An Employment Equation for Belgium

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Abstract

Economic theory considers economic growth and wage costs as crucial determinants in the process of job creation. In this paper, we try to quantify the relationship that exists between these variables in Belgium. Our objective being mainly the use of the empirical model for forecasting purposes, we use a VAR model to enable us to apply statistical tools to test some possible constraints within a loose model. We analyse the relationship at three levels: one national and two sectoral.

Keywords: Employment growth, long-run equilibrium, VAR model.

JEL classification: C32, C52, E24, E27.

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1 Introduction

This paper is aimed at evaluating the relationship between employment and economic growth and wages in Belgium. The assertion that economic growth should affect employment positively is well documented in the economic literature. Our objective here is to concentrate on determining empirically the nature of this relationship. We will therefore consider questions such as the short and long-run impacts of growth on employment as well as how the adjustment process is spread over time. Changes in employment as a result of changes in production are indeed considered to take time. This may either be due to adjustment costs resulting from the hiring and firing of employees, or to uncertainty with regards to the permanent nature of new production levels.

Economic growth is clearly not the only variable that affects employment. Wage costs are equally important and are expected to have a negative impact: the higher the cost of labour, the more firms will substitute labour by less costly production factors. A firm can also increase its production by improving the productivity of its labour force, for example by modernising the production process.[1]

Our efforts here will be focussed on estimating a simple three-variable model explaining the behaviour of employment, output and wages in Belgium. We will estimate the model over the period 1980:I to 2002:IV. We will then use the model to produce forecasts of employment levels under certain scenarios regarding economic growth and wage settlements over the period 2003:I to 2007:I and compare those results to the actual employment levels achieved during that period, the aim being to evaluate the possible contribution of some measures such as the reduction of labour costs through lower social security contributions.

The main contribution of the paper is to investigate how economic activity and labour costs affect employment in Belgium. As far as we know, there is indeed no study providing such evidence for Belgium. A particular feature of our study is to examine this relationship both at an economy-wide and at a sectoral level, while in most emiprical studies, the evidence is only provided for the overall economy.[2]

The paper is organised as follows. Section 2 explains the data and related difficulties. Section 3 summarises the methodology used. Section 4 reports the estimated results. The estimation is done at three levels, one national and two sectoral levels. Section 5 investigates the implications of the estimated models in out-of sample forecasts. Section 6 concludes.

[1] Formally, the dependence of employment on output, real labour costs and labour productivity can be derived from the maximisation of a production function with two production factors, labour and capital. See for instance Dixon et al. (2004), p.17-20 and Moure (2004), p.8-10.

[2] See for instance Moure (2004) for the euro area, Dixon et al. (2004) for Australia, Prachowny (1993) for the United States and Decressin et al. (2001) *et. al.* for France, Germany, Italy.

2 Data

Over the last few years and driven by the unified national accounting rules imposed by Eurostat, the Belgian national accounts data, including employment levels and wage bills, have undergone major revisions. As a result, it is no longer possible to have data series which are both recent and long enough on our three variables of interest, namely the GDP, employment and wages. Given the necessity of using a large enough sample in order to be able to depict meaningful long-term relations between these variables, we have opted for using the older quarterly data on the three variables which still constitute a homogeneous set over the period 1980 to 2002.[3] The revised data go back only to 1995.

Apart from the period over which suitable data are available, there is one more problem which will affect our results. In the literature on this subject, the normal approach is to use the volume of hours worked for employment and hourly wage rates for wage costs.[4] The reason is simply that firms first determine the volume of hours of work they need, based on the hourly wage rates they have to pay. It is only then that they translate this into the number of persons to employ, as this can vary within the legal limits imposed.

In our case, we could not obtain suitable data on hours worked and hourly wage costs which would cover the whole period or have a quarterly frequency. As a result, the employment variable we use is total employment (employees and independents, including those nationals working at the border regions) expressed as the *number of persons* in employment. As for the wage cost variable, we obtain the *wage cost per employed person* by dividing the quarterly series for the wage bill by the number of persons in salaried employment.[5] Clearly, this implies that both these variables are affected by the evolution of the average number of hours worked per employed person during this period. Aware that this is a major shortcoming, we have tried to face this problem by including in our models a variable which is an estimate of the average hours worked. We found however that this variable had no significant effect and our results reported here therefore do not include it. We are nevertheless conscious that the analysis of the evolution of wage costs as suggested by our model may be reflecting various possible sources of change, namely centralised wage negotiations, various government measures taken to alleviate employers' social security contributions but also changes in the average number of hours worked per

[3] These older series have been revised not because of poor quality, but in order to conform to new national accounting rules.

[4] See Dixon et al. (2004) amongst others.

[5] Similar definitions are used for sectoral employment and real wages.

employed person.[6][7]

We note finally that both the wage cost and GDP variables are in real terms. The deflator used is either the GDP deflator in the case of the national results, or the deflator of the sectoral value added in the case of sectoral data.

The analysis presented in this paper is done on the rates of growth of the different series. We did at first try to estimate the model so as to find a long-term relationship between the levels of the three variables. We could not however find any evidence of cointegration between them and decided therefore to proceed with the growth rates.[8] Table 2.1 shows some descriptive statistics on the three variables used in our study. As mentioned earlier, our analysis is done at the national level and for the two most important sectors in Belgium, namely industry and services.[9]

	Mean	Median	Standard Deviation
Quarterly growth rate of output			
National	0.52	0.61	0.70
Industry	0.47	0.47	1.21
Services	0.59	0.60	0.70
Quarterly growth rate of employment			
National	0.15	0.12	0.35
Industry	-0.39	-0.42	0.47
Services	0.43	0.41	0.48
Quarterly growth rate of wage costs			
National	0.33	0.27	0.96
Industry	0.86	0.94	1.28
Services	0.14	0.18	1.39

[6] Detailed information on wage formation in Belgium can be found in Burggraeve and Caju (2003), p. 8-10. We shall simply remind the reader here that in Belgium, wages are settled through negotiations that are held successively at three levels: national, sectoral and firm level. These negotiations have to comply with three important institutional characteristics: an overall guaranteed minimum wage, the automatic indexation of gross wages and a maximum imposed on the growth rate of nominal hourly labour costs. In the past, labour tax reductions have played an important role in slowing down the growth of labour costs in Belgium. The tax wedge in belgium remains however important. According to the OECD estimates (OCDE (2008)), it is the highest in Europe (EU15).

