Unions and economic inefficiency in Brazil: a CGE approach

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Abstract

The aim of this paper is to investigate how wage distortions provoked by the presence of union negotiation affect economic efficiency in Brazil using a static CGE model. The CGE model is calibrated to replicate a 2003 Brazilian SAM. The SAM is disaggregated into 12 activities. Because the union density varies across industries, a multi-sectorial model can provide a more accurate representation of unionized labor in each industry. The wage premium was econometrically estimated by using micro data for the 2003 Brazilian National Sampling Research (PNAD 2003). Two experiments were simulated. In the first experiment, union bargaining power was totally removed. In the second experiment, bargaining power was reduced by a half. As wages become closer to the value of marginal products, economic efficiency increases. The union wage premium falls when bargain power is reduced. The model results also reveal some of the potential effects induced by a labor market reform in Brazil, as the findings show how labor costs could affect resources allocation.

Key words: Unions, wage premium, efficiency, CGE models.

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1 - Introduction

It is well recognized that unions raise wages above the competitive level. According to EHRENBERG and SMITH (2000) labor unions constitute a monopoly that while benefitting its own members, may impose substantial costs on other members of society. However, it is sometimes believed that unions are the major way by which the employees can improve their economic situation. In fact, currently, collective negotiations between workers and firms, normally carried out by unions, consider a range of issues broader than wage levels. Among them are usually included payments for holidays, insurance, health, pensions and non-financial issues, as well as better working conditions. According to the current Brazilian employment laws, the benefits achieved by unions must be extended to all employees regardless the fact they are union members.

Despite all these objectives, in the economic literature the unions have two objectives: wage and employment level. The union achieves its objectives of wage and employment using its bargaining power, for example, imposing strikes or slowing down production. The overall result is a wage differential between union and non-unionized employees. This wage differential or wage premium was empirically determined in several countries. In Brazil, wages of unionized workers are, on average, 17% higher than wages of non-union workers. Consequently, according to Arbache (2003), unions in Brazil are responsible for a considerable portion of the national income inequality. This wage differential between union and non-union workers affects the allocation of resources and economic efficiency as the unionized wage may reflect more the bargaining power of the union than the productivity of the worker. In other words, there may exist other combinations of wage/employment that leave the employer and the unionized workers in a better situation.

In spite of the persuasive evidence of the existence of a wage premium for unionized workers in Brazil, until now, there is no empirical evidence about the impact of unions on economic efficiency in Brazil. The aim of this paper is to fill this gap investigating how wage distortions provoked by the presence of union negotiation affect economic efficiency in Brazil.

The strategy adopted in this paper is one developed by DeFina (1983) and Fisher and Waschik (2000). A disaggregated CGE model of the economy that incorporates the influence of unions on relative wages is constructed first. Values are then assigned to parameters of the model both by using extraneous estimates and by using parameters values consistent with an initial benchmark situation. This benchmark situation is based on the prices and quantities of factors and commodities that are actually observed for the base period of study (2003). In the model, the labor market equations capture the relationship between union bargaining power, represented by a parameter, and wage premium. The effect of the bargaining power on economic efficiency will be examined comparing the benchmark equilibrium with a new equilibrium with the reduced bargaining power.

This paper is organized as follows: after this introduction, we present some evidence of union wage premium in Brazil, depicting it per economic sector. In the third section, the CGE model structure is shown. The approach used to include union negotiation in the model is also presented. The fourth section shows the results from the simulations. Finally, some conclusions are presented.

2 - The union wage premium in Brazil

One of the first studies that measured the wage differential between union and non-union workers in Brazil was carried out by Barros and Mendonça (1998). They used micro-data from the Research of Living Standard. Initially, they showed that only 20% of the Brazilian workers were unionized. However, the average earnings of unionized employees were almost twice as the earning of the non-unionized one. Controlling for individual characteristics, this wage differential declined to 23%.

Arbache and Carneiro (1999) investigated the importance of trade unions in collective bargaining in the context of a developing country manufacturing labor market. Their results indicated that, in Brazil, unions contribute to increasing rather than decreasing the spread of wages within the union sector. Arbache (2003) also provides empirical evidence of a wage premium for unionized workers. According to the author, on average, the wage differential in favor to union labor was about 17%.

