Explaining Unemployment Insurance Spending in Brazil: Determinant Factors and Sensitivity Analysis

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ABSTRACT

Unemployment insurance presents a paradox for the Brazilian economy. One would expect that more people would call upon the benefit in times of recession and that there would be fewer claims during expansions. In Brazil, however, the number of beneficiaries decreases when unemployment increases. Furthermore, when unemployment goes down, the number of beneficiaries goes up.

This paper analyzes which factors explain this behavior. We created an econometric model of unemployment insurance spending with an almost identical predicted and actual value, with an R^2 of 0.99. We estimate that the minimum wage and formalization explain an increase of 69% and 15% in spending in the period of economic expansion. Meanwhile, the cyclical component, expressed by the employment rate, explains a reduction of 71% in the period of recession. We suggest a path for spending control: decoupling from the minimum wage and changing the potential duration of the unemployment insurance in the opposite direction of the business cycles.

Keywords: Unemployment Insurance, Labor Market, Turnover, Minimum Wage

RESUMO

O seguro-desemprego é um paradoxo para a economia brasileira. Espera-se que na recessão, mais pessoas recorressem ao benefício, e, em períodos de expansão, houvesse menos segurados. Todavia, no Brasil, quando o desemprego aumenta, a quantidade de beneficiários diminui. E quando o desemprego reduz, há mais beneficiários.

Este artigo analisa quais fatores explicam esse comportamento. Criamos um modelo econométrico do gasto com seguro-desemprego, cujo valor predito e o realizado são quase idênticos, com R^2 de 0,99. Estimamos que o salário mínimo e a formalização explicam um aumento de 69% e 15% nos gastos no período de expansão econômica. Enquanto o componente cíclico, expresso pela taxa de ocupação, explica uma redução de 71% no período de recessão. Ademais, sugerimos um caminho para o controle de gastos: desvinculação do salário mínimo, e alteração da duração potencial do seguro-desemprego, em sentido oposto aos ciclos de negócios.

Palavras-chave: seguro-desemprego, mercado de trabalho, rotatividade, salário mínimo

JEL classification: J65, H53, C54.

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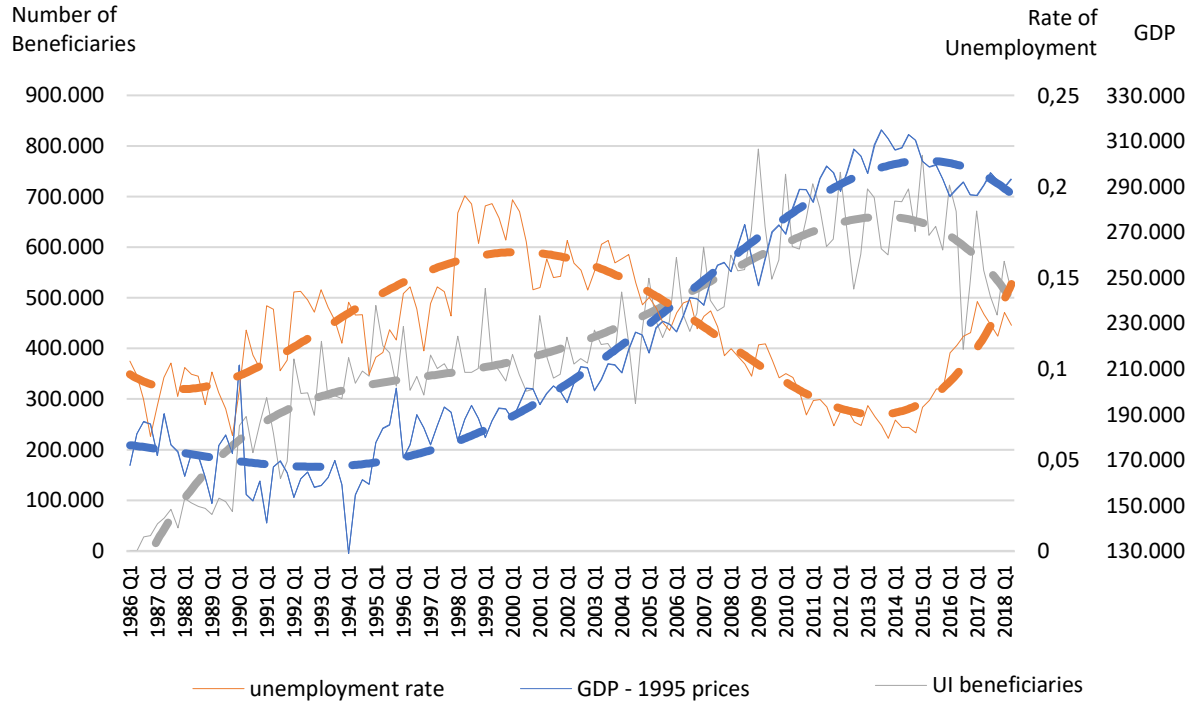
1. INTRODUCTION

Unemployment insurance spending presents a paradox for the Brazilian economy. According to Meyer (2002), one of the purposes of the benefit is to serve as an "automatic stabilizer" in crisis periods. Because of the transfer of income to the unemployed, one hopes the increase in unemployment will not be fully passed on to aggregate demand in periods of recession. As such, unemployment insurance spending is expected to be countercyclical. As Figure 1 shows, however, when the unemployment rate trends up in Brazil, the number of beneficiaries of unemployment insurance trends down. Conversely, when the unemployment rate trends down, there is a significant increase in the number of beneficiaries. What could explain this apparent paradox?

Figure 1: Quarterly series and trends of the unemployment rate, GDP, and the number of unemployment insurance recipients.



Source: developed by the author based on SCN2000/IBGE, SCN2010/IBGE, PME/IBGE, PNADC/IBGE and MTE.

The main explanations in the literature for this behavior involving the beneficiaries of unemployment insurance are: the high turnover of the Brazilian labor market (PINTO; GONZAGA, 2014) and the increase in formal employment (MENEZES FILHO; CABANAS; KOMATSU, 2014). Combined with the significant real increase in the minimum wage since the turn of the century, we get the three main explanatory factors for the increase in unemployment insurance spending. However, how much does each factor contribute to the increase in spending? Are there other reasons that explain this phenomenon? Which is the most important explanatory factor? Do estimates change in different business cycles?

To answer these questions, this study develops an explanatory regression model of unemployment insurance spending. Instead of using an *ad hoc* regression model, we created an explanatory model through mathematical decomposition. This is similar to the methodology used by Barros *et al*. (2006) for the decomposition of per capita income. The mathematical decomposition represents a relevant contribution of this paper to the literature since we develop a selection method of the explanatory variables in the

regression. Mathematical decomposition works as a theoretical model that sustains the choice of the explanatory variables. We believe that it was essential for the regression's high level of fit ($R^2 = 0.99$).

We estimate that the minimum wage was the most significant factor for the increase in spending in the economic expansion phase, contributing 71% to the spending increase. Formalization was the second most important factor, explaining 14% of the increase in spending. Turnover explained only 4% of this increase. During the crisis, on the other hand, turnover explained 104% of the decrease in spending. Contrary to what would be expected, the employment rate, which expresses the cyclical component, was another essential factor in explaining the reduction in spending. This contributed to 79% of the decrease. The sum of the contributions exceeds 100%[3] because there are factors working in the opposite direction, generating an intensifying effect on spending during this period of crisis, such as the minimum wage (30% increase), the job destruction rate (46% increase) and the labor formalization rate (26% increase).