[7] Everything equal, the growth rate of the wage costs per person employed will be lower when the number of people working part-time increases.

[8] We would have expected to find cointegration in the levels of the variables. The inability to reject the null hypothesis of no cointegration in the levels is most probably due on the one hand to a small sample, and on the other, to the problem of the appropriate definition of the variables of interest as mentioned at the start of this section. We plan to revisit this problem as and when more data become available.

[9] This refers to services in the private sector, including commerce, finance, insurance, transport and communication. In 2002, which is the last year of our estimation period, the share in *GDP* of private services and manufacturing industries were respectively 53% and 18.5%, compared to 42.6% and 26.3% in 1980. In 2002, 54.3% of the total number of persons in salaried employment was employed in private services and 18.5% was employed in manufacturing industries.

Table 2.1: Descriptive Statistics, sample: 1980:I-2002:IV.

The table shows that over the period considered, Belgian GDP grew at an average quarterly rate of 0.5%, equivalent to an annual rate of roughly 2%. During this period, employment grew at a much slower pace of 0.15% per quarter (0.6% per annum), while wage costs grew at double that rate, i.e. 0.33% per quarter. When we consider the sectoral results, we note that the growth rate of value added in both sectors is not so different from GDP. On the other hand, the movement of employment and wage costs has been very different in these sectors. Over the period 1980:I-2002:IV, employment in Industry fell by an average of 0.4% per quarter (1.5% per annum), while the opposite happened in the Services sector, where employment increased by the same rate.[10] On the other hand, wage costs have increased much more sharply in Industry (0.9% per quarter) than they did in Services (0.1% per quarter). This observed fact may be due to differences in the evolution of hourly wages or productivity growth. It may also be reflecting structural differences such as standard hours, reduction of social security contributions, the development of interim and part-time employment, $\cdots$ A look at the standard deviations in Table 2.1 also shows that employment is less volatile than economic activity, that is fluctuations in activity do not create equally important fluctuations in employment. Wage costs on the other hand appear to be much more volatile.

3 The methodological framework

The approach we have taken here is to study a VAR system composed of the three variables of concern, i.e. employment l, output y and wages w.[11] A VAR model essentially treats all variables in the system as endogeneous. Given that all explanatory variables are lagged values of the endogeneous variables in the system, simple estimation by OLS provides consistent and asymptotically normally distributed estimators, so that statistical inference may be applied in the usual way.

The most important factor in the choice of the variables that enter a VAR is economic theory. Our choice of l, y and w as the basis of our VAR model reflects our main interest here to estimate labour demand as a factor of production. A second factor, which is not negligible in practice, is the limited size of available data. Finally, if too many variables are included in the system, the number of coefficients becomes very large and much inefficiency may be introduced in the estimated coefficients. If the main purpose of using a VAR model is to produce forecasts, this can be a serious problem. Given our interest in developing this simple model to evaluate its usefulness for forecasting future trends in employment

[10] The reduction in industrial employment in Belgium is generally explained by the move to the tertiary sector, but also by the shift outside the sector of various previously internal service activities, such as cleaning, personnel management, etc $\cdots$

[11] Lower case letters denote logarithms of actual variables. For example, $l = Ln(L)$.

in Belgium, there was further reason to keep the number of endogeneous variables in the system to a minimum.

As we found no satisfactory evidence of any long-term relationship, we concentrate our analysis on the growth rates of the three series. We report here the results for the quarterly growth rates. We have done a similar analysis for the annual growth rates, but the overall conclusions do not change substantially.[12] We have also done the analysis at three different levels. The first one is at the national level. The other two deal with the two most important sectors in the Belgian economy, namely Industry and Services.

4 Empirical Results

The sample used for the results shown below covers the period 1980:I to 2002:IV. Data on employment and the GDP are available for periods beyond 2002:IV. However, due to changes in the definition of these variables, the available data are not always consistent with the earlier period. Moreover, the same is not true about the wage bill, which is not yet available at all beyond 2002:IV. We can therefore not calculate wage costs per head beyond 2002:IV.

4.1 Total Employment

We begin by estimating the unconstrained reduced form of the model. The variables included in the model are Δl, Δy et Δw. Our first task is to check that we are dealing with a system of stationary variables. To this end, we test for cointegration using Johansen's tests on the estimated VAR model.[13] The results are reported in Table 4.1.1. They show that this VAR system is indeed stationary.

rank	Trace test[Prob]	Max test[Prob]	Trace test(T-nm)	Max test(T-nm)
0	48.85[0.000]**	22.16[0.034]*	36.34[0.007]**	16.48[0.206]
1	26.69[0.001]**	20.13[0.004]**	19.86[0.009]**	14.97[0.037]*
2	6.57[0.010]*	6.57[0.010]*	4.89[0.027]*	4.89[0.027]*

* means significance at 5% and ** at 1%

Table 4.1.1: Johansen tests for cointegration, at the national level.

Our next task is to estimate the model by maximum likelihood so as to be able to test a certain number of restrictions to simplify the model and reduce the number of parameters. Given that our main focus in this paper is on employment, we only report here the estimated employment equation. Table 4.1.2 shows the result of the most parsimonious equation obtained. Throughout the reduction process, we

[12] Interested readers can obtain these results from the authors.

[13] See Johansen and Jeselius (1990). The empirical results reported in this paper have been obtained using the software *Oxmetrics*.

have kept a close eye on misspecification tests which are reported at the bottom of the table. In this table as in the tables that will follow, *Normality* is the statistic proposed by Doornik and Hansen (1994) to test if the residuals of an equation could be from a normal distribution. *Portmanteau* refers to the Box and Pierce (1970) statistic for testing for autocorrealtion. This statistic is only valid in a single equation context, but is reported anyway. $AR : F$ is the more appropriate LM test for autocorrelated residuals. $ARCH : F$ is the LM test proposed by Engle (1982) for Autoregressive Conditional Heteroscedacity or autocorrelated squared residuals. $Hetero : F$ is the statistic proposed by White (1980) to test the hypothesis of unconditional homoscedasticity against the alternative that the variance of the errors depends on the regressors and/or their squares.

