6. Impact on employment

In recent years, both the number of employees and gross minimum wage registered significant increases (Figure 14).

Figure 14. Number of employees and gross minimum wages

![Graph showing number of employees and gross minimum wages](source)

Source: NIS, Eurostat

In order to assess the effects of minimum wage changes on unemployment and the economy-wide number of employees, we apply an event study framework. First, in order to isolate potential non-linearity related to the business cycle position, we divide the 2004-2016 sample into two episodes, a positive output gap period (2004 Q1-2008 Q3) and a negative output gap period (2011 Q1-2016 Q4); the crisis years (2008 Q4-2010 Q4) are omitted from this analysis given their specificity. Then, for each of the two subsamples and each minimum wage increase episode, we collect the value of labor market indicators in the month of the increase, in the three consecutive months before the increase, and in the three consecutive months after the increase. In the figures that follow we plot the averages of these series, with the month of the minimum wage change denoted with “0”.

In the case of the unemployment rate gap,\(^{10}\) during the period of positive output gap (2004 Q1-2008 Q3), an increase in the minimum wage is associated (on average) with a temporary reversal of its sign, i.e. negative unemployment gap becomes positive in the month the minimum wage increases and returns into negative territory only after three months (see Figure 15, left). This

\(^{10}\) Defined as the difference between observed unemployment rate and its trend. The unemployment rate trend was estimated using a Hodrick-Prescott filter with \(\lambda=14400\), the latter being the standard value of the smoothing parameter for monthly data. All variables used in this section are seasonally adjusted.
suggests that a hike in the minimum wage during a positive output gap period might be correlated with a temporary “cooling down” of the economy. The reverse is true in a period of below potential growth (2011-2016): a minimum wage hike corresponds to a reduction of the positive unemployment rate gap and, accordingly, to a decrease in the size of the slack in the economy (see Figure 15, right).

*Figure 15. Mean of unemployment rate gap during 2004 Q1-2008 Q3 (left) and 2011 Q1-2016 Q4 (right) within a period of three months before/after a minimum wage hike*

![Figure 15](image)

Source: NIS, NBR calculations

Note: The time of the minimum wage hike is marked “0” on the x-axis

Figure 16 shows similar conclusions for the youth (aged 15-24) unemployment rate gap, for the two periods mentioned above. In this case, given the prevalence of minimum wage contracts among young persons (which have less experience and skills), the effects described above are potentially stronger. In particular, for the negative output gap period between 2011 and 2016, the positive unemployment rate gap diminishes more suddenly and abruptly for youth (see Figure 16, right) than for total unemployment (see Figure 15, right).

*Figure 16. Mean of youth (aged 15-24) unemployment rate gap during 2004 Q1-2008 Q3 (left) and 2011 Q1-2016 Q4 (right) within a period of three months before/after a minimum wage hike*
Figures 15-16 seem to suggest that a minimum wage hike could be associated with a reduction in inflationary pressures during the positive output gap period (i.e. negative unemployment rate gap shrinks or becomes positive), while having a reflationary effect during the negative output gap episode (i.e. positive unemployment rate gap shrinks or becomes negative). Similar nonlinearities can be observed in the case of the growth rate in the number of employees. In the positive output gap phase of the cycle, a minimum wage hike corresponds to an increase in the growth rate of the number of employees (see Figure 17, left). Conversely, in the negative output gap phase of the cycle, an increase in the minimum wage is associated with a temporary slow-down in the growth rate of the number of employees (see Figure 17, right).

**Figure 17. Mean of the rate of growth in the number of employees in 2004 Q1-2008 Q3 (left) and 2011 Q1-2016 Q4 (right) within a period of three months before/after a minimum wage hike**

Source: NIS, NBR calculations

Note: The time of the minimum wage hike is marked “0” on the x-axis

We continue our employment impact assessment with a sector level analysis. Based on averages during the post-crisis period, we construct two groups of economic sectors. The one with above-
average share of minimum wage workers consists of activities A (agriculture), F (construction), G-H-I (wholesale and retail trade, other services), L (real estate), M-N (professional and scientific activities) and R-S (cultural activities). The remaining sectors – industry, IT&C, public sector activities – compose the below-average share of minimum wage workers sector (Figure 18).

Figure 18. Share of employees paid with minimum wage by NACE sectors

Source: NIS, NBR calculations

It should be mentioned that the evolution of the salaries in the below-average minimum wage sectors is also driven by the dynamics of public sector wages (comprising activities O-P-Q), which represent another instrument (apart from the regulation of economy-wide gross minimum wage) of the government wage policy.
During 2012–2016, on average, the sectors which registered the highest increases in the share of minimum wage workers also increased their share in total economy-wide number of employees (Figure 19).