The explanatory role of the turnover and job destruction rates in periods of crisis are intuitive. During negative business cycles, more layoffs, fewer hires, and less incentives for people to seek better jobs are expected. On the other hand, the importance of the level of formalization and the employment rate suggests that the number of eligible persons directly influences unemployment insurance spending. Since the base of eligible workers is pro-cyclical, this result suggests that the unemployment insurance rules create incentives for the eligible people to become beneficiaries. As such, the number of beneficiaries is directly dependent on the business cycles (SANTOS, BUGARIN, and LOUREIRO, 2020).

The explanatory variables of the model are statistics of the labor market, such as the turnover rate[4], job destruction rate[5], formalization rate[6], employment rate[7] and minimum wage. The database pulls statistics from the Annual Corporate Information List (*Relação Anual de Informações Sociais*, RAIS), the National Household Sample Survey (*Pesquisa Nacional por Amostra de Domicílios*, PNAD), and Continuous National Household Sample Survey (*Pesquisa Nacional por Amostra de Domicílios Contínua*, PNADC). The statistics were calculated in the panel format, with annual periodicity, for Brazil's 62 regional divisions, between 2006 and 2017. However, since the purpose of this study was to explain the spending level in the periods of expansion and recession, we used the year 2017 only to estimate the model parameters. The unit of analysis corresponds to a regional division, which can be a: (i) State Capital; (ii) Metropolitan Region, but not a Capital; (iii) Not a Metropolitan Region and not a Capital, according to PNAD's regional division.

This paper analyzes various regression methodologies and uses the panel data methodology with fixed effects. The value predicted by the model and the actual expenses are very similar, with a R^2 result of 0.99. Based on this model, we estimate each explanatory factor's contributing percentage for the increase in unemployment insurance spending in periods of economic expansion (between 2006 and 2014) and recession (between 2014 and 2016). The model's high level of fit is recommended for forecasting spending

[3] The sum of the explanatory factors' contributions to the unexplained part of the model is 100%. The unexplained part reflects the explanatory variables' associations, according to the methodology section of this study.

[4] $$TR = \frac{\sum_j min\ Admissions_j, Dismissals_j}{formal\ employed\ population} \quad (1)$$

, where *j* represents the firm.

[5] $$JD = \frac{\widehat{\sum_j (Dismissals_j - Admissions_j).1_{(Dismissals_j > Admissions_j)}}}{formal\ employed\ population} \quad (2)$$

, where *j* represents the firm.

[6] $$FR = \frac{formal\ employed\ population}{employed\ population} \quad (3)$$

[7] $$ER = \frac{employed\ population}{economically\ active\ population} \quad (4)$$

during crises and expansions, and it corroborates the reliability of the estimates of the variables' effects on the spending.

It is worth mentioning that there are papers in the literature associating unemployment insurance with business cycles (SCHMIEDER, VON WACHTER, and BENDER, 2012; FARBER, ROTHSTEIN, and VALLETTA, 2015). However, these studies analyze how the moral hazard *ex-post* generated by the unemployment insurance (increase in the duration of unemployment) behaves in periods of recession and expansion. No study in the literature explains and models spending in these phases of the economy. The explanatory regression model represents a further contribution of this paper to the academic literature.

Additionally, the paper develops a sensitivity analysis to evaluate the effect of 1% variations in turnover, minimum wage, employment rate, and formalization rate on unemployment insurance spending. We found substantial contributions of the minimum wage, employment rate, and formalization rate.

Finally, the study suggests reforms to reduce the adverse incentives of unemployment insurance. Reforms that would seek to make unemployment insurance spending countercyclical, as should be expected. We suggest a path for the control of spending: decoupling from the minimum wage and changing the potential duration of the unemployment insurance in the opposite direction to the business cycles, just as occurred in the United States after the crisis of 2008. We simulated spending scenarios between 2008 and 2018, reducing the duration of the potential benefit in periods of expansion and increasing it in periods of crisis. In all scenarios, the proposed unemployment insurance policy develops a countercyclical spending behavior. In the conservative scenario, which considers the same number of layoffs as in the previous years, the unemployment insurance spending would generate a reserve fund in the period of economic expansion to defray the higher costs in the period of crisis. The other scenarios consider that reforming unemployment insurance policy would realign the incentives for workers, and that there would be a reduction in the number of layoffs. In these scenarios, the reserve fund would not have to be used, since spending would be less than in other years, even during the economic crisis.

2. THEORETICAL MODEL OF UNEMPLOYMENT INSURANCE SPENDING

We created a mathematical decomposition methodology of unemployment insurance spending. Barros *et al*. (2006) developed a similar methodology to decompose families' per capita income when they analyzed the explanatory factors of the reduction of income inequality in Brazil at the beginning of the 2000s.

Initially, unemployment insurance spending is represented mathematically in a quantum factor and a value factor by multiplying the number of benefits paid and its average value (AV).

$$Spending\_UI = Benefits \times AV \tag{5}$$

The quantum factor represents the number of installments paid to the unemployment insurance beneficiaries of each region. To receive the benefit, the unemployed worker must: (i) be eligible, i.e., have a minimum employment time in a formal job and be laid off; (ii) request the benefit from the government; and (iii) not be employed again while receiving benefits. The non-observable factor k brings all these conditions together. The number of benefits is represented by a function associating the factor k and the number of formal layoffs. For the sake of simplification, this function is a multiplication.

$$Benefits = f\left(k, Demissões_{formal}\right) = k \times Demissões_{formal} \quad (6)$$

A mathematical identity decomposes the number of layoffs from formal jobs. It includes the economically active population (EAP), the employment rate (ER), the formalization rate (FR), and the formal dismissal rate, as follows:

$$Layoffs_{formal} = EAP \times \overbrace{\frac{Employed}{EAP}}^{employment\ rate} \times \overbrace{\frac{Formal}{Employed}}^{formalization\ rate} \times \overbrace{\frac{Layoffs_{formal}}{Formal}}^{formal\ dismissal\ rate} \quad (7)$$

In turn, another mathematical identity can decompose the formal dismissal rate in two labor market statistics: the turnover rate (TR) and job destruction rate (JD). These statistics list the number of admissions (A) and dismissals (D) of firm j in each region.

$$\frac{Layoffs_{formal}}{Formal} = \overbrace{\frac{\sum_j min\{A_j, D_j\}}{Formal}}^{TR} + \overbrace{\frac{\sum_j (D_j - A_j).1_{(D_j > A_j)}}{Formal}}^{JD} \quad (8)$$

In short, the quantum factor can be represented by a function that relates the factor k with the various statistics of the labor market.

$$Benefits = f(k, EAP, ER, FR, TR, JD)$$
$$= k \times EAP \times ER \times FR \times (TR + JD) \quad (9)$$

At the same time, the value factor represents the average value of the unemployment insurance benefits for a region. Since the real increase in the minimum wage occurs at the same time as the increase in unemployment insurance spending, and since the minimum wage is the minimum benefit, this study assumes that the average unemployment insurance benefit is a function of the minimum wage.

$$AV = g(MW) \quad (10)$$

The unemployment insurance spending is rewritten using equations (9) and (10) into equation (5).

$$Spending\_UI = Benefits \times AV$$
$$= k \times EAP \times ER \times FR \times (TR + JD) \times g(MW) \quad (11)$$

Since virtually all variables are multiplying and function $g(.)$ is unknown, we performed a logarithmic transformation of the equation. We represented the sum of the turnover and job destruction rates as function

$h(.)$. Additionally, we included a dummy variable for the change in the unemployment insurance rules because of the rule changes in unemployment insurance that occurred at the end of 2014 and entered into effect after March 2015.[8] These rule changes increased the minimum employment time for unemployment insurance eligibility for workers who asked for the benefit for the 1st and 2nd time and probably generated a reduction in spending after 2015. This dummy captures this effect and estimates the impact on unemployment insurance spending generated by the change in rules.

$$ln(Spending\_UI) = ln(k) + ln(EAP) + ln(ER) + ln(FR) + h(TR, JD) + Change\_in\_Law + g(MW) \quad (12)$$

Due to the unknown sub-functions $h(.)$ and $g(.)$, the non-observable factor k, and the differences between the various databases involved, it is not possible to obtain the mathematical identity. However, a function that relates these variables and uses these transformations can estimate similar results to the actual unemployment insurance spending.