	Coefficient	Std error	p-value
Constant	-0.063	0.039	0.12
Δl_{-1}	0.606**	0.090	0.00
Δl_{-2}	−0.415**	0.125	0.002
Δl_{-3}	0.387**	0.096	0.000
$\Delta l_{-4} - \Delta l_{-5}$	−0.25*	0.10	0.017
$\Delta l_{-6} - \Delta l_{-7}$	-0.16	0.09	0.084
Δy_{-1}	0.134**	0.031	0.000
Δy_{-2}	0.078*	0.032	0.017
$\Delta y_{-3}+\Delta y_{-5}$	0.076**	0.023	0.002
Δw_{-2}	−0.051*	0.023	0.032
Δw_{-3}	-0.042	0.023	0.077
$\Delta w_{-6}+\Delta w_{-7}$	−0.044*	0.019	0.026

T=82(1982:(3)-2002(4)), $\sigma = 0.18\%$, *Portmanteau(6)*=2.08, $Normality : \chi^2(2) = 2.7$
$AR : F(6, 54) = 1.27$, $ARCH : F(10, 54) = 2.44^*$, $Hetero : F(42, 31) = 0.83$
$AR^{vec} : F(54, 161) = 0.67$, $Normality^{vec} : \chi^2(6) = 8.35$, $Hetero^{vec} : F(252, 163) = 0.64$
$LR : \chi^2(40) = 13.704$

* means significance at 5% and ** at 1%

Table 4.1.2: The quarterly growth of employment in Belgium.

The equivalents of these statistics for the system as a whole are reported with a *vec* superscript. Finally, $LR : \chi^2$ is the likelihood ratio test of the over-identifying restrictions imposed on the system as a whole. A look at the statistics reported for the employment equation shows that practically all mis-specification tests are satisfactory. There is only some heteroscedasticity in the errors of the employment equation which might signal the need for a longer maximal lag. Further evidence of the reasonable fit of the equation estimated in the sample is provided in Figure 4.1. The upper part of Figure 4.1 shows the actual and fitted values and the lower part shows the residuals scaled by their estimated standard error. The latter remain mainly (except for two observations) within $\pm 2\hat{\sigma}$. We also estimated the system recursively to check for possible structural shifts in the relationships as a result of various policies implemented by the Belgian government in this period. No such breaks are detected.

It is worth noting from Table 4.1.2 that an increase in the rate of growth of the economy has a positive effect on employment growth in the long-run. And an increase in the growth rate of wages has the opposite effect. In each case, the impact on employment is persistent.

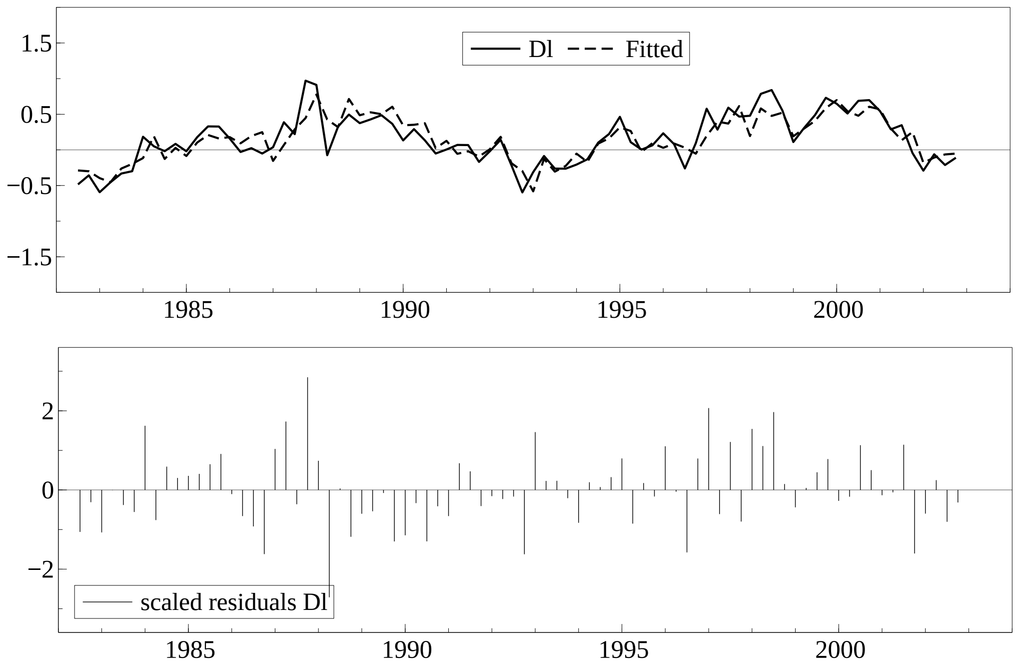

Figure 4.1: The quarterly growth of employment in Belgium.

One way of analysing the effects of past shocks on current variables in a dynamic system of variables is through a look at the impulse response functions. This amounts to looking at the dynamic multipliers implied by the system, when the shock in question can be treated as exogenous. If these multipliers turn out to be different from zero, then a response is depicted from one variable to another. When a dynamic system is stable, such dynamic mulitpliers usually die out quite quickly.

There are various ways of approaching the impulse response analysis. The simplest is to look at the system after an innovation of one unit in only one of the variables in the system and trace out the dynamic multipliers. However, if the variables in the system happen to be measured in different scales, and when we want to analyse the responses of each and every variable to possible shocks in the other variables in the system, applying the same innovation of one unit each time is not very helpful for comparing the effects. To correct for this problem, a rescaling of the multipliers is required, which can be achieved by considering innovations of one standard deviation. Finally, if the shocks in different variables are not independent, then a shock in one variable in the system will be accompanied by a shock in other variables and the dynamic multipliers calculated above will be misleading. An orthogonal transformation of the VAR model is then required to create a system with independent errors. This final approach however comes with its own problems. The transformation, based on the Choleski decomposition of the initial variance-covariance matrix, is not unique and depends on the order in which the variables appear in the system.[14]