Figure 19. Changes in the shares of employees paid with minimum wage and in the shares of employees (in total number of employees) by NACE sectors, 2012-2016

The positive relationship between the change in the share of minimum wage workers and the change in the share of total employees, across the different sectors of the economy, is statistically significant at 5% and it has a strong explanatory power (30%).

These findings contradict the belief that an increase in the minimum wage will eventually lead to a decrease in the number of employees. The evidence for Romania, for the period 2013-2016, shows exactly the opposite.
7. Impact on the shadow economy

The size of the shadow economy, as estimated in a recent IMF paper by Medina and Schneider (2018), decreased gradually over the last 15 years, with the notable exception of the worst year of the recent financial crisis. The estimated gradual reduction in the size of the shadow economy occurred alongside the progressive increase in gross minimum wages (Figure 20). The correlation between the two series over the 2000–2015 period is about –0.95 (and highly statistically significant), suggesting that successive minimum wage increases may have contributed to a gradual whitening of the labor market.

*Figure 20. Size of the shadow economy (% of GDP) and gross minimum wage (RON)*

![Graph showing the size of the shadow economy as a percentage of GDP and gross minimum wage.](image)

*Source: NIS, Medina and Schneider (2018)*

| Correlation coefficient | t-statistic | p-value |
|-------------------------|-------------|---------|
| -0.9451***              | -10.8250    | 0.0000  |

*Table 4. Testing the correlation coefficient between shadow economy and gross minimum wage, 2000-2015*

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11 Their MIMIC (Multiple Indicators, Multiple Causes) model is cast in a state space framework and assumes that the shadow economy is a latent unobserved variable determined by a series of causal observed proxy indicators, like the size of the government, fiscal freedom, rule of law, government stability, control of corruption etc. The measurement equation further assumes that the shadow economy affects macroeconomic outcomes like labor force participation, the amount of currency in circulation and real GDP per capita growth.
In order to avoid some of the wage-related fiscal costs, firms presumably pay workers “envelope wages” using cash (e.g. official wage amount is set at a certain low level, like the minimum wage, but actual earned wage includes additional informal cash payments). The ratio of cash outside banking system to M1 (which includes cash and overnight deposits) can be used as a measure of cash-based transactions. This indicator has declined since 2013, when the gross minimum wage started to hike and the share of minimum wage workers recorded successive increases (see also Section 3). These outcomes suggest a possible favorable impact of minimum wage increases on reducing the size of the informal economy.

Figure 21. Cash outside banking system to M1 ratio and gross minimum wage (RON)

Source: authors, based NIS, NBR
8. Impact on firms’ competitiveness

Unit labor costs

Before the EU accession, the dynamics of compensation per employee and labor productivity (in PPS terms and relative to the EU average) were similar. Since 2007 and especially after the crisis, the dynamics of labor productivity generally surpassed that of compensation per employee, contributing to a reduction of ULC below the EU average (Figure 22).

Figure 22. ULC in Romania relative to EU; computed using PPS series

A note of caution related to PPS series should be mentioned. Despite its utility for cross-country comparison, Eurostat recommends against using these for temporal comparison.12

In comparable terms, in recent years labor costs have been significantly lower in Romania as compared to the major advanced European economies. Relative to the new EU members, Romania registered the largest decrease in labor costs over the 2002-2017 sample (Figure 23). Note that labor market data series for Romania are subject to several statistical breaks that affect the computed ULC series.

Source: Eurostat, NBR calculations; productivity computed as GPD at PPS per person employed

12 Source: https://ec.europa.eu/eurostat/web/products-datasets/-/tec00114.
Figure 23. ULC relative to EU; computed using PPS series

Source: Eurostat, NBR calculations; productivity computed as GPD at PPS per person employed.
Note: Eurostat acknowledges statistical breaks in Romanian employment and employee series in 2002, 2003 and 2010 (e.g. employment decreases in 2002 to 9.57 mln from 10.66 mln in 2001).

Sectoral data (turnover, exports, profits) presented in this section were computed by aggregation of firm-level databases handled by the Ministry of Public Finances (MFP). The data do not include financial services. ULC series for above- and below-average minimum wage groups are computed using the across-sectors corresponding indicators.