3 EXPLANATORY METHODOLOGY USING DETERMINING FACTORS

The methodology to explain the spending variation through determining factors is very similar to the one developed by Barros *et al*. (2006) to explain the variation in the Gini coefficient. The great advantage of this methodology is the simulation of the explanation of 100% of the variation in spending with the explanatory variables. Its weak point, however, is the extrapolation of projections of the explanatory variables with significant variations. It does not consider marginal changes in these variables. Therefore, the estimates of this method are not causal but constitute an interesting exercise of explaining unemployment insurance spending in the periods under analysis.

Let $F_{w,z}$ be a function that represents the spending variation on unemployment insurance. And let $F_{w,z}$ be a function that represents the variations of the marginal distributions of two random variables (w, z) and the association[9] between them. Then:

$$F_{w,z} = \Phi(F_w, F_z, A_{w \to z}) \quad (13)$$

Using this notation to represent the unemployment insurance spending of equation (12), all the theoretical model variables and an association between them are included:

$$\Delta Spending\_UI = \Phi\left(F_{EAP}, F_{ER}, F_{FR}, F_{TR}, F_{JD}, F_{MW}, F_{LAW}, A_{UI}\right) \quad (14)$$

To estimate the spending variation explained by one variable, the predicted spending values in t_0 and t_1 are estimated, using the real value of this variable in t_0 and t_1, and using the mean value between t_0 and t_1 of the other variables. Finally, the difference between the predicted spending values is calculated. As an example, one can look at the procedure to estimate the EAP's contribution to unemployment insurance spending between 2006 and 2016.

[8] MP no. 665/2014 and Law no. 13.134/2015.

[9] Where $f(w, z) = wz$. Then, $F_{k,z} = \Delta f(w, z) = \Delta wz + w\Delta z + \Delta w\Delta z = \Phi(F_w, F_z, A_{w \leftrightarrow z})$, where $A_{w \leftrightarrow z}$ is the association between the variations of the random variables w and z.

First, the predicted spending value is estimated if all variables had mean values between 2006 and 2016, for each i, apart from EAP, which will have the value of 2006.

$$ln\left(Spending\_UI_{i,2006}^{EAP}\right) = \beta_1 ln(EAP_{i2006}) + \beta_2 ln(\overline{ER_i}) + \beta_3 ln(\overline{FR_i}) + \beta_4 \overline{TR_i} + \beta_5 \overline{JD_i} + \beta_6 ln(\overline{MW}) + \beta_7 \overline{Change\_in\_Law} + \bar{k}_i \quad (15)$$

Second, the predicted spending value is estimated using the EAP with the values of 2016.

$$ln\left(Spending\_UI_{i,2016}^{EAP}\right) = \beta_1 ln(EAP_{i2016}) + \beta_2 ln(\overline{ER_i}) + \beta_3 ln(\overline{FR_i}) + \beta_4 \overline{TR_i} + \beta_5 \overline{JD_i} + \beta_6 ln(\overline{MW}) + \beta_7 \overline{Change\_in\_Law} + \bar{k}_i \quad (16)$$

Finally, the subtraction ratio of the predicted values is calculated, without the logarithmic transformation, through the variation in spending.

$$\Delta EAP_{SD} = \frac{\sum_i Spending\_UI_{i,2016}^{EAP} - Spending\_UI_{i,2006}^{EAP}}{\sum_i Spending\_UI_{i2016} - Spending\_UI_{i2006}} \quad (17)$$

4. DATABASES AND REGRESSION MODELS

The databases include annual information from 62 regional divisions in Brazil between 2006 and 2017. However, since the purpose of this paper was to explain the spending level in the periods of expansion and recession, we used the year 2017 only to estimate the parameters of the model. We created the unit of analysis based on information from State, Metropolitan Region and State Capital, i.e., each "i" of equation (18) refers to a region that can be a: (i) State Capital; (ii) Metropolitan Region, but not a Capital; (iii) Not a Metropolitan Region and not a Capital. In all, there are nine metropolitan regions (Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo, Curitiba and Porto Alegre) that are available in the National Household Sample Survey (*Pesquisa Nacional por Amostra de Domicílios*, PNAD).

The labor market statistics of EAP, ER, RF and $average\ wage$, between 2006 and 2015, except 2010, were calculated with the PNAD, a database with annual periodicity published by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística*, IBGE), the government's official statistics agency and the main and internationally recognized provider of data and information on the country. Starting in 2016, the source of these statistics becomes the Continuous National Household Sample Survey (*Pesquisa Nacional por Amostra de Domicílios Contínua* – PNADC), a survey published by the IBGE and the successor of the PNAD after this year. In 2010, the source is the statistical Census conducted by the IBGE. All statistics were calculated from microdata on the level of individuals and then consolidated in averages for the 62 regional units used.

The remaining labor market statistics, TR and JD, were initially calculated for each company using the microdata identified from the Annual Corporate Information List (*Relação Anual de Informações Sociais*, RAIS) of the defunct Ministry of Labor. The unemployment insurance spending was obtained from the administrative database of the defunct Ministry of Labor. Finally, we deflated all monetary variables to 2016 prices. Table 1 presents the descriptive statistics of the variables used.

Table 1 - Descriptive statistics of the database

Variable	Mean	Standard Deviation	Minimum	Maximum
UI Spending (R$ million)	510	808	109	6060
EAP (millions of people)	1.64	2.08	0.05	12.7
ER	0.91	0.04	0.71	0.98
FR	0.58	0.16	0.15	0.87
TR	0.30	0.14	0.00	1.13
JD	0.08	0.04	0.00	0.35
MW (R$)	807	88	658	937
Average Wage (R$)	1,852	793	464	4,508

Source: Developed by the author based on PNAD, PNADC, 2010 Census (IBGE), and MTE. EAP: Economically Active Population. ER: Employment Rate. FR: Formalization Rate. TR: Turnover Rate. JD: Job Destruction Rate. MW: Minimum Wage. Maximum UI Maximum Unemployment Insurance Benefit.

The employed regression model lists the variables of equation (12) in a fixed effects approach without constant, where factor k can be represented by the individual characteristics of each region constant in time.

$$ln(Spending\_UI_{it}) = \beta_1 ln(EAP_{it}) + \beta_2 ln(ER_{it}) + \beta_3 ln(FR_{it}) + \beta_4 TR_{it} + \beta_5 JD_{it} + \beta_6 ln(MW_t) + \beta_7 Change\_in\_Law + k_i + u_{it} \quad (18)$$

Table 2 describes all the explanatory variables used in the study and describes the origin of the data.