In the impulse response analysis presented here, we have opted for shocks of one standard deviation. The results are presented in the Appendix and are summarised in graphs which show the accumulated responses after an innovation of one standard deviation for each variable. A look at the Figures in the Appendix makes it clear that there is great variation in the standard errors of the equation errors. Whereas at the national level, the largest standard error is that of the innovations in the growth rate of wages which still remains well below one, the situation is very different at the sectoral level. It is particularly striking in the Service sector, where the standard error of the innovation in sectoral wages is four times larger than that in sectoral employment.[15]

Figure A.1.b shows clearly that a one time increase in the growth rate of the GDP leads to the accumulated effect over time of an increase in the growth of employment of about the same order of magnitude. It takes about twenty quarters, i.e. five years, for this adjustment to be completed. Such a shock also leads to a positive but modest increase in the growth of wages, even though the initial effect is negative. It takes about ten quarters, i.e. two and a half years, before this effect becomes apparent. Similarly, we can see in Figure A.1.c that a one time increase in the growth rate of wages leads over time to the accumulated effect of a decline in the growth of employment which is of the same order of magnitude and which also takes about twenty quarters to take its full course. Notice also that such a shock has a negative impact on the growth of the GDP which is more substantial than the effect of increased GDP on wages.[16]

4.2 Employment in Industry

In this section, we repeat the exercise, but this time applied to the Belgian industrial sector. The main objective is to see if this sector's employment behaves more or less as at the national level, or whether discernible differences exist. The relation to the sectoral real wage is of particular interest.

[14] An impulse response analysis can not really be a very reliable source for a structural interpretation of a model. It plays a more useful role in a forecasting exercise where the dynamic multipliers are of interest. See Lütkepohl (1993) and Hendry (1995).

[15] We did also look at the orthogonalised system, but found that no major changes occur in the impulse responses. The ordering reported in this paper consists of the system $\Delta l, \Delta y, \Delta w$. The estimated equation errors display little correlation between them. For the sake of robustness, we have also verified other orderings and found that the covariance matrix of the VAR innovations continues to remain approximately diagonal.

[16] The figures in the appendix are the accumulated and not the simple impulse responses. It is the latter which would tend to 0 in a stable system.

We begin by estimating the unrestricted reduced form. The variables in the model are now Δl^{Ind}, Δy^{Ind} et Δw^{Ind}.[17] Johansen's tests for cointegration confirm the stationarity of the system. The results are given in Table 4.2.1:

rank	Trace test[Prob]	Max test[Prob]	Trace test(T-nm)	Max test(T-nm)
0	54.21[0.000]**	30.74[0.001]**	40.33[0.002]**	22.87[0.026]*
1	23.47[0.002]**	16.93[0.017]*	17.46[0.023]*	12.59[0.090]
2	6.54[0.011]*	6.54[0.011]*	4.87[0.027]*	4.87[0.027]*

* means significance at 5% and ** at 1%

Table 4.2.1: Johansen's tests for cointegration, in Industry.

Maximum likelihood estimation of this system allows us to test some restrictions and reduce the number of parameters to estimate. The reported model in Table 4.2.2 passes satisfactorily all misspecification tests as seen from the statistics

	Coefficient	Std error	p-value
Constant	-0.0625	0.083	0.46
Δl^{Ind}_{-1}	0.635**	0.10	0.00
Δl^{Ind}_{-2}	-0.353**	0.114	0.003
$\Delta l^{Ind}_{-3} + \Delta l^{Ind}_{-5}$	0.292**	0.075	0.000
Δl^{Ind}_{-4}	-0.21	0.114	0.067
Δy^{Ind}_{-1}	0.12**	0.025	0.000
Δy^{Ind}_{-2}	0.058	0.029	0.051
Δy^{Ind}_{-3}	0.114**	0.026	0.000
$\Delta y^{Ind}_{-4} + \Delta y^{Ind}_{-5}$	0.038*	0.018	0.037
$\Delta y^{Ind}_{-6} + \Delta y^{Ind}_{-7}$	-0.050**	0.018	0.007
$\Delta w^{Ind}_{-1} + \Delta w^{Ind}_{-4}$	-0.047*	0.018	0.014
Δw^{Ind}_{-2}	-0.094**	0.025	0.000
$\Delta w^{Ind}_{-3} + \Delta w^{Ind}_{-5}$	-0.029	0.016	0.08

T=82(1982:(3)-2002(4)), $\sigma = 0.22\%$, *Portmanteau(6)*=3.15, $Normality : \chi^2(2) = 3.0$
$AR : F(6, 54) = 1.70$, $ARCH : F(6, 62) = 1.22$, $Hetero : F(42, 31) = 0.67$
$AR^{vec} : F(54, 161) = 0.85$, $Normality^{vec} : \chi^2(6) = 7.28$, $Hetero^{vec} : F(252, 163) = 0.77$
$LR : \chi^2(41) = 13.93$

* means significance at 5% and ** at 1%

Table 4.2.2: The quarterly growth of Industrial employment in Belgium.

reported at the bottom of the table. Recursive estimation also confirms the absence of a structural break in the relationships. Once again, we note from Table 4.2.2 that an increase in the growth rate of industrial output has a positive long-term effect on employment growth in the sector. And an increased growth rate in

[17] l^{Ind} is the (logarithm of the) level of wage-earning employees in the industrial sector, y^{Ind} is the sector's real value-added and w^{Ind} is real wages per person in the sector. We should mention that we also tried GDP as the income variable for this section, but the results were not interesting.

sectoral real wages has the opposite effect and leads in the long-run to reduced employment growth.

Figure 4.2 shows the good fit of the estimated industrial employment equation. The upper part shows actual and fitted values, and the lower section the scaled residuals. In this case, all residuals remain within two estimated standard errors and confirm the absence of any outliers. Comparing Figure 4.2 with Figure 4.1 shows clearly that the growth rate of employment in Industry has essentially been negative in the period considered. This was already noted in Table 2.1.