Using quantiles regressions, Xavier *et. al*, (2007) studied to what extent the wage differential between union and non-union workers changes when the wage equation is estimated in different quantiles of the conditional distribution of wage. They have found that in the quantile 0.10 of the conditional distribution of wages, the union wage premium is about 12%. In the quantile 0.70, this wage differential rose to 18.5%. However, in a higher quantile (0.9), the premium falls to 17%.

Table 1 shows the model sectors and some relevant sectorial information to this study about unions in Brazil. The union density, defined here as the share of unionized workers out the total labor force of each economic activity. In the sectors Water, Energy and Gas and Financial services, more than 40% of the labor force is unionized. In Agriculture, Mining, The Transformation industry, Transport and Public education health and Administration sectors, more than a fifth of the workers are associated to a union.

In the following columns we may observe the average wage of unionized and non-unionized workers. In all sectors, the average wage of unionized labor is greater than the wages of non-unionized workers. This difference is larger in the service sector and smaller in the transport sector. Analyzing the union density with respect to the share of total wages received by unionized workers out the total wage bill, only two sectors (Construction and Commerce) do not have a participation greater than 20% in the total wage bill. In the sector production and distribution of Electricity, Water and Gas, the total wage of unionized workers is almost 60% of the wage bill.

Table 1: Sectorial data about Unions in Brazil

Sectors	*Union Density*	*Average wages (R$)*		*U/NU*	*Union Density (wages)*	*Wage Premium (%)*
		Union	*Non Union*			
Agriculture	0.25	255.42	200.01	1.28	0.30	4.256
Mining	0.25	989.11	471.11	2.10	0.41	18.286
Transfomation industry	0.21	564.02	352.86	1.60	0.30	13.523
Water, eletricity and gas	0.45	944.79	534.46	1.77	0.59	22.708
Construction	0.07	553.22	393.11	1.41	0.10	24.788
Commerce	0.11	550.96	343.49	1.60	0.17	15.335
Transport	0.24	543.04	442.19	1.23	0.28	15.398
Information services	0.18	865.94	433.12	2.00	0.30	31.044
Finacial services	0.41	1104.65	746.43	1.48	0.51	17.916
Rental activities	0.19	519.44	416.61	1.25	0.23	11.951
Other services	0.12	675.09	286.24	2.36	0.24	26.813
Public education, health and administration	0.30	787.04	489.76	1.61	0.41	20.412

Source: PNAD 2003.

The wage differentials between unionized and non-unionized workers observed in table 1 may occur due to human capital or other differences such as gender and experience. As pointed out by Arbache (2003), the distribution of education between unionized and non-unionized worker suggests unions are concentrated in sectors that use highly skilled labor. Furthermore, Brazilian labor market data show that the unionized workers tend to be white and male. Thus, to consider all those variables that affect wages and union membership, a mincerian wage equation was estimated to each sector including a dummy variable indicating if the worker is unionized or not. The equations took into account education level, experience, gender, race, location dummies (urban and rural), regional dummies, etc.

The estimate of this wage equation indicates that the wage premium of unionized workers is near to 19%. The estimates of the dummy parameters are shown in the last column of table 1, in percentages. All the estimates were statistically significant at 5%. Now, the larger wage differential is observed in the information services sector. In this sector, the unionized workers wage, are, on average 31% larger than the wages of non-unionized workers. Despite the low union density in the construction sector, the unionized workers receive, almost 25% more than the non unionized workers.

The results of the wage premia shown in table 1 indicate that earning rises obtained by unions may be not extended to non-unions workers, otherwise there were no wage premia for union workers. In Brazil, the employment law establishes that results of collective bargaining must be extended to all formal workers of the same category, thus, the existence of a wage premium suggests, according to Arbache (2003) that the legislations regulating collective bargaining are not being observed.

3 - Model structure

The CGE model that will be used in this paper has the usual characteristics. However, the labor market will be modeled in a different way, taking into account the presence of a union with bargaining power to determine wage and employment level.