Table 2 - Description of the explanatory variables

Variables	Description	**Source**
ln.EAP (people)	Logarithmic transformation of the Economically Active Population.	Between 2006-2009, and between 2011-2015: PNAD. in 2010: Census. in 2016 and 2017: PNADC
ln.Employment Rate	Logarithmic transformation of the employment rate (ratio between employed people and the Economically Active Population)	Between 2006-2009, and between 2011-2015: PNAD. in 2010: Census. in 2016 and 2017: PNADC
ln.Formalization Rate	Logarithmic transformation of the formalization rate (ratio between people employed in formal jobs and employed people). The following are considered formal jobs: contracts with the employment record card (*carteira de trabalho*), public servants, military, employers, and self-employed workers with CNPJ and any professional with a contribution to social security.	Between 2006-2009, and between 2011-2015: PNAD. in 2010: Census. in 2016 and 2017: PNADC
Turnover	Turnover rate calculated initially by company and recalculated as an average for the region of study.	RAIS
Job Destruction	Destruction rate calculated initially by company and recalculated as an average for the region of study.	RAIS
ln.Minimum Wage	Logarithmic transformation of the annual minimum wage in real terms, in 2016 prices.	Between 2006-2009, and between 2011-2015: PNAD. in 2010: Census. in 2016 and 2017: PNADC
Maximum UI/MW	The ratio between the maximum unemployment insurance benefit and the minimum wage.	Developed by the author based on the directives of the defunct Ministry of Labor.
ln.Average Wage	Logarithmic transformation of the average wage of the job market in the region of study.	Between 2006-2009, and between 2011-2015: PNAD. in 2010: Census. in 2016 and 2017: PNADC
ln.Average Wage (Lagged 1A)	Logarithmic transformation of the average salary of the job market in the region of study. Lagged for 1 year.	Between 2005-2009, and between 2011-2015: PNAD. in 2010: Census. in 2016: PNADC
Trend ln.GDP (HP)	Trend of the logarithmic transformation of the GDP, estimated by the Hodrick-Prescott filter.	Municipal GDP from the IBGE, aggregated for the region of study.
ln.BFP Households	Logarithmic transformation of the annual average number of households who are recipients of the *Bolsa Família* Program.	Beneficiary households per municipality per month: Ministério da Cidadania. Subsequently, the families were aggregated for the region of study.
ln. UI Spending (lagged 1A)	Logarithmic transformation of the unemployment insurance spending.	Defunct Ministry of Labor.
Change in the UI Law	Dummy indicating 1 for the years 2015, 2016 and 2017 and 0 for the years between 2006 and 2014.	Developed by the author.
Year dummy	Dummy indicating 1 for each year and zero for all others.	Developed by the author.

Source: Developed by the author.

Initially, we chose models with a high explanatory power of the predicted spending concerning the actual spending. Subsequently, we chose a model from those with good fits by analyzing the significance of the explanatory variables. To evaluate each regression model's fit, this study develops a new R^2 measure, referred to in the table as R^2_{exp}. This new measure was necessary because the traditional R^2 measure uses values predicted with logarithmic transformations. In this scenario, we obtained models with an R^2 greater than 0.9, but with high errors of the estimated spending in monetary units. To avoid this problem, this study recalculated the R^2 statistic considering the measures in monetary units, as follows.[10]

$$R^2_{exp} = \frac{ESS}{ESS + RSS} \tag{19}$$

The regression models presented in Tables 3 and 4 were based on equation (18), with changes regarding the inclusion or exclusion of: (i) constant of the model; (ii) year dummies; (iii) fixed effects (variables k_i); (iv) lagged dependent variable; (v) lagged average income; (vi) ratio between the maximum and minimum unemployment insurance values; (vii) dummy of the unemployment insurance rule change in 2015 and 2016; (viii) number of households who were recipients of the *Bolsa Família* Program; and (ix) GDP trend estimated by the Hodrick-Prescott filter.

As estimation methodology, we used regressions with pooled panels (POLS), Random Effects (RE), Fixed Effects (FE), Maximum-Likelihood (ML), and Generalized Method of Moments (GMM). The ML method used previously modified variables with transformations *within* (variable minus the average in time). The GMM models analyze dynamic panels, which use the lagged dependent variable and the lagged average income as explanatory variables. The configuration of the instruments of the GMM models can be seen in the footer of Table 4.

Table 3 - Estimates of the unemployment insurance spending models

Variables	**POLS**	**RE**	**FE**	**FE**	**FE**	**FE-ML**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
ln.EAP (people)	1.05***	1.02***	0.49***	0.27***	0.48***	0.49***
	(0.0075)	(0.02)	(0.064)	(0.061)	(0.05)	(0.061)
Ln.Employment Rate	-0.59*	0.79***	1.36***	0.58**	1.37***	1.36***
	(0.23)	(0.22)	(0.2)	(0.21)	(0.19)	(0.19)
Ln.Formalization Rate	1.52***	0.99***	0.54***	0.36***	0.54***	0.54***
	(0.058)	(0.07)	(0.072)	(0.068)	(0.071)	(0.069)
Turnover	1.13***	0.73***	0.45***	0.24**	0.45***	0.45***
	(0.098)	(0.083)	(0.078)	(0.074)	(0.078)	(0.074)
Job Destruction	3.44***	2.38***	1.87***	1.62***	1.86***	1.87***
	(0.34)	(0.26)	(0.24)	(0.23)	(0.23)	(0.23)
ln.Minimum Wage	0.81***	1.02***	1.77***	0.16	1.76***	1.77***
	(0.12)	(0.087)	(0.098)	(0.49)	(0.093)	(0.093)
Maximum UI/MW	1.04***	0.58**	0.49**	-4.10**	0.46***	0.49**
	(0.28)	(0.19)	(0.18)	(1.44)	(0.13)	(0.17)
ln.Average Wage	-0.097*	0.15**	-0.008	0.081	-0.01	-0.008
	(0.044)	(0.052)	(0.053)	(0.048)	(0.052)	(0.051)
Constant	x	x	x	x		
Year dummy				x		
Fixed Effects			x	x	x	x
N	744	744	744	744	744	744
R^2	0.98		0.85	0.89	1.00	
R^2_{exp}	0.96779	0.96607	0.08148	0.02200	0.98841	0.98840

Source: Developed by the author. Note: The values in parentheses are standard errors. Legend: * p<0.05; ** p<0.01; *** p<0.001.

Model 1 uses a POLS regression of pooled data. Its fit had a R^2 of 0.98 and R^2_{exp} of 0.97. As for the coefficient signals, only the employment rate's parameter had a different signal than expected.

[10] Since the dependent variable in the regression has a logarithmic transformation, the mean error is no longer zero after transforming the predicted value in R$. Therefore, $RSS + ESS \neq TSS$. As such, we chose to include the sum $ESS + RSS$, instead of TSS, in the denominator to ensure values of R^2_{exp} between 0 and 1.

With the progression of the models, Table 3 introduces the panel methodologies as RE and FE. The Hausman test between models (2) and (3) rejected the null hypothesis with a p-value = 0. This result indicates the importance of the regression model controlling the fixed effects constant in time. However, when comparing the R^2_{exp} statistics, the RE model has a much higher fit of 0.97 than the 0.08 fit of the FE model.