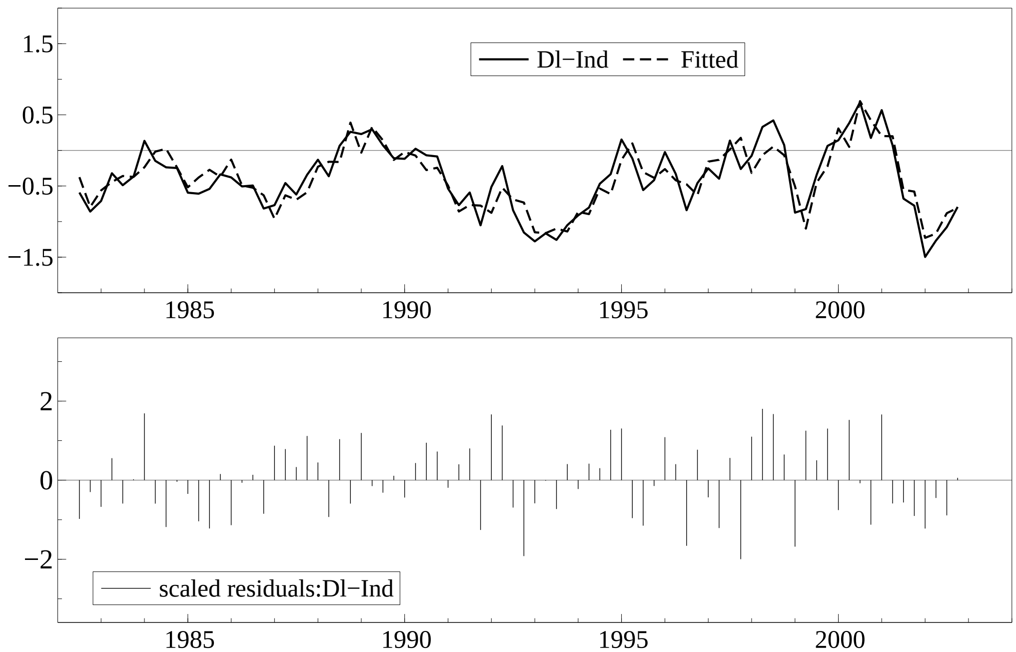

Figure 4.2: The quarterly growth of Industrial employment in Belgium.

Once again, we can analyse the effects that a shock on one of the variables in the system would have on the behaviour of all the variables in the long-run. The accumulated impulse response functions are shown in the appendix. A close look at Figure A.2.b shows that an increase in the growth rate of output in the industrial sector would result over time in a similar increase in industrial employment growth. The effect on real wages in the sector will also be positive but of a much smaller magnitude than for employment. The positive effect on wages in Industry is however much more clear than at the national level. The most important part of the response to the shock becomes apparent after six quarters, so considerably faster than at the national level. As for a one-time increase in the growth of sectoral wages, we can see in Figure A.2.c that the effect is a decline in the growth of employment, but of a much smaller magnitude compared to the initial shock. The response of employment in industry to a wage shock is also smaller than at the national level. Such a shock also has a very small negative effect on the growth of sectoral output, which unlike the situation at the national level, is insignificant compared to the effect of increased sectoral output on sectoral wages. It is also worth noting that the long-term effects of a shock to sectoral wages take about twelve quarters to become apparent.

4.3 Employment in Services

In this section, we repeat the same exercise to analyse employment in Services. Unlike the industrial sector which experienced a steady decline in employment during the whole of the period analysed, employment in Services has seen a steady increase in the same period. Once again, it is of interest to see if employment behaves differently in this sector compared to the national level. The relationship to real sectoral wages is of particular interest.

Estimating the unconstrained reduced form of the model here involves the variables Δl^{Ser}, Δy^{Ser} and Δw^{Ser}.[18] Johansen's tests confirm the stationarity of the system and the results are reported in Table 4.3.1:

rank	Trace test[Prob]	Max test[Prob]	Trace test(T-nm)	Max test(T-nm)
0	46.49[0.000]**	26.90[0.005]**	36.28[0.007]**	20.99[0.051]
1	19.59[0.010]*	13.13[0.074]	15.29[0.052]*	10.25[0.20]
2	6.46[0.011]*	6.46[0.011]*	5.04[0.025]*	5.04[0.025]*

* means significance at 5% and ** at 1%

Table 4.3.1: Johansen's tests for cointegration, in Services.

The following table shows the results of estimating the model by maximum likelihood and simplifying as far as possible. Once again, the misspecification tests are reported at the bottom of the table. There is some possible autocorrelation remaining in the errors of the employment equation. Normality is also rejected both for the employment equation and for the system as a whole. But a close look at the residuals (Figure 4.3) show the presence of one outlying observation for the employment equation in the Service sector, occurring in the last quarter of 1987. This could well explain why normality is rejected for this equation. A similar oulying observation exists in the wage equation for this sector in the last quarter of 1991. The combination of the two probably explains why normality is also rejected for the system. No structural breaks are detected when doing recursive estimation and looking at the recursive Chow-test statistics at the 1% significance level.

[18] These variables have the same definitions as for the Industrial sector.

	Coefficient	Std error	p-value
Constant	0.077	0.070	0.28
Δl_{-1}^{Ser}	0.71^{**}	0.10	0.000
$\Delta l_{-2}^{Ser} - \Delta l_{-3}^{Ser}$	-0.44^{**}	0.10	0.000
$\Delta l_{-4}^{Ser} + \Delta l_{-6}^{Ser}$	-0.24^{**}	0.09	0.009
Δl_{-5}^{Ser}	0.42^{**}	0.12	0.001
$\Delta y_{-1}^{Ser} + \Delta y_{-2}^{Ser}$	0.083^{*}	0.037	0.028
Δy_{-4}^{Ser}	-0.120^{*}	0.056	0.036
Δy_{-5}^{Ser}	0.09	0.054	0.091
Δw_{-2}^{Ser}	-0.044	0.027	0.102
Δw_{-6}^{Ser}	-0.066^{*}	0.027	0.019

T=82(1982:(3)-2002(4)), $\sigma = 0.33\%$, *Portmanteau(6)*=4.33, $Normality : \chi^2(2) = 9.23^{**}$
$AR : F(6,57) = 3.16^{**}$, $ARCH : F(6,62) = 0.62$, $Hetero : F(36,37) = 0.82$
$AR^{vec} : F(54,161) = 0.74$, $Normality^{vec} : \chi^2(6) = 28.78^{**}$, $Hetero^{vec} : F(216,198) = 0.80$
$LR : \chi^2(33) = 8.77$

* means significance at 5% and ** at 1%

Table 4.3.2: The quarterly growth of employment in Services in Belgium.