Figure 24. ULC, % annual growth

Source: NIS, NBR calculations; productivity computed as real gross value added per person employed

Note: The annual growths in ULC series are shown starting 2013 given a structural break in sectoral gross value added series in 2012. INS is revising backwards sectoral National Accounts, but the revision calendar is not publicly available.
Exports, turnover and profits

*Figure 25. Exports of goods and services, % annual growth, real terms*

In Romania, before the Great Recession, turnover growth was higher than exports’ dynamics. During the crisis and in the recovery phase, exports’ growth outpaced that of domestic turnover. Since 2014, domestic turnover and exports have been growing at a similar pace (Figure 26).

*Figure 26. Index of exports to turnover ratio, 2015=100, nominal terms; retail trade, except of motor vehicles and motorcycles*

In recent periods the exports-turnover ratio of sectors with above-average minimum wage workers share is declining slightly, while that of below-average minimum wage workers share sectors is on an upward trend (Figure 27).

Source: Eurostat, NBR calculations
Sectors with below-average minimum wage workers share had registered positive profits even during the crisis period (Figures 28 and 29).

The ratio of net profits to turnover can also be interpreted as markup and, consequently, can be used as a measure of market competition (higher markup implies lower competition). In general, markups were higher in below-average minimum wage workers share sectors.
Figure 29. Net profits, % of turnover

Source: MPF, NBR calculations

The steady increase in total exports to turnover ratio over the last decade was driven by exports growth rate outpacing that of total turnover (Figure 30).

Figure 30. Exports, turnover and firms’ profits

Source: MPF, NBR calculations

Sectoral exports to turnover ratios are diverging (Figure 27). Behind the increase of this indicator in below-average minimum wage workers share sectors stands a generally higher growth of exports relative to turnover (Figure 31, right). Negative growth rates of exports in above-average minimum wage workers share sectors during 2013-2016 (Figure 31, left) resulted in an inversion of the trend in exports to turnover ratio for these economic activities. Nevertheless, this shift from
external markets to domestic clients resulted in a more pronounced increase of firms’ profits (as compared to below-average minimum wage workers share sectors).

*Figure 31. Exports, turnover and firms’ profits across sectors*

![Graph showing sectors with above-average and below-average minimum wage workers share](image)

Source: MPF, NBR calculations

**Foreign direct investment**

Following the significant reduction during the Great Recession, foreign direct investment (FDI) flows are gradually recovering. The equity (including reinvested profits) component of the FDI approaches in 2016-2017 the levels seen before the crisis (Figure 32). There does not appear to be a direct negative impact of raising the minimum wage on FDI.

*Figure 32. Foreign direct investment (bln. euro) and gross minimum wage (RON)*

![Graph showing foreign direct investment and minimum wage](image)

Source: Eurostat, NBR calculations
The drop in intercompany lending is a sign of widespread deleveraging and it has nothing to do with internal labor market conditions, but rather with international capital flows. Equity (including reinvested profits) represents a much more stable source of financing for the current account deficit.

**Labor and capital shares**

Labor share in production can be computed using National Accounts data and assuming a Cobb-Douglas production function. In order to take into consideration a significant share of non-employees in the total labor force (these comprise self-employed persons and contributing family workers), whose income is not included in compensation of employees series, we adjust the calculation following the IMF methodology.\(^\text{13}\)

![Figure 33. Labor share](image)

*Figure 33. Labor share*

Following the increase in the minimum wage there was no significant change in the share of capital and labor. Also, there was no reversal to the pre-crisis period when the labor share was higher than the capital share. This brings additional support to the finding that firms’ competitiveness was not affected by the increase in the minimum wage in the period 2013-2016. Things may have changed since 2017, when further unwarranted wage increases (including the minimum wage) augmented an already existing positive output gap in the economy.

\(^{13}\) See IMF World Economic Outlook, April 2012, *Box 1.1. The Labor Share in Europe and the United States during and after the Great Recession*. Basically, the adjustment assumes self-employed persons and contributing family workers have labor income equal to the average compensation of employees.
9. Impact on the general consolidated budget

The impact on the budget was assessed by taking into account the effects of the increase in minimum wage on the revenues side (first-round effects, but also second-round effects) and on the expenditure side (for more details see Annex 4).

Between 2012 and 2016, the net impact of the increase in the minimum wage on the general consolidated budget was a positive one, between 3.4 million RON in 2012 and 1,362 million RON in 2016. The impact of the measure on the revenues side was between 56 million RON in 2012, when the minimum wage increased by almost 5% and 1,468 million RON in 2016, when the minimum wage increased by around 19%. The impact on the revenues side has significantly increased in 2015 as the number of employees from the private sector that were influenced by the measure grew by more than 40%. This trend continued in 2016.

