Further Evidence on the Wage Curve for Austria

Martin Falk and Thomas Leoni

Austrian Institute of Economic Research WIFO
P.O. Box 91
A-1103 Vienna
Austria
Phone: + 43-1-798 26 01 – 226
Fax: + 43-1-798 93 86
E-mail: Martin.Falk@wifo.ac.at

This version August 2008

Abstract:

In this paper, we estimate a wage curve using grouped data based on 121 districts in Austria for the year 2001. The elasticity of annual earnings of full-time workers with respect to the unemployment rate is about -0.03 and significant using the spatial lag model. However, ignoring spatial correlation leads to an insignificant wage curve elasticity. However, for females we do not find a wage curve. Allowing for a more flexible functional form by estimating a spatial lag model with linear spline functions reveals that the elasticity of wage with respect to the unemployment rate is highly elastic above the top quartile threshold (i.e. level of unemployment of 7.3 percent) for both males and females but close to zero in the lower quartiles.

Keywords: wage curve, unemployment, spatial dependence, spline functions.

JEL classification: R10, J3, J6.

1. Introduction

The wage curve describes an inverse relationship between individual wages and the local unemployment rate. This means that workers living in regions with high unemployment earn a lower wage than those with similar characteristics living in regions with low unemployment. Blanchflower and Oswald (1990, 1992, 1994) carried out a broad, in-depth empirical study of this issue and conclude that the average elasticity of wages with respect to unemployment is about -0.1. The wage curve elasticity of -0.1 is often regarded as an “empirical law of economics”. Recently, Nijkamp and Poot (2005) conclude that the wage curve elasticity corrected for the publication bias is about -0.07 using a meta-analysis based on 208 wage/unemployment wage curve elasticities from the literature. An interesting result is that the elasticity of wages to unemployment is quite stable across countries, time periods, levels of aggregation and empirical methodologies. In this paper, we provide new empirical evidence on the wage curve for Austria. In particular, we estimate the wage curve using spatial econometric techniques combined with a spline function in order to account for nonlinearities in the wage curve.

Our paper makes an original contribution to the existing literature in several respects. The main aim is to provide updated, fine-grain empirical evidence. The analysis of the wage curve for Austria is especially relevant because of the institutional characteristics of its labour market such as the role of wage bargaining processes and wage setting institutions. In Austria for the majority of industries wages are negotiated at the industry level by bargaining between employer representatives and unions. These negotiations lead to a set of collective agreements that apply not only to union members, but in practice to all employees working in the sector. According to Traxler and Behrens (2002) and Golden et al. (2007) the coverage ratio (i.e. ratio of workers covered by a collective wage agreement to the total dependent workforce) is about 70 percent. However, since the public sector is excluded from the right to bargain collectively, the adjusted coverage rate is 98% (Traxler and Behrens, 2002)[1]. This coverage, which is extremely high by international standards, is due to the legal framework governing industrial relations in Austria: on the employers’ side almost all agreements are concluded by the Economic Chambers (*Wirtschaftskammern*), for which membership is mandatory (Traxler, 2000). Our hypothesis would be that in Austria the wage curve is less elastic compared to the Anglo-Saxon countries due to the presence of collective wage bargaining at the sectoral (national) level. In summarizing the literature, Nijkamp and Poot (2005) conclude that the wage curve is more elastic in Anglo-Saxon countries. In addition, Austria's labour market is relatively flexible with intermediate

[1] “[…] The unadjusted rate is defined as the number of employees covered by a collective agreement as a proportion of the total number of employees (regardless of whether certain groups are excluded from bargaining); and the adjusted rate is defined as the number of employees covered by a collective agreement as a proportion of the number of employees equipped with the right to bargain (ie the total number of employees minus the number of employees excluded from the right to bargain)” (Traxler and Behrens, 2002).

high firing costs, a moderate benefit system, high regional mobility and low long-term unemployment rates. Consequently, we expect a lower elasticity of pay with respect to unemployment in absolute terms compared to countries with a more rigid labour market. To our knowledge, so far only one paper has dealt with the relationship between regional wages and regional unemployment rates in Austria at the district level: For male workers, Winter-Ebmer (1996) estimates an unemployment elasticity of hourly wages between -0.02 and -0.07 with a point estimate of -0.029 using micro data for the year 1983 matched with unemployment rates for 99 administrative districts.