As is clear from Table 4.3.2, an increased growth rate of value-added in this sector has a long-term positive effect on employment growth. And an increased growth in real sectoral wages has the opposite effect in the long-run.

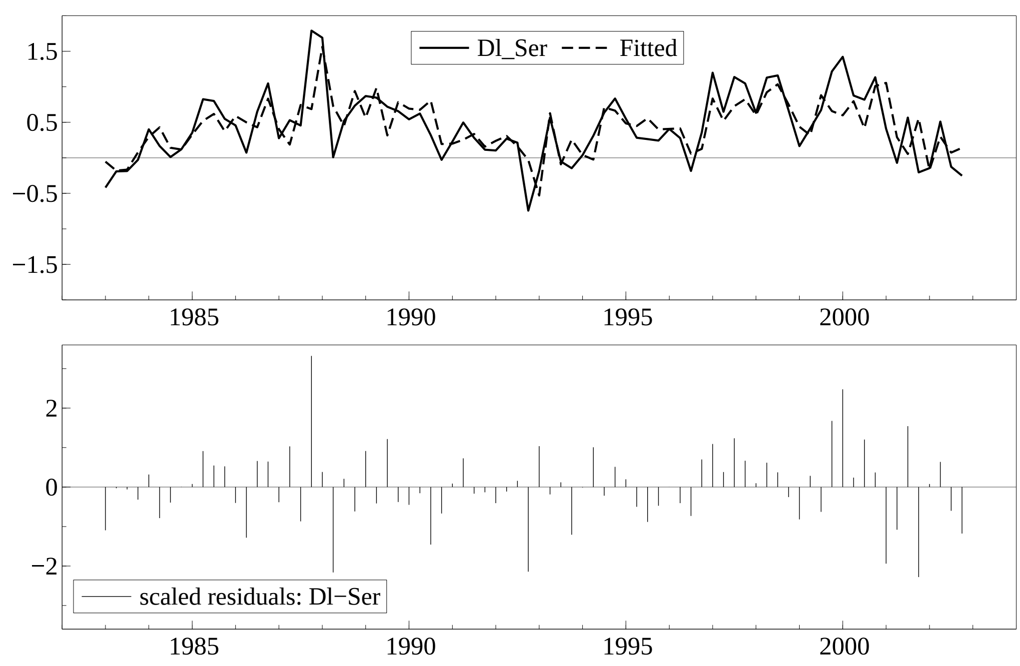

Figure 4.3: The quarterly growth of employment in Services in Belgium.

Figure 4.3 above sheds more light on the behaviour of employment in Services. As before, the upper part shows how the estimated values compare with the actual values. And the lower part shows the residuals for the employment equation. The fit of the equation is good, although the outlying nature of the observation in the last quarter of 1987 is evident. It is also worth noting that the standard error of the equation is larger than both the national and the Industry equations.

Comparing Figure 4.3 with Figure 4.1 shows clearly that as for employment at the national level, employment growth in Services has been essentially positive throughout the period considered. In fact, the mean rate of employment growth in Services has been significantly greater than employment in general. It is worth noting however that this growth rate has slowed down towards the end of the sample period.

Figure A.3 in the appendix summarises the effect that a shock on one of the variables in the system would have on the others. We can see from Figure A.3.b that an increased growth of the sectoral output has no sizeable effect on employment in services over time. The effect of the shock on the growth of sectoral real wages is positive but small, although larger than at the national level. The full responses become apparent after eight quarters. If we now look at an increased growth rate of real sectoral wages as shown in Figure A.3.c, this has a negative effect on employment in the sector. This was also the case in Industry as well as the national level. But the response in Services is much smaller than in the other two cases. The effect of such a shock on the sectoral output is almost insignificant in the long term.

4.4 Stationary Equilibrium

We finish this section by using the results in Tables 4.1.2, 4.2.2 and 4.3.2 to calculate what would be the relationship between employment growth, output growth and the growth of real wages in a stationary equilibrium. The results are summarised in Table 4.4.1. The difference with the impulse responses is that here these effects are calculated from the employment equation only and therefore do not take into account the possible feedback effects from changes in employment on the other variables, nor the possible feedback effects of changes of output growth on the growth of wages or vice versa.

To begin with, we can see clearly that output growth does indeed have a positive long-term effect on employment growth at all levels. For example, a permanent 1% increase in output growth nationally leads in the long-term to an increase in employment growth of 0.86%, excluding other feedback effects. We also notice clearly the differences at the sectoral level. The impact on employment in Industry is about twice that in Services. In addition, we also observe the negative effect of an increase in the growth of wages on employment growth. The largest effect is felt in Industry, and the smallest is in Services. Even if the result in Table 4.4.1 cannot be compared directly with the impulse response analysis, it is worth noting that the impulse response analysis also show a smaller impact of a wage shock on employment in the Service sector compared to Industry. It is found however that the largest response was at the national level.

Sectoral Level	Maximal lag	Output	Wages
National	7	0.86	-0.43
Industry	7	0.78	-0.72
Services	6	0.37	-0.28

The second column simply states the maximal lag of any variable in the employment equation.

Table 4.4.1: Long-term effects of output and wage growth on employment growth: 1982:III-2002:IV.

5 Forecasts of employment trends

As a final exercise, we use the estimated employment equation at the national level, to see what it forecasts as trends in employment over a four year period, the lifetime of a legislature. We therefore simulate the model under specific scenarios, whereby we impose a given growth rate of output and of wages. These scenarios are completely fictitious and only serve to illustrate what the estimated model suggests are the impact of these variables on employment. It should also be added that the simulations reported below do not allow for any feedback effects between variables, given that we impose the growth profile of both output and wages. They are therefore to be treated with caution and only be seen as providing a sensitivity analysis within the framework of a theoretical scenario. In particular, it would not be appropriate to compare the simulated profiles with the actual employment levels observed over the period 2003-2007.[19]

Table 5 summarises the results of three different simulated scenarios. The first scenario (A) is one where it is assumed that over the four year projection period, output is growing at its potential rate, which in the case of Belgium is of the order of 0.5% per quarter. In this scenario, wages are assumed to be growing at their average level for the period 1980-2002, i.e. the estimation period. The second scenario (B) retains the same assumption for wages, but assumes now that output grows at a faster rate, namely 0.7% per quarter over the whole of the period of

[19] It is of course possible to imagine simulating the model using the actual values of growth in output and wages to view the resulting employment profile. However, given the disparity between the data set we have used to estimate the model and the actual data available for the later period, our estimated model may not quite correspond to the new data set. We cannot test for this possible structural shift, given the small size of the new series.

projection. Finally, scenario (C) lets output grow at its potential level, but now assumes complete wage moderation, i.e. a freeze on the movement of real wages.