3.1 - Consumer behavior

The total consumption (CT) is obtained aggregating in Cobb-Douglas function the consumptions of goods i, according to equation 1:

$$CT = \prod_i C_i^{\propto H_i} \qquad (1)$$

The consumer budget constraint is represented by the equation below:

$$PCT.CT_t = \sum_i P_i C_i$$

Where P_i is the price of the product i, which originates from the domestic production and from imports. Maximizing the total consumption level subjected to the budget constraint, we can find the following demand function to C_i:

$$C_i = \frac{\alpha H_i(Y - S - TY)}{P_i} \; . \qquad (2)$$

Where Y indicates the income level, S is the savings and TY the income tax.

The total income is calculated from the following equation:

$$Y = PL.LS + \sum_i DIV_i \; +\text{TRF}, \qquad (3)$$

Where TRF is the transferences from government and firms. The capital income from the sector i (DIV_i) is defined as:

$$DIV_i = PVA_i VA_i - PL_i L_t \quad . \tag{4}$$

Consumer savings are calculated as total income minus total consumption (equation 5)

$$S = Y - PCT.CT \tag{5}$$

3.2 - International Trade

It is assumed that domestic and imported goods are imperfect substitutes. This geographical differentiation is introduced in the model specifying an Armington type aggregation function, where the imported and domestically produced goods are aggregated to generate a composite good X_i, as can be seen in the equation below

$$X_i = aA_i\left[\gamma A_i M_i^{1-\sigma A_i} + (1-\gamma A_i) XDD_i^{1-\sigma A_i}\right]^{-1/\rho A_i} \tag{6}$$

Where X_i is the composite good, M_i *are* the imports of the sector *i*, XDD_i indicates the production Sales in the domestic market of the good i. The parameter σA_i is the substitution elasticity between imposts and domestically produced goods, and $\sigma Ai = \frac{1}{1+\rho A_i}$.

A cost minimization program subject to equation 6, results in the demand equations for imports and domestically produced goods (equations 7 and 8):

$$M_i = \gamma A_i^{\sigma A_i} PM_i^{1-\sigma A_i}\left[\gamma A_i^{\sigma A_i} PM_i^{1-\sigma A_i} + (1-\gamma A_i)^{\sigma A_i} PDD_i^{1-\sigma A_i}\right]^{\frac{\sigma A_i}{1}-\sigma A_i}\left(\frac{X_i}{aA_i}\right) \quad . \tag{7}$$

and

$$XDD_i =$$
$$(1-\gamma A_i)^{\sigma A_i} PM_i^{-\sigma A_i}\left[\gamma A_i^{\sigma A_i} PM_i^{1-\sigma A_i} + (1-\gamma A_i)^{\sigma A_i} PDD_i^{1-\sigma A_i}\right]^{\frac{\sigma A_i}{1-\sigma A_i}}\left(\frac{X_i}{aA_i}\right) \tag{8}$$

The producers differentiate the production destiny, choosing the share out of the domestic sartorial production (XD_i) which is sold within the domestic market (XDD_i) and other share which is sold abroad (E_i). Thus, the domestic production is modeled according to the constant transformation elasticity (CET) function, as is show in equation 9:

$$XD_i = aT\left[\gamma T_i E_i^{1-\sigma T_i} + (1-\gamma T_i) XDD_i^{1-\sigma T_i}\right]^{-1/\rho T_i}, \tag{9}$$

Where $\sigma T_i = \frac{1}{1+\rho T_i}$ is the transformation elasticity.

Maximizing its receipts ($PDD_i XDD_i + PE_i E_i$), subject to the equation 11, the producers choose the destiny of its production, according to equations 10 and 11:

$$XDD_i = (1-\gamma T_i)^{\sigma T_i} PDD_i^{-\sigma T_i} \left[\gamma T_i^{\sigma T_i} PE^{1-\sigma T_i} (1-\gamma T_i)^{\sigma T_i} PDD_i^{1-\sigma T_i}\right]^{\frac{-\sigma T_i}{1-\sigma T_i}} \left[\frac{XD_i}{aT_i}\right] \tag{10}$$

$$E_i = \gamma T_i^{\sigma T_i} PE_i^{-\sigma T_i} \left[\gamma T_i^{\sigma T_i} PE^{1-\sigma T_i} (1-\gamma T_i)^{\sigma T_i} PDD_i^{1-\sigma T_i}\right]^{\frac{-\sigma T_i}{1-\sigma T_i}} \left[\frac{XD_i}{aT_i}\right] \tag{11}$$

The balance of payments includes only the commerce flows, as can be seen in the equation 12,

$$SEXT = \sum_i PWM_i M_i - \sum_i PWE_i E_i. \tag{12}$$

Where SEXT denote the external savings.