When the year dummies were included, the estimated coefficients of the minimum wage and the variable "$Maximum\_UI/MW$" started having negative values. This result is counter-intuitive, and it signals that there is multicollinearity between these variables and the year dummies.[11] The fit measure R^2_{exp} also did not improve.

Model 5 used a POLS regression with dummies for each region and no constant and no year dummies. In practice, this model is a FE without constant. Its fit measure R^2_{exp} improved significantly with a value of 0.99. When comparing model 5 to model 3, we observed that the cause of the poor fit of FE models could be traced to the inclusion of the constant. In model 5, all coefficients had the expected signals. All estimates were significant at the level of 1%, except for the average wage.

Following the evolution of the models, model 6 uses a FE approach with the maximum-likelihood estimation method. With the variables previously subtracted from the mean of each region in time, the ML method estimates the parameters without the constant of the model. The estimates were identical to model 3, but since there is no constant, the degree of statistical fit R^2_{exp} improved significantly, being almost equal to model 5.

[11] The VIF measures in model 3 of the variables ln(minimum wage) and "Maximum UI/MW" were 6.75 and 4.32; in model 4, these measures went to 225.34 and 383.98.

Table 4 - Estimates of the unemployment insurance spending models

Variables	**FE (7)**	**FE (8)**	**FE (9)**	**GMM (10)**	**GMM (11)**
ln.EAP (people)	0.6*** (0.04)	0.52*** (0.041)	0.29*** (0.043)	0.38*** (0.051)	0.3*** (0.047)
Ln.Employment Rate	1.54*** (0.19)	0.98*** (0.21)	0.64** (0.22)	-0.032 (0.25)	-0.15 (0.27)
Ln.Formalization Rate	0.51*** (0.063)	0.52*** (0.062)	0.23*** (0.065)	0.44*** (0.065)	0.32*** (0.062)
Turnover	0.56*** (0.072)	0.37*** (0.078)	0.14 (0.078)	0.4*** (0.12)	0.1 (0.13)
Job Destruction	1.57*** (0.22)	2.07*** (0.23)	1.53*** (0.23)	0.56 (0.34)	1.23* (0.53)
ln.Minimum Wage	1.64*** (0.075)	1.80*** (0.078)	0.88*** (0.17)	-0.1 (0.091)	0.039 (0.1)
ln.Average Wage (Lag. 1 year)				0.057 (0.053)	0.11 (0.067)
Trend ln.GDP (HP)			0.42*** (0.062)		
ln.BFP Households			0.19*** (0.035)		0.014 (0.03)
ln. UI Spending (Lag. 1 year)				0.64*** (0.05)	0.7*** (0.039)
UI Law Change		-0.094*** (0.016)	-0.16*** (0.022)		-0.15*** (0.017)
Constant					x
Year dummy					
p-value AR (2)				0.447	0.902
p-value Hansen				0.421	0.467
N	744	744	682	620	620
R^2	0.99997	0.99997	0.99997		
R^2_{exp}	0.98713	0.98833	0.98924	0.98619	0.98920

Source: Developed by the author.

Note: (1) The values in parentheses are standard errors. (2) GMM models instrumentalize lagged spending and average wage variables. (3) GMM models use all exogenous explanatory variables as instruments in the difference, except for the dummy of the amendment of the unemployment insurance law. (4) GMM models use the year dummies, the unemployment insurance law amendment dummy, and the lagged spending and average wage variables with 1 and 2 additional lags, as level variables. (5) Model 10 also uses the GDP trend and the logarithmic transformation of the BFP Household instruments. (6) Model 11 also uses the instruments in t and with a lag of the GDP trend and the logarithmic transformation of the BFP Household. Legend: * p<0.5; ** p<0.01; *** p<0.001.

All models in Table 4 use model 5 as a reference. Model 7 excludes the variables "Maximum UI/MW" and the average wage. In this model, only the minimum wage explains the average unemployment insurance benefit, in accordance with the hypothesis presented in equation (10). All estimates are within expectations and the measure R^2_{exp} had a small drop.

Model 8 adds a dummy to model 7, indicating the years after the unemployment insurance rule change through MP 665/2014 and Law 13.134/2015. All estimates are significant and within the expected range. We chose this model to carry out the simulations and estimates in the rest of the paper. The choice for model 8 occurred because of the excellent fit of its R^2_{exp} and the significance of the estimates.

Model 9 adds the variables GDP trend and number of beneficiary households of the *Bolsa Família* Program (BFP). In this model, the turnover coefficient ceases to be significant, and the formalization rate coefficient

had low significance. This may be the result of the multicollinearity[12] between the GDP trend and those variables that are strongly dependent on business cycles, like turnover and employment rate.

Models 10 and 11 include the lagged dependent variable and the lagged average wage as explanatory variables. They estimate dynamic regression models and use the GMM method. However, with the inclusion of lagged unemployment insurance spending, the main variables of the spending model (minimum wage and employment rate) lose their explanatory power and significance. All its instrument configurations are described in the comments of the footnotes in Table 4.

5. EXPLANATION OF THE UNEMPLOYMENT INSURANCE SPENDING DURING ECONOMIC RECESSION AND EXPANSION

How much does each factor contribute to the increase in spending in the period between 2006 and 2016, which was R$ 10.4 billion and went to R$ 35.6 billion? Does the contribution of each factor change when the economy is expanding and when it is in crisis? This section seeks to answer these questions and estimate how much each explanatory factor contributed to the spending variation. Table 5 first presents estimates on how each factor explains the variation in spending from 2006 to 2016.

Table 5: Contribution of each explanatory factor to the increase in unemployment insurance spending between 2006 and 2016

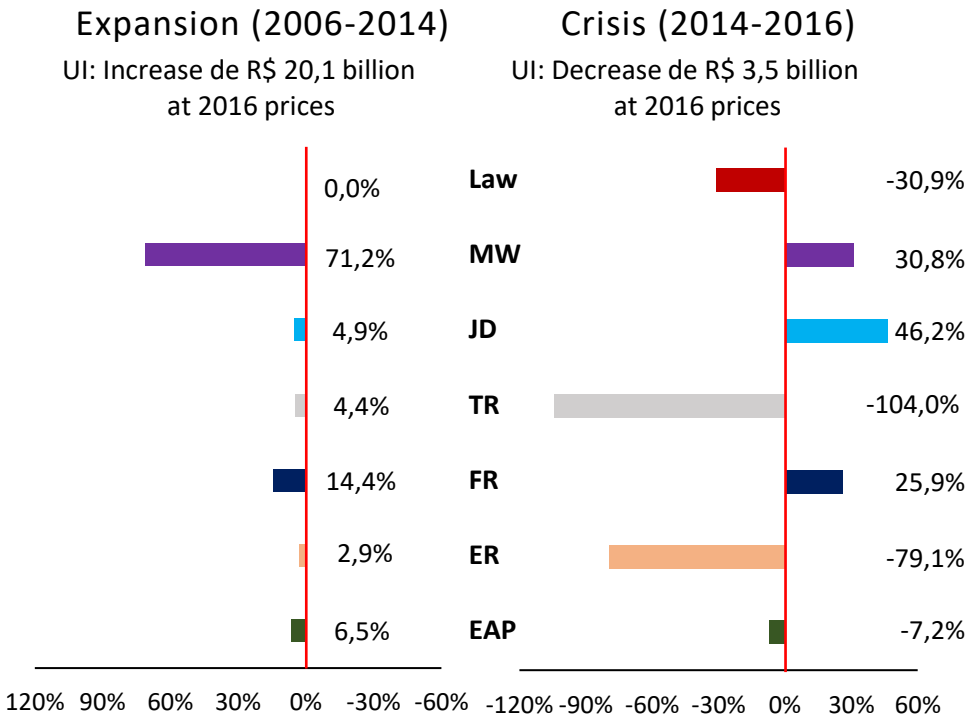
Variables	Contribution (in R$ billion)	Contribution (in %)	Standard Error	Confidence Interval	
				Minimum Value	Maximum Value
EAP	1.78	7.1%	0.2%	6.8%	7.4%
ER	-1.12	-4.4%	0.2%	-4.8%	-4.0%
FR	4.83	19.2%	0.5%	18.4%	20.0%
TR	-0.29	-1.1%	0.1%	-1.4%	-0.9%
JD	2.70	10.7%	0.3%	10.2%	11.2%
Minimum Wage	23.34	92.8%	1.2%	90.8%	94.7%
UI Law Change	-3.87	-15.4%	0.6%	-16.5%	-14.3%
Associations	-2.22	-8.83%	-	-3.59%	-14.06%