As expected, we note that job creation is much improved when output growth is higher than normal: keeping wage increases at the same level, our model suggests that when output grows at the slightly higher rate of 0.7% rather than 0.5% per quarter, then over a period of four years we can expect an increase in the net creation of jobs of the order of 50%. We also see that for a given rate of growth of output, wage moderation (in this case a freeze) does help to increase net job creation by about 30% over the same period.

Scenario	Output growth	Real Wage growth	Net number of jobs created over 4 years
A	0.5%	0.33%	62000
B	0.7%	0.33%	96000
C	0.5%	0.%	85000

Table 5: Simulating the model: 2003:I-2006:IV.

6 Conclusions

Our primary objective in this paper was to understand the dynamic relationship between three fundamental variables in Belgium: economic activity measured by the GDP, employment and wages. Despite the limitations imposed upon us due to the lack of a reliable and long historical data set, we have nevertheless shown that there exists a close relationship between growth and employment. We have also shown that employment growth is related to the movement of wage costs. What we cannot analyse is the distinction between changes in wage costs resulting from changes in working hours or from changes in hourly wages.

Our analysis shows that increased output growth can be expected to lead to increased growth of employment in general. This effect is quite insignificant in the service sector, but it is of the same order of magnitude when it comes to Industry or at the national level. We also find that increased output growth leads to an increased growth in wages which is less significant at the national level than at the sectoral level. These effects take between 1.5 to 2.5 years to take their full effect.

Our analysis also shows that an increased real wage growth generally leads to lower employment growth. Once again though, the effect in the service sector is almost insignificant. It is also less important in the Industry sector than at the national level, where the effect tends to be of the same order of magnitude. These effects take about 5 years to complete at the national level, much longer than the 3 years it takes in Industry. We also find that an increased real wage growth can lead to a downward pressure on output growth in Industry and at the national level, but seems to have little effect on output growth in services.

Finally, we reconfirm these results in a simple exercise of post-sample forecasting of employment levels under certain scenarios. At given wage levels, job creation is much improved with higher growth. Similarly, at given growth rates of output, many more jobs can be expected to be created when wage moderation is exercised.

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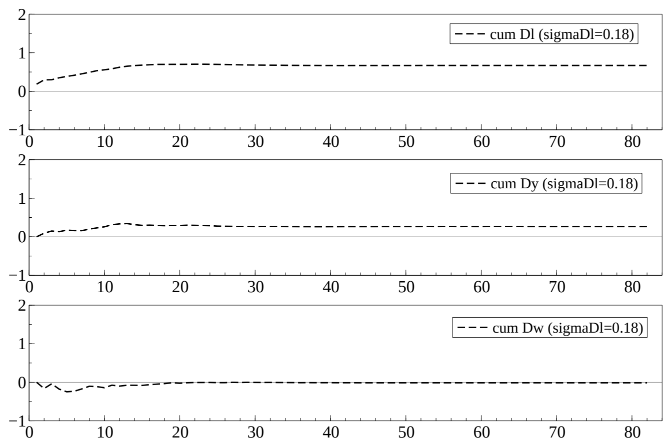
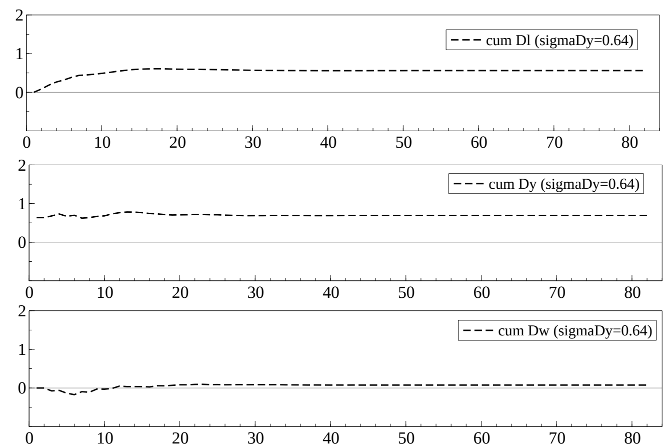
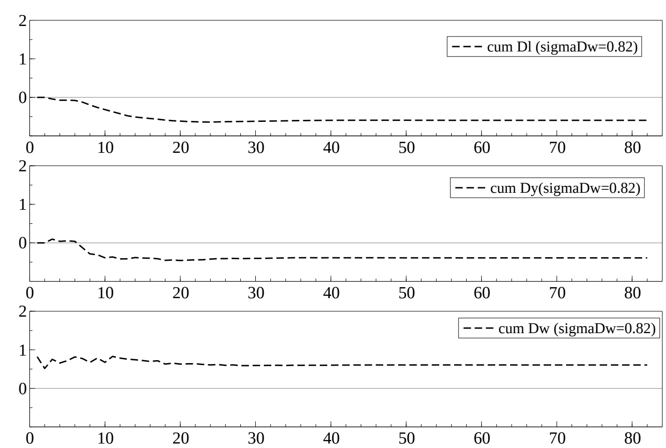
Appendix



a: Innovation in employment growth.