An important result in the literature on the wage curve is that the unemployment elasticity of wages might vary across different groups of workers and different types of regions. To investigate this issue, we estimate separate wage curve equations for male and females. The previous empirical evidence on elasticities of wages with respect to unemployment for males and females has largely yielded inconclusive results. Wages of female workers are found to be less responsive to the local unemployment rate than wages of male workers in a number of studies (see Blanchflower and Oswald 1994; Baltagi and Blien, 1998; Baltagi, Blien, and Wolf, 2008; Card 1995; Janssens and Konings, 1998; Sanz-de-Galdeano-Turunen, 2006). However, Baltagi et al. (2000), Kennedy and Borland (2000) and Poot and Doi (2005) find that the unemployment elasticity of pay is greater for females than for males.

A small but increasingly important strand of literature has focused on the fact that regional labour markets are not isolated areas which are independent from each other. Geographic proximity and the extent of economic integration play an important role for understanding regional variations in wage levels. A number of studies account for spatial effects in the wage curve equation (Buettner, 1999; Elhorst et al., 2007 and Longhi et al., 2006). Accordingly, we account for spatial dependence across regions using information on road distance between district capitals. A special feature of the study is that we use data at a highly disaggregated regional level (below NUTS 3). Furthermore, we use unique administrative data on earnings from the wage tax statistics which includes all dependent workers in Austria with more than two million observations. Finally, we allow for a nonlinear relationship between wages and the unemployment rate by using a spline function in which the unemployment rate can have a different effect below and above its median, 25th percentile and 75th percentile.

Our results confirm the presence of spatial effects in the wage curve. The elasticity of pay with respect to unemployment is about -0.03 using the spatial lag model. Based on OLS we do not find a significant wage curve elasticity. Our model, which includes average years of education and population density as control variables, explains 80 percent of the variation in the level of wages across districts. Spline functions indicate that the wage curve elasticity in absolute terms is considerably greater in high-unemployment regions. We present and discuss our results at some length in section 4. The remainder of the paper is organized as follows: the next section (section 2) presents the empirical model and highlights the importance of the spatial dimension of the wage curve. In section 3 we present our data. The model is then applied and tested for robustness using different specifications in section 4.

2. Empirical model

There are several reasons why we expect wages and unemployment to be characterised by a spatial pattern. Elhorst et al. (2007) suggest that an employee may work and live in two different regions. If wages in surrounding areas are higher due to lower unemployment and the higher wage compensates for the time and travel costs of commuting, an employee may supply its labour outside his home area. Therefore, earnings in the home region may depend on the level of earnings in the surrounding regions and/or unobserved labour market characteristics in the neighbouring regions. In the presence of spatial effects one can use the spatial lag model where the spatial dependence is accounted for by including a spatially weighted lag term (WY) (Anselin and Bera, 1998):

$$Y = \rho WY + X\beta + \varepsilon ,$$

where Y is the dependent variable, X is a matrix of explanatory variables and W denotes the spatial weight matrix. β denotes the corresponding coefficient vector, ρ is the spatial lag parameter and ε is the error term that is normally distributed with mean zero and variance σ^2. The spatial lag parameter can be positive or negative. Negative spatial dependence occurs if areas with high wages are located side by side with low values or vice versa. This is commonly referred to as the existence of a so-called checkerboard pattern (Anselin and Bera, 1998). It is well known that OLS is biased in the presence of significant spatial lag effects resulting from misspecification of omitting a significant explanatory variable in the regression model.

An alternative way to incorporate spatial effects is to model the error term as an autoregressive random term. The resulting spatial error model can be written as follows (Anselin and Bera, 1998):

$$Y = X\beta + u \text{ and } u = \lambda Wu + v ,$$

where parameter λ is the coefficient on the spatially correlated errors indicating the extent of spatial correlation between the residuals. v is the disturbance term that is independent and identically distributed.