Figure 34. Evolution of the minimum wage impact on the budget

On the expenditure side, the impact varies between 53 million RON in 2012 and around 106 million RON in 2016. The maximum impact on the expenditure side was registered in 2015, when almost 500,000 employees from the budget sector were beneficiaries of the measure. After a 25% across-the-board wage cut in July 2010, employees from the public sector had

Source: Authors, based on MPF, Substantiation notes of the Government decisions, NBR calculations
benefited from two increases in the basic wages in 2012, 8% starting June 1 and 7.4% starting December 1. As such, in 2013 the increase in the minimum wage did not have any influence on the expenditure side, as all the wages from the public sector were already slightly above the new minimum level.

**Figure 35. Evolution of the minimum wage earners**

Source: Authors, based on MPF, Substantiation notes of the Government decisions

In 2016, most of the public employees had earnings at the level of or higher than the minimum wage, as a result of an increase in the public sector wages at the end of 2015.\(^{14}\) As such, the negative impact of the increase in the minimum wage on the expenditures side had substantially diminished in 2016.

\(^{14}\) 25% increase to hospital staff; 15% increase to teaching staff; 12% increase for public institutions subordinated at the local level; 25% increase to social assistance staff; 10% wage increase to the rest of the public sector employees.
10. Conclusions

We can summarize the main findings of our paper as follows:

- Gross minimum wage in Romania increased successively from 700 RON in January 2013 to 1,250 RON in December 2016, when the minimum-to-average gross wage ratio slightly exceeded the mean value across EU countries. As a result, the share of employees earning the minimum wage increased from 6% in 2012 to 31% in 2016. The majority of workers earning the minimum wage were employed in the private sector.

- At the same time, the share of people at risk of poverty or social exclusion decreased; moreover, empirical evidence suggests that, in general, Central and Eastern European countries that increased the ratio of minimum-to-average wage the most between 2010 and 2016 also saw a larger reduction in the share of employees at risk of poverty or social exclusion.

- The strong negative correlation between the size of the shadow economy and the gross minimum wage suggests that successive minimum wage increases may have possibly contributed to a gradual whitening of the labor market. Additional supporting evidence of this result is offered by the decline of the ratio of cash outside the banking system to M1 since 2013, when gross minimum wage growth started accelerating and the share of minimum wage workers recorded successive increases.

- The sectoral distribution of minimum wage earners suggests that during 2012–2016, on average, the economic sectors that registered the highest increases in the share of minimum wage workers (e.g. wholesale and retail trade; transport and storage; hotels and restaurants; professional, scientific and technical activities) also increased their share of employees in the economy-wide number of employees.

- The significant increases in gross minimum wage since 2013, with the adjustments being preannounced, coincided with a recovery of firms’ profits (across sectors with both above- and below-average minimum wage workers share), while the potential negative spillover effects on unit labor costs and international competitiveness appear to have been limited.

- Using an event study framework, although difficult to be attributed one-to-one to an increase in the minimum wage, we show that a minimum wage hike could be associated with a reduction in inflationary pressures during the positive output gap period (i.e. negative unemployment rate gap shrinks or becomes positive), while having a reflationary effect during the negative output gap episode (i.e. positive unemployment rate gap shrinks or becomes
The effects are generally stronger in the case of youth unemployment, given a higher incidence of minimum wage contracts for this age group. In the case of the total number of employees, the effects of minimum wage hikes appear to be limited: the growth rate of the number of employees increases slightly during the positive output gap episode and slows down during the slack episode.

- The estimated direct impact of gross minimum wage increases on gross average wage dynamics ranges from 0.5 percentage point in 2013, when the minimum gross wage increase directly affected around 6% of the employees, to 1.5 percentage points in 2016, when the number of full-time employees earning the minimum wage reached 31% of the total.

- The impact on CPI inflation and on economic growth of the average gross wage increase as a result of the minimum wage raises was evaluated to be relatively contained during the analyzed period (2013-2016): it is estimated in the range of 0.1 to 0.4 percentage point for CPI inflation and around 0.2 percentage point for economic growth.

Overall, the positive effects of the minimum wage hikes in the period 2013-2016 seem to prevail. This does not mean that any increase in the minimum wage is warranted at any time. Our study shows that the positive effects were attributable to the very low starting levels, the cycle of the economy (negative output gap), the pre-announced program and support from IFIs for the first rounds of minimum wage increase, the country-specific factor that most of the minimum wage employees work in the private sector and the efficiency resources coming from whitening the labor market. Once the economy has moved into a positive output gap, and the gap between minimum and average wage has narrowed, further minimum wage increases need to be carefully addressed while considering their implications on a wide array of sectors, as described in our study.
References

Agenor, P.R. (2004). The Economics of Adjustment and Growth. 2nd edition, Harvard University Press

Allegretto, S.A., Dube, A., and Reich, M. (2011). Do minimum wages really reduce teen employment? Accounting for heterogeneity and selectivity in state panel data. Industrial Relations: A Journal of Economy and Society, 50, 205–240.