3.3 - Prices

The equations 13, 14, 15 and 16 calculate the domestic prices (P_i) the prices of the products produced domestically (PD_i), the prices of imported products (PM_i) and the price of the exported products (PE_i),

$$P_i = \frac{PM_i M_i + PDD_i XDD_i}{X_i} \tag{13}$$

$$PD_i = \frac{PE_i E_i + PDD_i XDD_i}{XD_i} \tag{14}$$

$$PM_i = (1 + tm_i + icmsim_i) ER \quad PWM_i \tag{15}$$

$$PE_i = ER.PWE_i \tag{16}$$

Where *ER* is the Exchange rare, PWM_i and PWE_i are the international prices of the imported and exported products. The parameters tm_i and $icmsim_i$ are import tax rates.

3.4 - Production

In the two-factor model, the sectorial production is obtained from a two levels nested function. In the top level, the value added and intermediate consumption are combined in a Leontief function to result in the sectorial production. In the second level, capital and labor are aggregated in a Cobb-Douglas function, generating the value added, as can be seen in equation 17.

$$VA_i = aF_i K_i^{\alpha K_i} L_i^{\alpha L_i} \ . \tag{17}$$

In the three-factor model, the unionized sector has a different production structure. First of all, labor is divided in union and non-unionized labor. These two categories of labor are combined in CES function (equation 18) to generate the total sectorial labor force which is combined in a Cobb-Douglas function to generate the value added (equation 19). The final product is obtained combining the value added and intermediate goods in a Leontief function.

$$L_{iU} = [\delta LU^{-\rho L} + (1-\delta) LNU^{-\rho L}]^{-\frac{1}{\rho L}} \tag{18}$$

Where L_{iu} is the total labor of unionized sectors, LU indicates the unionized labor and LNU the non-unionized labor.

$$VA_{iu} = aF_{iu} K_{iu}^{\alpha K_i} L_{iU}^{\alpha L_{iU}} \ . \tag{19}$$

3.5 - Investments

The total demand for investments goods (IT_i) is Cobb-Douglas aggregation of the sectorial demand for investments goods I_i,

$$IT_i = aI \prod_i I_{it}^{\alpha I_i}. \tag{20}$$

The quantity of investment goods sold by each sector is found maximizing the equation 24 subjected to the budget restriction of firms to make its investments

$$\sum_i INV_i \, PK = \sum_i I_i P_i = PK.IT \ . \tag{21}$$

The investment goods originate from the domestic and external market. Hence, the sectorial demand for these goods is evaluated at the price Pi, the price of the composite product. The sectorial demand for investment goods will be:

$$I_{it} = \frac{\sum_i PK_t INV_{it}}{P_{it}} \tag{22}$$

The price of the capital good, PK is calculated according to equation 23.

$$PK = \frac{1}{aI} \prod_i \left(\frac{P_i}{\alpha I_i} \right) \tag{23}$$

3.6 - Government

The government income (YG) is formed by taxes receipts. In the model, there are eight categories of tax. The sales tax of imported and domestic goods (ICMSI and ICMS), the production tax (IMPR and IPI), imports tax (TXM), other tax (OIMP), income tax (TXY) and tax on the firms income (TTXF).

$$YG = \sum_{i=1}^{n} IMPR_i + \sum_{i=1}^{n} ICMSI_i + \sum_{i=1}^{n} ICMS_i + \sum_{i=1}^{n} IPI_i + \sum_{i=1}^{n} OIMP_i + \sum_{i=1}^{n} TXM_i + TXY + TTXF. \tag{27}$$

Public savings is equal to government income minus transfers (GTRF) and public expenses (GP). Here, only public purchases are considered.

$$SG = YG - GTRF - GP \tag{28}$$

3.7 - Market equilibrium

The following equations describe the market equilibrium conditions of the model. Initially, equation 24 establishes the labor market equilibrium. Equation 25 shows the equilibrium between demand and supply in the product market and finally, in equation 26, savings is equal to investments.

$$LS = \sum_i L_i \tag{24}$$

$$X_i = DI_i + C_i + I_i + G_i \tag{25}$$

$$S + RP + SG + SEXT = \sum_i PK.INV_i \qquad (26)$$

3.8 - Labor market

The most common approach to model labor markets in CGE models is to suppose that marginal product of labor is equal to real wage. In this case, wages reflect labor productivity and adjust to keep labor market in equilibrium.