The parameters of both spatial models can be estimated by maximum likelihood. Note that in the case of spatial autocorrelation OLS is still unbiased but no longer efficient. The specification of the weight matrix is the sensitive point of the spatial econometric approach (Anselin and Bera, 1998). There are various ways to define the spatial weight matrix. In this study, we use an inverse distance function to calculate the weights in the spatial weight matrix, $w_{ij} = 1/d_{ij}$, where d_{ij} is defined as the shortest road distance in kilometres between district capital *i* and district capital *j*. In the next step, the elements of the spatial weight matrix have been row standardized i.e. the elements of each row add to unity. Beyond some distance, wages of district *j* should no longer affect those in district *i*. For this reason, an upper distance is typically chosen beyond which all weights are equal to zero. Given the log likelihood values, 100 km was selected as the upper distance above which the spatial weights are assumed to be zero. This is done by replacing values above the upper distance by an infinite value.

The wage curve equations with spatial effects can be written as follows:

$$\ln E_i = \alpha_0 + \alpha_1 \rho W + \alpha_2 \ln U_i + \sum_{j=1}^{J} \ln X_{ji} \beta_j + e_i,$$

$$\ln E_i = \tilde{\alpha}_0 + \tilde{\alpha}_1 \ln U_i + \sum_{j=1}^{J} \ln X_{ji} \tilde{\beta}_j + \lambda W u_i + v_i,$$

where *E* denotes annual average earnings of full-worker excluding temporary and/or seasonal workers for the year 2002, *U* is the unemployment rate for the year 2001, and *X* includes control variables such as population density and average years of education. All variables are measured at the district level, covering Austria's 121 political districts. The advantage of the use of grouped data compared to individual data is that the standard error of the unemployment is not biased downward ("Moulton bias"). Note that we take logarithm of the population density because descriptive statistics show large differences between the mean and median value.

It is well known that the functional form of the wage equation has to be determined from the data. There are a number of possible explanations in favour of a non-linear relationship between wages and unemployment. In general, the wage curve elasticity (in absolute terms) is expected to be smaller in countries with a high degree of regional labour mobility (Nijkamp and Poot, 2005). This explanation may also be relevant at the regional level. For instance, in the case of high unemployment regions, firms pay lower wages leading to smaller wage flexibility (Nijkamp and Poot, 2005). Hence, in regions with non-competitive tendencies of the regional labour market we expect larger wage curve elasticities in absolute terms. This suggests that the wage curve elasticity (in absolute terms) is increasing with the level of unemployment rate. Finally, one can argue that regions differ with respect to the share of workers with low bargaining power. Since the unemployment elasticity of pay is higher for low-skilled workers than for the higher educated (Nijkamp and Poot, 2005) and the fact that high unemployment regions are often characterised by a high share of low skilled workers, we expect that wage curve is more elastic in high-unemployment regions.

In this paper, we apply linear spline techniques in order to account for non-linearities (see Greene, 2003). The piecewise linear spline function approach is used over the quadratic approach because it is more flexible. The basic idea is that any continuous function can be approximated by a piecewise linear function. In case of the spatial lag model, the specification of the wage curve equation using a spline function with one knot can be written as:

$$\ln E_i = \tilde{\alpha}_0 + \tilde{\alpha}_1 \rho W + c_1 \ln U_{1i}(k_1) + c_2 \ln U_{2i}(k_2) + \sum_{j=1}^{J} \ln X_{ji} \tilde{\beta}_j + \tilde{e}_i,$$

where $\ln U_{1i}(k_1) = \begin{cases} k & k \leq D \\ D & k > D \end{cases}$ and $\ln U_{2i}(k_2) = \begin{cases} 0 & k \leq D \\ k - D & k > D \end{cases}$.

D denotes the cut-off point or knot. Here, the log unemployment rate is divided into two segments and the knot is equal to median of the logarithm of the unemployment rate. In addition, we use two and three knots determined by the 33th and 66th percentile as well as quartiles.