Auclert, A. (2017). Monetary Policy and the Redistribution Channel. NBER Working Paper No. 23451

Brown, C., Gilroy, C., and Kohen, A. (1982). The Effect of The Minimum Wage on Employment and Unemployment. Journal of Economic Literature, Volume 20, Issue 2, 487-528

Burkhauser, R., V., Couch,K., and Wittenburg, D.C. (2000). A Reassessment of the New Economics of the Minimum Wage Literature with Monthly Data from the Current Population Survey. Journal of Labor Economics 18, no. 4: 653-80. doi:10.1086/209972.

Card, D. and Krueger, A. (1994). Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania. The American Economic Review, 84, 772–793.

Carpio, X. and Pabon, L. (2014). Minimum Wage Policy: Lessons with a Focus on the ASEAN Region, Research Paper 87864 – EAP

Convergence programme 2016-2019 – Romania April 2016, Government of Romania

Davidescu, A. A., and Schneider, F. (2017). Nature of the Relationship between Minimum Wage and the Shadow Economy Size: An Empirical Analysis for the Case of Romania, IZA DP No. 11247.

Deere, D., Murphy, K., and Welch, F., (1995). Employment and the 1990-1991 Minimum-wage Hike. American Economic, vol.85, issue 2, 232-37

de Linde Leonard, M. and T.D.Stanley, H. Doucouliagos (2014), Does the UK Minimum Wage Reduce Employment? A Meta-Regression Analysis, British Journal of Industrial Relations, Volume52, Issue3, Pages 499-520

Employment Policy Institute (2007). EPI Minimum Wage Survey of Labor Economists.

Even, W.E. and Macpherson, D.A. (2004), Wage Growth Among Minimum Wage Workers, Employment Policy Institute, June 2004

European Committee of Social Rights (2015). Activity Report

Friedman, M., (1962). Capitalism and Freedom. Review, University of Chicago Press, Chicago, IL/London.
Harasztosi, P. and Lindner, A. (2017). Who Pays for the Minimum Wage?. Manuscript

International Monetary Fund (2012), World Economic Outlook

International Monetary Fund (2016). Cross-country report on minimum wages. IMF Country Report no.16/114, prepared by Li Lin, Piyaporn Sodsriwiboon, Vahram Stepanyan and Ivohasina Razafimahefa

Iordache, S., Militaru, M. and Pandioniu, L. (2016). Jobless recovery in Romania: the role of sticky wages and other frictions. Firm-level evidence from the WDN survey. National Bank of Romania, Occasional Papers No. 20, 2016

Keynes, J.M. (1936). General Theory of Employment, Interest and Money. Macmillan

Koop, G., Pesaran H. and Potter, S. (1996). Impulse response analysis in nonlinear multivariate models. Journal of Econometrics, 74(1), pp. 119-147

Maloney, W.F. et al. (2001). Measuring the impact of Minimum Wages – Evidence from Latin America. The World Bank, Policy Research Working paper 2597

Medina, L. and Schneider, F. (2018). Shadow Economies Around the World: What Did We Learn Over the Last 20 Years?. IMF Working Paper WP/18/17

Michl, T. (2000), Can Rescheduling Explain New Jersey Minimum Wage Studies?, Eastern Economic Journal, vol. 26, issue 3, 265-276

NBR (2018). Evaluation of minimum wage effects. Working documentation of the Macroeconomic Modelling and Forecasting Department, unpublished.

National Bank of Romania (2017). Inflation Report, 2017

Neri, M., Gonzaga, G. and Camargo, J. M. (2000) "Efeitos Informais do Salário Mínimo e Pobreza". Texto para discussão no.724, IPEA

Neumark, D., J. Salas, and W. Wascher (2013). Revisiting the Minimum Wage Employment Debate: Throwing Out the Baby with the Bathwater?. NBER Working Paper No. 18681.

Neumark, D., M. Schweitzer, and W. Wascher (2004). Minimum wage effects throughout the wage distribution. Journal of Human Resources, 39, 425–450.

Pinoli, S. (2010). Rational expectations and the puzzling no-effect of the minimum wage. IZA DP No. 4933.