In the model non-unionized sectors, the demand for labor (equation 29) is obtained solving the profit maximization problem and marginal product of labor is equal to real wage.

$$L_i = \frac{\alpha L_i PVA_i}{PL} \quad , \qquad (29)$$

Where PVA is the price of the value added and PL is the nominal wage.

In spite of the large number of studies that used CGE models, few models take into account wage rigidities[1]. Wage rigidities can be modeled in different ways. For example, as Agénor (2003) proceeded in his CGE model, some categories of labor can receive a fixed real minimum wage, whose nominal value was indexed to a consumer price index.

The wage rigidity may also be endogenous. It can arise when firm-level excess profits exist and labor takes a share of these in addition to its competitive wages. In this approach, wages can be the result of a bargaining process carried out by unions. Maechler and Roland-Host (1997) points out the existence of two broad categories of wage bargaining models. In the first one, which is named Monopoly Wage Model, the union can set only wages. The union has no power in employment setting. In this approach, the union is called passive. The second is the Efficient Bargaining Model, where firms and unions share equal bargaining power in wage and employment setting. In this case, the union is called active.

In this paper, the bargain mechanism is the same as that used by Fisher and Waschik (2000)[2]. The bargaining over wage and employment levels in each union industry is incorporated into the CGE model by adding a bargaining stage to the production stage.

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[1] See for example, Maechler and Roland-Host (1997, Thierfelder and Shiells (1997), Devarajan et al. (1997), Fisher and Waschik (2000), Decaluwé et al (2000), Agénor et al (2003).

[2] In the passive union approach, the union maximizes its utility function constrained by the firm labor demand curve.

In each industry where a union is present, we use the modified Stone-Geary utility function to represent the union's preferences:

$$U(W, L) = (W_U - W_{NU})^{\phi} L, \tag{30}$$

where W_U is the negotiated union wage, W_{NU} is the wage of non-union labor, and L is the negotiated employment level of the union. The parameter ϕ is the excess wage (W_U -W_{NU}) elasticity of U. The union is wage (employment) oriented if ϕ>1 (ϕ<1).

For the bargaining stage, usage of all other factors is fixed, so industry profits are:

$$\pi(W, L) = PVA.VA(L) - W_U L, \tag{31}$$

where VA(L) is the production function and PVA is the value added price (normalized to 1 in the initial equilibrium).

The union and firm bargain over the wage W_U and employment level L through a cooperative generalized Nash bargaining process. The bargaining disagreement point results in a zero employment level, which drives the union's utility and profit to zero. Therefore, the generalized Nash product is:

$$G(w, L) = [PVA.VA(L) - W_{NU} L]^{1-\beta} \left[(W_U - W_U)^{\phi} L\right]^{\beta}, \tag{32}$$

where 0 ≤ β ≤ 1 is a parameter that denotes the relative bargaining power of the union. Maximizing G with respect to w and L yields first-order condition:

$$\frac{\partial \ln(G)}{\partial w} = \frac{\beta\phi}{W_U - W_{NU}} - \frac{(1-\beta)L}{PVA.VA - W_U L} = 0 \tag{33}$$

$$\frac{\partial \ln(G)}{\partial L} = \frac{\beta}{L} - \frac{(1-\beta)(W_U - PVA.MP_L)}{PVA.VA - W_U L} = 0 \tag{34}$$

Where MP_L denotes the marginal product of labor.