Source: Developed by the author.
NOTE: The standard error estimate used the projected variance for each region i, considering independence between the regions for each variable.

The minimum wage and formalization rate can be highlighted between 2006 and 2016, explaining 93% and 19% of the increase in spending. Surprisingly, turnover had a small and negative effect in explaining the increase in spending. This may be because the turnover rate decreased considerably after 2014 with the beginning of the economic crisis. It remains to be seen whether this result is comparable in the period of economic expansion and recession since spending in constant prices grew during the economic expansion and decreased during the crisis.

[12] The VIF measure of the GDP trend is 423.

Figure 2 - Contribution of each explanatory factor to the increase in unemployment insurance spending during periods of economic expansion and crisis in Brazil



Source: Developed by the author. To ensure that the sums were 100% and -100%, the associations must be added, which were 4.4% during the expansion and high during the crisis: 18%.

According to Figure 2, the minimum wage had a continuous effect on the increase in unemployment insurance spending during both the economic expansion and crisis. This variable explains 71% of the increase in spending in the period of expansion and 31% during the crisis. The same effect also occurred with the formalization rate, which explains 14% of the increase in spending during the expansion and 26% during the crisis.

Turnover contributed to a 4% increase in spending during the economic expansion and a -104% reduction in spending during the crisis, constituting a strongly pro-cyclical component of spending. The job-destruction rate had a similar effect as turnover during the economic expansion, but during the crisis, it contributed to an increase of 46% in spending. This is because, in times of crisis, layoffs tend to be accompanied by job destruction, while during economic expansions, the dismissals are accompanied by the replacement of workers and an increase in turnover.

The employment rate during the economic expansion had a small effect of 3% on the spending increase, but during the crisis, it contributed significantly to the reduction in spending, with 79.1%. The importance of the level of formalization and the employment rate suggests that unemployment insurance spending is directly influenced by the number of people eligible for the benefit. Since the base of eligible workers is pro-cyclical, this could suggest that the unemployment insurance rules create incentives for the eligible persons to become beneficiaries. As such, the number of beneficiaries is directly dependent on the business cycles (SANTOS, BUGARIN, and LOUREIRO, 2020).

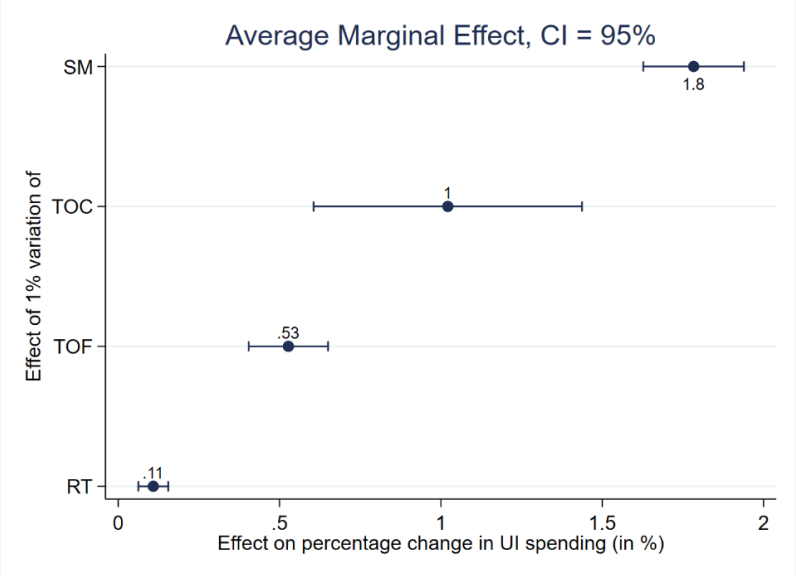
Finally, it is worth pointing out the role of the amendment to the law as established by MP 665/2014 and Law 13.134/2015. Since it went into effect after 2015, it had no effect during the expansion. During the crisis, it contributed 31% to the reduction in spending during this period. In terms of values, this amendment generated R$ 3.7 billion in savings per year.

6. SENSITIVITY ANALYSIS OF THE SPENDING AND PROPOSALS FOR REFORM

We know the role of each variable in explaining spending in the past. However, what is the expected effect on future expenses? Which variables are likely to be changed through public policy? All these questions will be analyzed in this section.

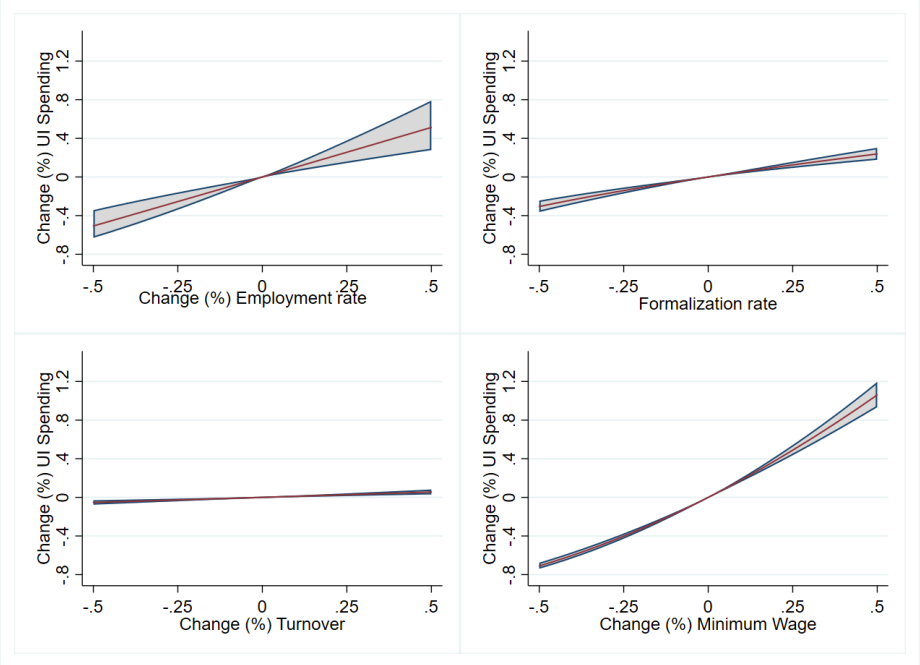
Figure 3 shows the marginal effect of a 1% change in the employment, formalization and turnover rates, and the minimum wage on the percentage change in unemployment insurance spending. This statistic - known as elasticity - measures the sensitivity that these variables have on spending.