Romania: Letter of Intent, Memorandum of Economic and Financial Policies, and Technical Memorandum of Understanding, March 5, 2014, retrieved from https://www.imf.org/en/Countries/ROU
Romania: Letter of Intent, Memorandum of Economic and Financial Policies, and Technical Memorandum of Understanding, June 10, 2013, retrieved from https://www.imf.org/en/Countries/ROU

Schmidt, J. (2013). Country Risk Premia, Endogenous Collateral Constraints and Non-linearities: A Threshold VAR Approach., retrieved from http://juliaschmidt.org/Nonlinearities_Schmidt.pdf

Sraffa, P. (1991), Lettere a Tania per Gramsci. Roma: Editori Riuniti

Substantiation notes of the Government decisions no. 1225/2011, Government decisions no. 23/2013, Government decisions no. 871/2013, Government decisions no. 1091/2014, Government decisions no. 1017/2015

Strain, M.R. and Brummund, P. (2016). Real and permanent minimum wages, AEI Economics Working Papers 875967, American Enterprise Institute.

Tilly, J., "Essays in Labor Economics" (2017). Dissertations available from ProQuest. AAI10261214.

Voinea, L. and F.Mihaescu (2012), A Contribution to the Public–Private Wage Inequality Debate (April 2012). Economics of Transition, Vol. 20, Issue 2, pp. 315-337.
Methodological Annex 1: Pass-through of the average wage increases to economic growth

Methodological framework: Structural VAR model, with and without threshold

The baseline VAR system was a four-variable, one-lag, quarterly model consisting of: (1) the imported inflation – approximated by the growth rate of the Romanian unit value of imports excluding fuels and motor vehicles, adjusted for the EURRON exchange rate dynamics, (2) the growth rate of the average gross wage, (3) the output gap – NBR estimates based on the medium term analysis and projection model, (4) the core inflation.

In order to investigate potential asymmetric reactions to wage inflation shocks generated by the economy’s position within the business cycle, a threshold VAR model was also estimated:

\[ Y_t = C_1 + \Phi_1(L)Y_t + \varepsilon_{1t} + (C_2 + \Phi_2(L)Y_t + \varepsilon_{2t})I(y^*_{t-d} > Y) \]  

(A1.1)

where \( I \) is an indicator function which equals one if the threshold variable \( y^* \) (output gap) at lag order \( d \) (the delay parameter) is greater than the threshold \( Y \) and zero otherwise. The threshold of the switching variable can either be fixed or estimated from the model. Following the approach presented in Schmidt (2013), the threshold was determined endogenously by a grid search over possible values of the threshold variable, where the grid was trimmed at the lower and upper ends (by 15%) in order to ensure a sufficient number of data points for the estimation in each regime.

The delay parameter, \( d \), was fixed to 0 (an alternative version with \( d \) fixed to 1 was also tested, without significant changes to the results).

Estimation

The variables were observed over the sample 2000-2016. The shock identification was performed using the Cholesky factorization scheme, which imposes a recursive form for the specified structural model, i.e. a causal chain for the endogenous variables. The restrictions are presented in the table below. The first shock refers to the external environment and the subsequent three shocks are domestic. The external variable was ordered first, i.e. global environment affects domestic variables immediately. Moreover, a block exogeneity restriction was imposed in order to account for the small open economy feature of Romania, i.e. the shock originating in the external sector was allowed to influence internal variables, but not the other way around.

TABLE
Table A1.1: Identification restrictions

| Shock Variable | Imported inflation | Wage inflation | Output gap | Core inflation |
|---------------|-------------------|----------------|-------------|----------------|
| Global        | +                 | ?              | ?           | ?              |
| Domestic      | 0                 | +              | ?           | ?              |
| Domestic      | 0                 | 0              | +           | ?              |
| Domestic      | 0                 | 0              | 0           | +              |

Notes: (+) = positive sign restriction, (0) = zero restriction and (?) = unrestricted.
All restrictions are imposed on impact.

The impact of wage inflation on output gap was determined based on the impulse response functions (IRFs), which are used to track the responses of endogenous variables to the system’s shocks.

The computation of IRFs for the threshold VAR model relies on the system being in one of the two regimes, i.e. the threshold variable being above or below the threshold $Y$. This history-dependence necessitates the computation of generalized IRFs, as developed by Koop et al. (1996), which implies the simulation of data depending on which regime the system is in at the time the shock hits the economy. In this approach, the response of output gap to a wage inflation shock was calculated by simulating the evolution of the variables of interest within the VAR system conditional on a certain history following the wage inflation shock and subtracting the evolution of the variables conditional of the same history without having imposed the shock.