Combining equations 33 and 34 we derive the contract curve, which is the locus of tangencies between the union's indifference curves and the firm's isoprofit contours on the wage-employment space:

$$\frac{W_U}{PVA} = \frac{W_{NU}/PVA - \phi MP_L}{1-\phi} \tag{35}$$

The contract curve does not depend on the relative bargaining power β of the union. We can derive an expression for real wages that takes into account the bargaining power, rewriting equation 35 as follows:

$$(1-\beta)(W_U - PVA.MP_L)L = \beta(PVA.VA - W_U L)$$

And solve for w/p we have:

$$\frac{W_U}{PVA} = \beta\frac{VA}{L} + (1-\beta)MP_L \tag{36}$$

The equation 36 is denominated Nash Bargaining Curve, in which wage and employment levels are consistent with the bargaining power of β. According to this equation, wages do not depend on the unions preferences parameter ϕ. As can also be noted, in equation 36 real wage is a weighted average of labor productivity and marginal product of labor. If the unions have no bargaining power, that is β=0, then the real wage is equal to the marginal product of labor.

In the model, the bargaining wage setting will be taken into account using equation 36. The equation 35 could also be used, however the bargaining power (β) will not affect the contract curve. In fact, using equation 35 and considering a wage premium of 19% for unionized employees, the parameter β or the union bargaining power can be calibrated for different values of ϕ. This calibration is done using equation 37 that is derived from equation 36

$$\beta = \frac{W_U/PVA - MP_L}{VA/L - MP_L} \tag{37}$$

Considering the same wage premium for all sectors, the average product plays an important role in the bargaining power determination. In other words, how higher the bargaining power is depends on the sectorial labor/capital ratio or the labor intensity in the production technology. In Industries with larger labor/capital ratio, unions tends to have higher bargaining power, for example, because, of the effects that a strike can induce in the production of such industries. In this paper, we will consider the same wage premia among sectors (19%). Table 2 shows the values of β for different values of ϕ .

Table 2: Bargaining power for different values of ϕ

Sectors	*Two-factor model*			*Three-factor model*		
	Bargain power β			*Bargain power β*		
	ϕ=0.5	*ϕ=1.0*	*ϕ=1.5*	*ϕ=0.5*	*ϕ=1.0*	*ϕ=1.5*
Agriculture	0.090	0.047	0.013	0.016	0.008	0.005
Mining	0.100	0.053	0.043	0.036	0.018	0.012
Transfomation industry	0.182	0.100	0.076	0.039	0.020	0.013
water, eletricity and gas	0.103	0.054	0.045	0.057	0.029	0.020
Construction	0.248	0.142	0.074	0.019	0.009	0.006
Commerce	0.264	0.152	0.081	0.028	0.014	0.009
Transport	0.301	0.177	0.083	0.053	0.027	0.018
Information services	0.251	0.143	0.101	0.063	0.033	0.022
Finacial services	0.181	0.099	0.083	0.077	0.040	0.027
Rental activities	0.005	0.003	0.002	0.001	0.001	0.000
Other services	0.837	0.720	0.310	0.108	0.057	0.039
Public services	0.872	0.773	0.694	0.194	0.107	0.074

As can be noted, the values for the bargaining power declines as the union becomes less wage-oriented or it becomes more powerful when it is more employment-oriented for a given wage premium. In the three-factor model, the bargaining power decreases sensibly, because the average product is calculated considering only the unionized workers. Thus, the two-factor model overstates the bargaining power justifying the use of more disaggregated models.

4 - Simulations

The model was calibrated to reproduce a benchmark equilibrium which represents a Brazilian Social Accounting Matrix (SAM) for the base year of 2003. This SAM was constructed using data taken from the Brazilian National Accounting System published by the National Institute of Statistics (IBGE). The sectors considered are the same as these presented in table 1 and 2. The labor factor was disaggregated into union and non-unionized labor using the shares of wages of both labor categories out of the total displayed in table 1. These data were obtained from the PNAD 2003.

Two simulations were carried out. Firstly, the bargaining power β in all sectors were set to zero. Hence, according to equation 35, the wages in all sectors are determined only by the marginal productivity of labor. The results will not depend on the union's preference parameterϕ. In the second simulation, the bargaining power was reduced by 50% in all sectors. In this case, the union's preference is important. Thus, this simulation will be done for different values of ϕ. At the benchmark equilibrium, it is supposed that the wage differential is equal to 19% in all sectors, according to the result of the estimates of wage equations done in the second section of this paper.