Figure 3 - Sensitivity analysis of the elasticity of the variables on unemployment insurance spending



Source: Developed by the author.

Figure 4 - Sensitivity analysis of the variation between -50% and +50% of the variables on the percentage variation of unemployment insurance spending



Source: Developed by the author.

Turnover also appears to be a feasible target of labor reforms in Brazil. However, its sensitivity levels on spending are minimal. A change of 1% in turnover generates a reduction of 0.11% in spending. Its effect is significant but small. This variable has frequently been pointed out as one of the main causes of the increased spending in the last decade (PINTO; GONZAGA, 2014). According to the estimates from the present study, the influence of turnover on spending is minimal. We will not address suggestions for reforms in the unemployment insurance system for this statistic.

Minimum wage is the variable that affects unemployment insurance spending most. A real increase of 1% generates a real increase of 1.8% in unemployment insurance spending. Moreover, the growth in spending was heavily influenced by the continued increases in the minimum wage since the last decade.

The minimum wage is fixed by the government each year and is meant to positively influence the wages of the poorest population, which cannot receive a lower wage. The policy for the real appreciation of the minimum wage in Brazil takes GDP growth and past inflation into account. Therefore, the minimum wage contributes to increases in spending in times of economic growth. However, the nominal wage does not decrease during crises, which generates another pull on expenses in times of crisis.

In the literature, Doyle (2007) and Jales (2018) analyze its behavioral effects in the labor market. Jales (2018), who analyzes the Brazilian case, estimated that increasing the minimum wage reduces employment in the formal sector by 9% and increases informality by 39%. However, he also estimates that the average income of formal workers increases by 16%, since the minimum wage increases the income of workers who earn less compared the case with no minimum wage policy.

But given that unemployment insurance is an insurance and not a work remuneration, should its value be downward limited by the minimum wage? We suggest decoupling the minimum value of the unemployment insurance from the minimum wage to reduce spending and reduce the adverse incentives generated by the unemployment insurance system in Brazil. In practice, the minimum value of the benefit would remain linked to the minimum wage at the level of 80% of its value, since this is the smallest remuneration allowed for formal workers. However, this reduction in the replacement rate of unemployment insurance would benefit cost control, realign the incentives of the unemployment insurance policy (TOPEL,1983) and ingrain the beneficial effects of the minimum wage increase policy on the wages of the poorest employed population.

Simultaneously, as can be seen in Figure 3, the high elasticities of the employment (elasticity = 1) and formalization (elasticity = 0.53) rates on spending reflect how the cyclical component exerts direct pressure on unemployment insurance spending. This effect probably exists because the unemployment insurance system creates adverse incentives for eligible people to become beneficiaries through a moral hazard *ex-ante* (SANTOS, BUGARIN, and LOUREIRO, 2020). Since the base of eligible workers is a direct function of the employment and formalization rate, the number of beneficiaries is directly dependent on the business cycles.

To contain this pro-cyclical effect, reduce the effects of the employment and formalization rates on spending, and inhibit the effect of the number of people in the labor market being translated into higher unemployment insurance costs, we suggest changing the rule regarding the potential duration of the unemployment insurance. We suggest reducing it in periods of expansion and increasing it in times of crisis. Just as occurred in the United States during the crisis of 2008 and after the beginning of the economic expansion in the following years.

During economic expansions, there are more job offers, and unemployment insurance is not as needed by the worker as during a crisis. Therefore, the potential duration of the unemployment insurance can be adjusted to the business cycles in the economy. The next section will examine a concrete proposal to change this rule and we will simulate some spending scenarios between 2008 and 2018, comparing the proposed rule with the rule that was in effect until 2014.

7. SPENDING SIMULATION WITH THE RULE CHANGE REGARDING THE POTENTIAL DURATION OF THE UNEMPLOYMENT INSURANCE

Table 6 presents a proposal for a new rule. It reduces the potential duration of the benefit in periods of expansion and increases it in periods of crisis, just as occurred in the United States after the crisis of 2008 and after the beginning of the economic expansion.

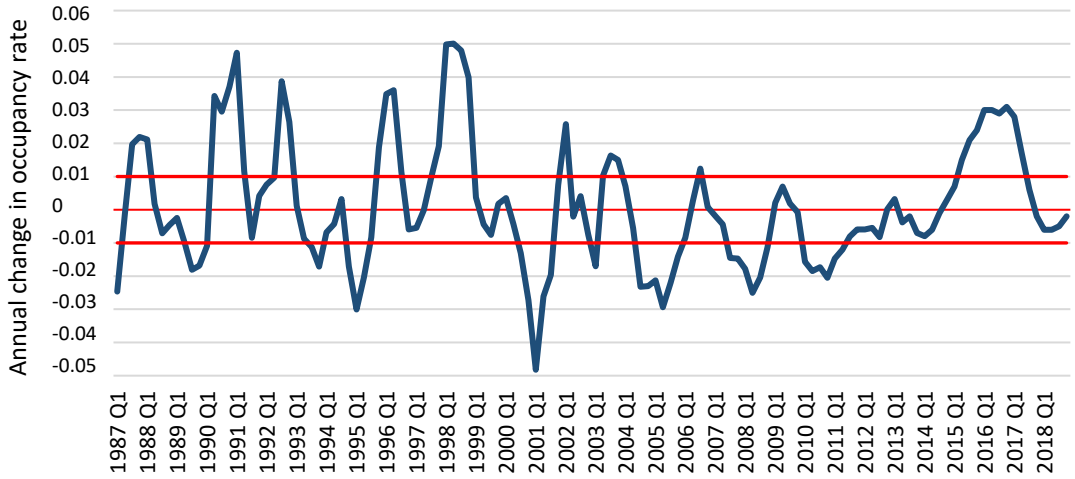
Table 6: New proposed rule for the potential duration with changes in the business cycles.

X = unemployment rate$_{(Q)}$ - unemployment rate$_{(Q-4)}$	**6-11 months**	**12-23 months**	**>=24 months**
$X \geq 1\,p.p.$	4	5	6
$0\,p.p. \leq X < 1\,p.p.$	3	4	5
$-1\,p.p. \leq X < 0\,p.p.$	2	3	4
$X < -1\,p.p.$	1	2	3

Source: Developed by the author. NOTE: Q = Quarter.

The parameter of the rule proposed in Table 6 is the annual variation of the unemployment rate, published quarterly by the IBGE. Figure 5 shows a time series of this parameter and the delimitation of the suggested potential duration levels of the unemployment insurance. According to the proposed rule, the potential duration of the unemployment insurance would be one month longer than is currently the case from the second quarter of 2015 until the second quarter of 2017. However, during most of the economic expansion period, from the beginning of the year 2000 until the fourth quarter of 2014, there would be a reduction in the potential duration of unemployment insurance.