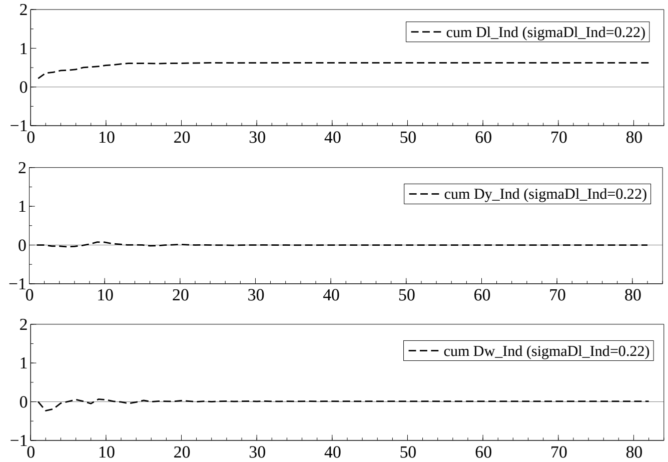


b: Innovation in GDP growth.

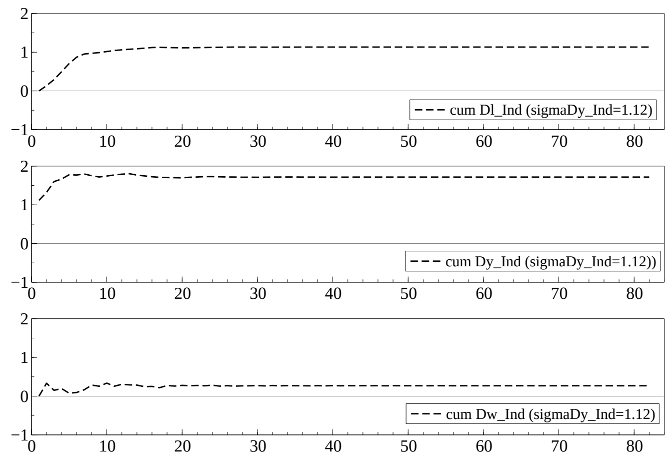


c: Innovation in wages.

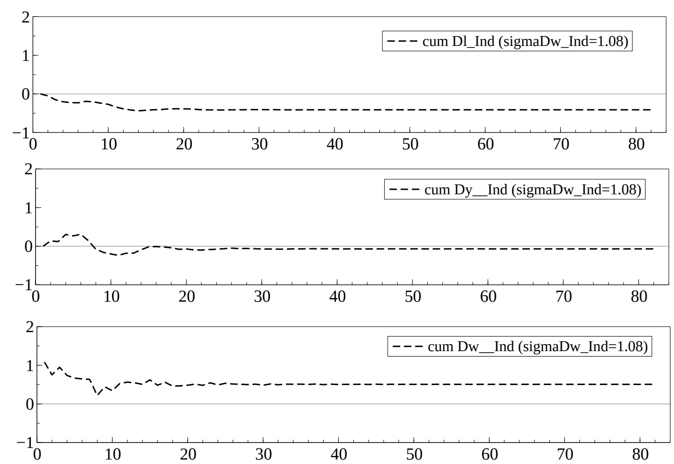
Figure A.1: Long-term adjustments to shocks in the quarterly growth rates of employment, GDP and real wages.



a: Innovation in industrial employment growth.

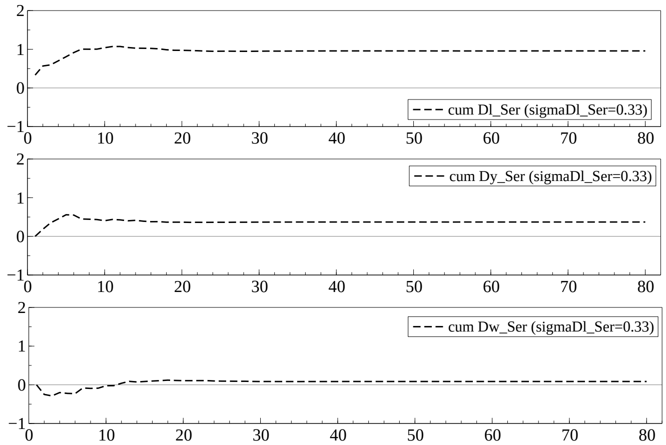


b: Innovation in the growth of industrial value-added.

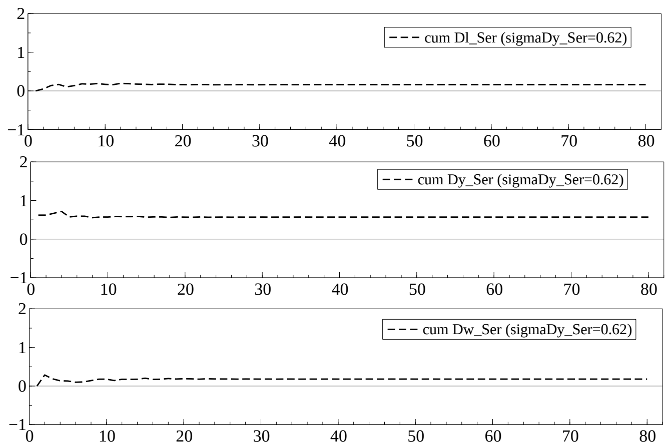


c: Innovation in the growth of industrial wages.

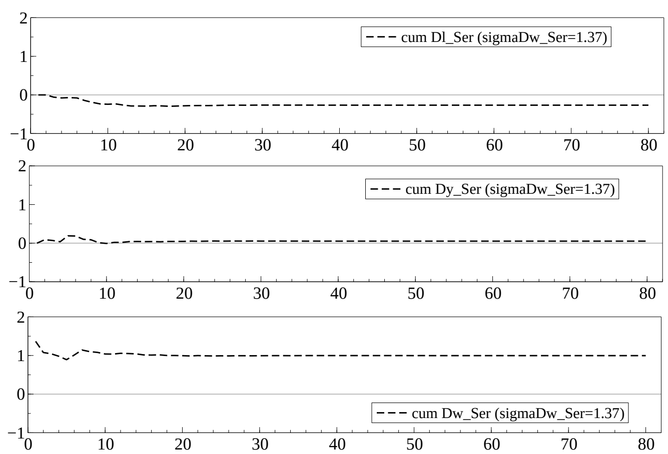
Figure A.2: Long-term adjustments to shocks in the quarterly growth rates of employment, value-added and real wages in Industry.



a: Innovation in employment growth in Services.



b: Innovation in the growth of value-added in Services.



c: Innovation in the growth of wages in Services.

Figure A.3: Long-term adjustments to shocks in the quarterly growth rates of employment, value-added and real wages in Services.

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