Methodological Annex 2: Pass-through of the average wage increases on core inflation

1. Single equations with fixed and time-varying coefficients, respectively

Methodological framework

The hybrid version of the New Keynesian Phillips curve, augmented with a measure (the growth rate of the average gross wage) reflecting potential additional inflationary pressures associated with the labor market was employed:

$$\pi_t = c + \beta_{1(t)}\pi_{t-1} + \beta_{2(t)}\pi^e_t + \beta_{3(t)}x_t + \beta_{4(t)}\pi^{imp}_t + \beta_{5(t)}\pi^{wages}_t + \epsilon_t$$

(A2.1)

where $\pi_t$ is the growth rate of the core index (which excludes from the CPI index a number of prices on which monetary policy has limited or no influence, i.e. administered prices, volatile prices, and tobacco and alcoholic beverage prices), $\pi^e_t$ are survey-based inflation expectations, $x_t$
is a slack measure, \( \pi_t^{imp} \) represents the imported inflation, while \( \pi_t^{wages} \) is the growth rate of the average gross wage.

The following measures of slack were considered: (1) output gap – NBR estimates based on the medium term analysis and projection model; (2) output gap – determined by applying the Hodrick-Prescott filter to the series of real GDP; (3) ILO unemployment gap – NBR estimates based on the medium term analysis and projection model; (4) the growth rate of the number of unemployed persons (ILO data).

The following measures as proxy for imported inflation were considered: (1) HICP inflation in the euro area; (2) the growth rate of an effective external price index (a composite indicator quantifying the impact of euro area and US price dynamics on domestic inflation, according to the shares held by the two currencies in Romania’s foreign trade invoices); (3) the growth rate of the euro area export deflator; (4) the growth rate of the Romanian unit value of imports excluding fuels and motor vehicles, adjusted for the EURRON exchange rate dynamics.

**Estimation**

The equation was set at quarterly frequency and the estimation was performed for the period 2000-2016, using the least-square method for the fixed-coefficients version of the equation. In case of the time-varying coefficients version, the equation was estimated using Bayesian methods, namely a Gibbs sampler, with Inverted-Gamma priors for all of the parameters of the model.

2. A semi-structural model

To further check the robustness of the results, a small-scale semi-structural model was also considered.

**Methodological framework**

The model consisted of three main equations: the equation of aggregate demand, i.e. output gap equation (IS curve); the equation of core inflation (Phillips curve), with the output gap as a slack measure and augmented with a measure (the growth rate of the average gross wage) reflecting potential additional inflationary pressures associated with the labor market; and the equation defining the Okun law.

**Phillips curve**

\[
\pi_t = A_1 \cdot (A_2 \cdot \pi_{t-1} + (1 - A_2) \cdot \pi_t^{e}) + A_3 \cdot y_t^{gap} + (1 - A_1) \cdot \pi_t^{imp} + A_4 \cdot \pi_t^{wages} + shock_{pc_t}
\]  

(A2.2)

where the variables are the same as the ones defined for the single equation approach and \( y_t^{gap} \) represents the output gap.
The monetary policy influence is captured by the impact exerted on future developments in aggregate demand by the broad real monetary conditions, defined based on: the real interest rates applied by credit institutions on leu- \((i_l)^{\text{gap}}\) and foreign currency-denominated loans \((i_{lv})^{\text{gap}}\) of non-bank clients, the real interest rate for bank deposits \((i_d)^{\text{gap}}\) of non-bank clients, and the leu real effective exchange rate \((z)^{\text{gap}}\). Output gap is also influenced by the foreign demand cycle \((y_{star})^{\text{gap}}\), approximated by the output gap of an effective external demand measure, calculated using a weighting system that takes into account the breakdown of Romania’s exports by destination. The fiscal impulse variable \((if)\), defined as the change in the structural balance (measure of the budget deficit that would have prevailed in the absence of business cycle effects), but with an inverted algebraic sign, captures the influence of the fiscal policy pursued by the government on aggregate demand. With the exception of the fiscal impulse, all variables were expressed as deviations from their long-term equilibria.

**Okun law**

\[
u_{ilo}^{\text{gap}} = F_0 \cdot u_{ilo}^{\text{gap}} + F_1 \cdot y^{\text{gap}} + \text{shock}_{uilo_{gap}} t
\]

(A2.4)

Okun law formalizes the empirically observed relationship between unemployment \((u_{ilo})^{\text{gap}}\), ILO definition for the unemployment rate) and production \((y^{\text{gap}})\), both variables being expressed as deviations from their long-term equilibria.