The effects of both shocks will be analyzed observing the changes on wages, welfare, sectorial prices and production. The welfare measure used in this paper is the Hicksian equivalent variation. In the two-factor model, the results are shown in an aggregated level. In the three-factor model, the results are presented according to the labor category (union and non-union labor).

Before performing the simulations, a homogeneity test was carried out, multiplying by two the model *numéraire*, a price index that is a weighted average of producer prices. After this shock, only the nominal variables changed its values. The real variables remained unchanged. Thus the model is homogeneous of degree zero on prices and the real variables are sensible only to changes in relative prices.

4.1 - Results

Table 3 shows the effects on wages and welfare induced by the first shock. With no bargaining power, the labor became cheaper compared to the other production factor, thus, demand for labor increased provoking a wage rise in both models. The total effect of the three-factor model is a weighted average of the effects on the union and non-union labor. As can be seen, this total (2.3%) effect is smaller than the wage change in the two-factor model (4.3%). This finding clearly indicates that the disaggregation procedure matters and the shocks effects would be overstated if we had not done it. The welfare changes due to the shock are inferior to 1%. DeFina (1983) and Fisher and Waschik (2000) have found results similar to ours. The results also show that in the three factor model, the welfare effect is even smaller.

Table 3: Effects on wage and welfare induced by the total removal of the bargaining power (%)

Type of labor	*Wage changes*		*Welfare changes*	
	Two-factor model	***Three-factor model***	***Two-factor model***	***Three-factor model***
Union	-	1.2	0.46	0.39
Non-Union	-	3.1		
Total	4.3	2.3		

In table 4 the effects of the total reduction on the union bargain power on prices and sectorial production are reported. In general, the price changes were higher in the unionized sector than in the non-unionized sectors. The results are sensible to the labor disaggregation and are lower in the three-factor model. The largest price change is observed in the water, energy and gas sector followed by public service sector, which are the ones with the larger share of unionized labor. In what concerns the effects on production, in the public services and water, energy and gas sectors, where it is observed many unionized employees, the production increase were 2.1% and 2.8%. As was expected, in the three-factor model, the effects are smaller, but still the most unionized sectors are those where the largest production increase occurred.

Table 4: Sectorial price and production effects induced by the total removal of the bargaining power (%)

Sector	*Price changes*		*Product changes*	
	Two-factor model	*Three-factor model*	*Two-factor model*	*Three-factor model*
Agriculture*	-0.6	-0.2	0.9	0.7
Mining*	0.1	0.5	0.8	0.6
Transfomation industry*	-1.6	-1.1	1.4	1.2
water, energy and gas*	-2.1	-1.6	2.8	2.2
Construction	-1.1	-0.8	1.2	1.1
Commerce	-0.8	-0.6	0.9	0.8
Transport*	-1.6	-1.2	2.1	1.8
Information services	0.8	0.4	-0.3	-0.2
Finacial services*	-0.9	-0.4	1.3	0.8
Rental activities	0.2	0.3	-0.5	-0.4
Other services	-1.2	-0.8	1.3	1.1
Public services*	-1.8	-1.1	2.1	1.9

* Indicates the sectors that are considered unionized. Here, a sector is considered unionized if the share of the sector out of the total labor is larger than 20%.

In the second shock, the results depend on the preferences of the union as is displayed in table 5. In general, the wage changes, due to the partial reduction of the bargaining power, are smaller than the wage variations when the bargaining power is totally eliminated. When the unions preference becomes more wage oriented (ϕ>1), the effects on wages becomes smaller. The same occurs with the welfare measure (EV). This has occurred because when the union is employment-oriented the bargaining power is benchmarked to a higher level. Furthermore, the results also show an even lower welfare gain, compared to those of the first shock.