Figure 5 - Annual variation of the unemployment rate

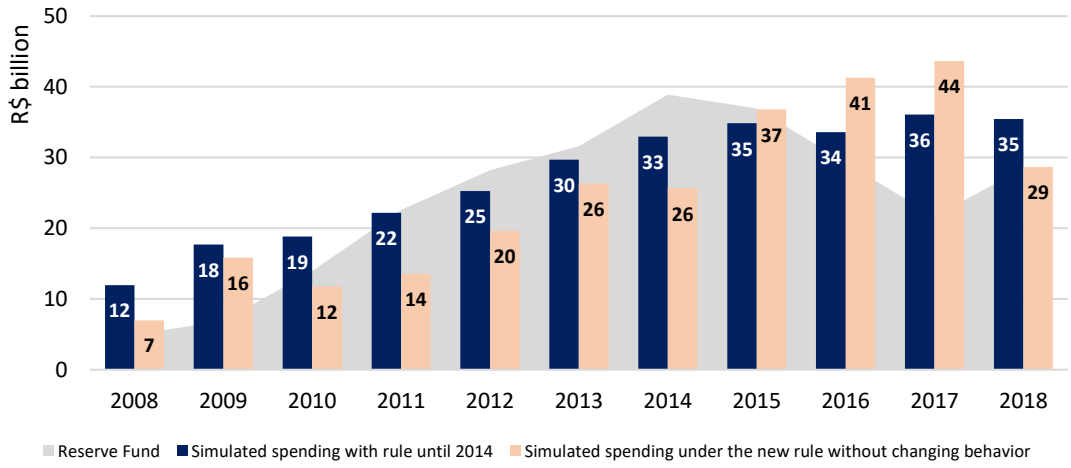


Source: Developed by the author based on PNADC, PNAD and PME.

In order to estimate the fiscal impact of the rule change, this study initially simulated unemployment insurance spending according to the rule that was in effect until 2014 (3, 4, and 5 months of duration of unemployment insurance for 6, 12 and 24 months of job tenure) and according to the proposed rule for the years between 2008 and 2018. This simulation considered that laid-off workers would use the full period of the potential unemployment insurance duration and start receiving payment immediately one month after applying for unemployment insurance. Since the data are simulated, they do not represent the actual spending in the period.

Figure 6 presents this simulation. The spending generated by the new rule was conservative and did not result in a reduction of layoff behavior. As can be seen, spending according to the proposed rule is less until 2014. Between 2015 and 2017, they were higher than the spending under the rule in force until 2014. In 2018 it was lower. By reducing spending in the period of economic expansion, the government could create a reserve fund to defray the higher costs in crisis. According to the simulation, the fund would be used between 2015 and 2017 and still have a balance of R$ 28.5 billion in 2018. This spending proposal ensures the countercyclical behavior that is expected of the unemployment insurance policy as well as the fiscal balance of the public accounts in face of the business cycles.

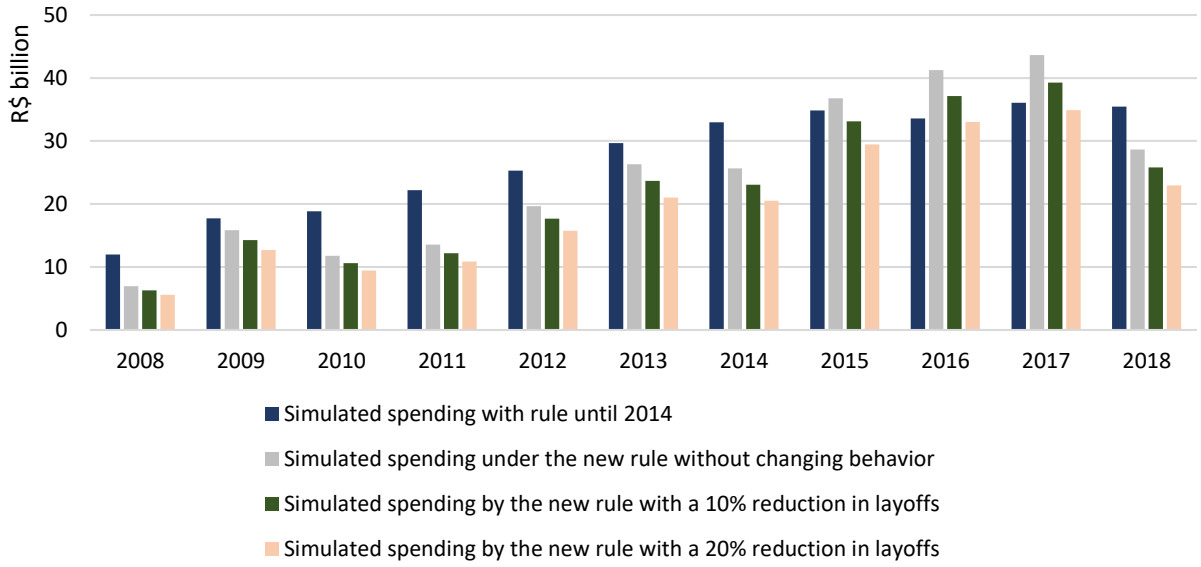
Figure 6: Spending simulation according to the rule in force until 2014 and according to the rule proposed in this study.



Source: Developed by the author. Simulated values, they do not represent actual spending.

Figure 7 simulates four unemployment insurance spending scenarios. The first two presented in Figure 6 and two more new scenarios with a reduction in the number of layoffs caused by the new rule. These scenarios assume that the new rule can reduce the moral hazard *ex-ante* (SANTOS, BUGARIN, and LOUREIRO, 2020) of the worker by 10% and 20% in the number of layoffs, respectively.

Figure 7 - Spending simulation according to the rule in force until 2014 and according to the rule proposed in this study with layoff reduction scenarios.



Source: Developed by the author. Simulated values, they do not represent actual spending.

The two scenarios with reductions in layoffs caused by the rule change have less unemployment insurance spending than the conservative scenario. The scenario with 20% fewer layoffs caused a spending reduction in all years, even during the crisis. According to this scenario, the change in the unemployment insurance rule would reduce public spending, increase the coverage of the benefit during the most challenging moments for the worker (the crisis), and promote the countercyclical behavior of the unemployment insurance policy.

8. CONCLUSION

We estimate that the minimum wage policy was the most significant factor in the increase of expenditures in the economic expansion phase. The second-largest contributor was the formalization rate. Turnover explained very little of this increase. In turn, turnover was the main explanatory factor for the reduction in spending during the crisis. Paradoxically, the second factor that contributed most to the reduction in spending was the reduction in the economy's employment rate.

The effects of the employment rate and formalization rate on unemployment insurance spending reveal how the unemployment insurance system rules induce pro-cyclical spending. These two variables show that the base of eligible workers for unemployment insurance generates a strong direct effect on spending. Santos, Bugarin, and Loureiro (2020) point to a possible reason that leads eligible workers to become beneficiaries when the economy is expanding. These authors found that the probability of dismissal increases when workers are eligible for unemployment insurance, estimated that this effect is greater when the economy is expanding, and modeled the worker's behavior , while employed, when faced with the incentives created by the unemployment insurance system. According to them, when the economy is expanding, the worker has more chance to find another job. This creates a moral hazard *ex-ante* for the worker, who will be more likely to behave to be fired since he can receive the unemployment insurance and enjoy leisure activities. When the economy is in crisis, however, there is less chance of rehiring and the worker tends to do more at work to keep their job.

Finally, we suggest changes in the unemployment insurance rules in order to contain spending, increase the coverage of the benefit in moments of crisis, realign the incentives created by unemployment insurance, and promote a countercyclical spending behavior. We suggest (i) to uncouple the minimum unemployment insurance value from the minimum wage; and (ii) to change the rule of the potential duration of unemployment insurance to reduce it in periods of expansion and increases it in times of crisis. These rule changes tend to reduce the adverse incentives created by the unemployment insurance system and increase the efficiency of the labor market, without necessarily removing workers' rights.

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