The long-term equilibrium of the output \((y^{\text{tnd}})\), its growth rate \((\mu)\) and the trend unemployment rate \((u_{ilo}^{\text{tnd}})\), were defined as univariate processes:

\[
y_t^{\text{tnd}} = y_{t-1}^{\text{tnd}} + (\mu_t/4) + \text{shock}_{y_{tnd}} t
\]

(A2.5)

\[
\mu_t = C_0 \cdot \mu_{t-1} + (1 - C_0) \cdot \bar{\mu} + \text{shock}_{mu} t
\]

(A2.6)

\[
u_{ilo}^{\text{tnd}} = UIT \cdot u_{ilo}^{\text{tnd}} + (1 - UIT) \cdot u_{ilo} + \text{shock}_{uilo_{tnd}} t
\]

(A2.7)

\[
y_t = y_t^{\text{tnd}} + y_t^{\text{gap}}
\]

(A2.8)

\[
u_{ilo} = u_{ilo}^{\text{tnd}} + u_{ilo}^{\text{gap}}
\]

(A2.9)

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\(^{15}\)The effective exchange rate was determined based on the EUR/RON and USD/RON exchange rates, with the weighting system mirroring the weights of the two currencies in Romania’s foreign trade. The Consumer Price Index (in Romania and the US) and the Harmonized Index of Consumer Prices (in the euro area) were used to deflate the nominal effective exchange rate.
**Estimation**

The estimation of the model was performed in a Bayesian framework. Except the output gap, the unemployment gap and the unemployment trend, which were estimated (using the Kalman filter) within the model, all other variables (broad real monetary conditions, external demand, fiscal impulse, core inflation, wage inflation, inflation expectations, and imported inflation) were treated as observables and represented NBR estimates based on the medium term analysis and projection model.

**Annex 3 Evaluating May 2016 minimum wage increase using monthly administrative data**

In May 2016 gross minimum wage increased from RON 1,050 to RON 1,250. This policy led to a rightward shift of wage distribution mainly for the workers for whom the new minimum wage was binding, i.e. those with gross wages between RON 1,050 and 1,250 in April, and also for part-time workers with contracts amounting to 50% of gross minimum wages, i.e. RON 525-625 (available data do not allow us to separate full-time and part-time workers, so that the partial overlap of these categories can blur the analysis). The distribution of high-wage earners did not change significantly. Despite the minimum wage increase being announced by the government several months in advance, available data suggest most firms adjusted employment contracts only starting in May, postponing as long as it was possible the increase in their labor costs.

Of 1.165 million workers with gross wages between RON 1,050 and 1,250 in April, 88% moved in May to wages of at least RON 1,250 (suggesting a high level of firm compliance with the new gross minimum wage regulations), 6% remained in the same wage bracket, 5% earned less than RON 1,050, and 1% (about 10,000) of contracts were destroyed in May. These include – apart from new unemployed persons – newly retired people, emigrants etc. (available data do not allow us to disentangle these categories).

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16 For a similar but more extensive analysis of the effects of minimum wage increases in Hungary see Harasztosi and Lindner (2017).
Annex 4 Methodological aspects in assessing the increase in the minimum wage increase on general consolidated budget

Data for assessing the impact of the increase in the minimum wage on the budget were taken as follows:
- the number of total employees with minimum wage, but also private and public sector, were taken from the Substantiation notes of the Government decisions.
- the rates of the contributions, personal income tax, VAT and deductions were taken from the Ministry of Finance
- the propensity to consume was taken from Auclert, A. (2017), *Monetary Policy and the Redistribution Channel*, Working Paper NBER

The impact assessment was made based on the legislation in place of each moment when the minimum wage has changed.
The net impact has two components: the revenues component and the expenditures component. The revenues component includes the first-round effects of the increase in the minimum wage and the second-round effects.
The first-round effects were assessed by taking into consideration social contributions of the employees and employers and the personal income tax coming from the beneficiaries of the minimum wage increase. Deductions were also included in the assessment.

In order to evaluate the second-round effects on the budgetary revenues, the hypothesis of 0.7% of the marginal propensity of consumption for the minimum wage earners was used (Auclert, 2017). The next step was to apply the net increase of the minimum wage; the standard VAT rate in place was applied.

The impact on the expenditures side was determined by taking into account the higher wages that had to be paid from the budget for the public employees, but also the social contributions related to the increase in the minimum wage that had to be paid by the employer.

The impact also depends on the number of months in a year influenced by the adopted measure. This is a very important aspect taking into consideration the fact that between 2013 and 2015 the minimum wage increased twice a year. Another important aspect is that the effects of a new measure are seen starting with the next month.