Table 5: Effects on wage and welfare induced by the partial removal of the bargain power for different values of ϕ (%)

<table>
<tr><th rowspan="3">Model</th><th colspan="4">ϕ=0.5</th><th colspan="4">ϕ=1.0</th><th colspan="4">ϕ=1.5</th></tr>
<tr><th colspan="3">Wage</th><th rowspan="2">EV</th><th colspan="3">Wage</th><th rowspan="2">EV</th><th colspan="3">Wage</th><th rowspan="2">EV</th></tr>
<tr><th>U</th><th>NU</th><th>Total</th><th>U</th><th>NU</th><th>Total</th><th>U</th><th>NU</th><th>Total</th></tr>
<tr><td>Two-factor model</td><td>-</td><td>-</td><td>2.9</td><td rowspan="2">0.24</td><td>-</td><td>-</td><td>2.6</td><td rowspan="2">0.21</td><td>-</td><td>-</td><td>2.2</td><td rowspan="2">0.19</td></tr>
<tr><td>Three-factor model</td><td>0.9</td><td>2.6</td><td>1.8</td><td>0.7</td><td>2.3</td><td>1.6</td><td>0.6</td><td>2.2</td><td>1.5</td></tr>
</table>

To what extent the partial reduction on the bargaining power reduced the wage premium of unionized workers is shown in table 6. The wage premia have fallen in all unionized sectors. Considering a wage-oriented union, the highest wage premium (6.8%) is observed in the Water, Energy and Gas sector. The findings also show that the reduction on wage premia is smaller when the union became more wage-oriented. The weighted average (with the participation of the sector on the total labor force) of the wage premium is 6.18%, almost a third of the original wage premium (19%).

Table 6: Effects on wage premium by the partial removal of the bargain power for different values of ϕ (%)

<table>
<tr><th rowspan="2">Sectors</th><th colspan="2">ϕ=0.5</th><th colspan="2">ϕ=1.0</th><th colspan="2">ϕ=1.5</th></tr>
<tr><th>Two-factor model</th><th>Three-factor model</th><th>Two-factor model</th><th>Three-factor model</th><th>Two-factor model</th><th>Three-factor model</th></tr>
<tr><td>Agriculture*</td><td>5.8</td><td>5.9</td><td>5.9</td><td>6.0</td><td>6.0</td><td>6.1</td></tr>
<tr><td>Mining*</td><td>5.7</td><td>5.7</td><td>5.8</td><td>5.9</td><td>5.9</td><td>6.0</td></tr>
<tr><td>Transfomation industry*</td><td>6.0</td><td>6.0</td><td>6.1</td><td>6.2</td><td>6.3</td><td>6.3</td></tr>
<tr><td>water, energy and gas*</td><td>6.5</td><td>6.6</td><td>6.6</td><td>6.7</td><td>6.8</td><td>6.8</td></tr>
<tr><td>Construction</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Commerce</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Transport*</td><td>5.9</td><td>6.0</td><td>6.1</td><td>6.1</td><td>6.2</td><td>6.2</td></tr>
<tr><td>Information services</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Finacial services*</td><td>6.2</td><td>6.2</td><td>6.1</td><td>6.3</td><td>6.4</td><td>6.5</td></tr>
<tr><td>Rental activities</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Other services</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Public services*</td><td>6.1</td><td>6.2</td><td>6.3</td><td>6.3</td><td>6.4</td><td>6.4</td></tr>
</table>

* Indicates the sectors that are considered unionized. Here, a sector is considered unionized if the share of the sector out of the total labor is larger than 20%.

5 - Concluding remarks

The aim of this paper was to study how the unions bargaining power affects the allocation of resources and economic efficiency in Brazil. To attain this objective, a computable general equilibrium model, calibrated to reproduce a Brazilian SAM for the base year 2003, was used. A Wage premium to Brazilian unionized workers was estimated econometrically using Brazilian micro-data and was introduced in the CGE model.

Simulating the total removal of the unions bargaining power, we had small welfare gains. The production rose in most unionized sectors. In this simulation, the union's preference (wage or employment-orientation) does not matter. Removing only half of the bargaining power, the results change according to the orientation of the union (wage or employment).

Reducing the bargaining power by a half, the welfare gain is reduced more than a half when the union is employment-oriented. Considering a union wage-oriented, the efficiency gains are even smaller. Because of the reduction of the bargaining power, the wage premium has fallen in all sectors. In the water, energy and gas sectors, one of the most unionized sector, the new wage premium is just above a third of the original. The average wage premium is also almost a third of the national wage differential.

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