3. Data and descriptive statistics

We use grouped data based on the 2001 Austrian population census provided by Statistics Austria.[2] The unemployment rate is defined as the share of the labour force that is unemployed and actively seeking work in the week of the survey for the year 2001. Population density is defined as total population per square kilometre for the year 2001. Average years of education is constructed from eight completed education categories following the methodology of De la Fuente and Doménech (2002). In addition, we draw data from the annual wage tax statistics disaggregated at the district level, i.e. average annual gross earnings of all dependent workers of full-time equivalents excluding temporary and seasonal workers as well as workers with employment breaks in EUR. Overall the number of observations that is used to calculate average earnings is 2,195,577 of which 1,366,942 are males and 828,635 are females. The advantage of the database is that there is no earnings threshold above which the exact value of the earnings is unknown. Road distance between district capitals is provided by the Federal Ministry of Transport, Innovation and Technology.

Table 1: Descriptive Statistics

	mean	median	standard deviation	minimum	maximum
average annual earnings in 2002 in EUR	25791	25046	3965	19068	43810
average annual earnings of males in 2002 in EUR	35462	34249	6084	28448	67649
average annual earnings of females in 2002 in EUR	23805	22368	3771	18702	36661
unemployment rate in 2001	6.0	5.4	2.5	2.2	13.0
population density in 2001	1964.5	88.6	4761.5	20.9	24433.3
average years of education in 2001	11.0	10.9	0.4	10.5	12.6
average years of education of males in 2001	11.1	11.1	0.4	10.6	12.7
average years of education of females in 2001	10.9	10.8	0.4	10.4	12.3

Notes: The number of observations is 121. Source: Census of population and Austrian labour tax statistics.

[2] These data can be downloaded from: www.statistik.at/web_en/publications_services/isis_database/index.html.

Table 1 presents descriptive statistics. The mean unemployment rate across the districts is 6.0 percent in 2001. The average annual gross earnings are EUR 25,791 for both males and females, EUR 35,462 for males and EUR 23,805 for females. Population density is 1,965 when measured as the mean and 89 when calculated as the median. Average years of education is 11 years on average.

4. Empirical results

Before presenting the estimation results we provide the results of the spatial autocorrelation tests (see table 4 in appendix). We find a significant negative spatial correlation for all variables indicating that areas with higher than average values of the variables are surrounded by areas with lower than average values. Furthermore, the negative spatial correlation is higher for annual earnings for full-time workers than for the unemployment rate. Table 2 displays the estimation results of the wage curve including the spatial lag of the logarithm of annual earnings. We report separate estimates for females and males and a pooled model. For comparison, we also provide OLS estimates (see the lower panel). In addition, we also have estimated the spatial error model. Lagrange multiplier (LM) and the robust LM tests show that spatial error model is rejected against the spatial lag model because the test statistics of LM (lag) test is lower than that of the LM (error) model.[3] Therefore, we only display estimation results of the spatial lag model. The spatial parameter, ρ, is negative and highly significant indicating that the level of earnings is negatively related to the wage level in the neighbouring region.

Using the spatial lag model, the elasticity of annual earnings with respect to the unemployment rate is -0.03 with a t-value of 2.23. This indicates that a 10 percent increase in the unemployment rate reduces the level of wages by 0.3 percent. This elasticity is considerable lower than the empirical law of the wage-unemployment elasticity of about -0.10 (Blanchflower and Oswald, 1994) as well as the average wage curve elasticity corrected for the publication bias reported by Nijkamp and Poot (2005). It is interesting to compare the wage curve elasticity of the spatial lag model with that using OLS. Based on the latter we find an elasticity of annual earnings with respect to the unemployment rate of -0.017 with a t-value of -1.19. This indicates that ignoring spatial effects leads to biased results. This is consistent with Longhi et al. (2006) and Buettner (1999) who also find that accounting for spatial dependence leads to a higher elasticity of pay with respect to unemployment in absolute terms. The results for the wage curve elasticity should be compared with previous studies based on Austrian data. For male workers, Winter-Ebmer (1996) reports a similar elasticity of -0.029 using cross-section regressions for the 1983 although the author uses a different empirical methodology. Niijkamp and Poot (2005) report a mean wage curve elasticity of -0.068 with respect to four studies based on Austrian data.

[3] Results for the spatial error model are available upon request.

Table 2: OLS and ML estimates of the spatial lag model for the wage curve equation

				spatial lag model					
	total			males			females		
	coeff		t	coeff		t	coeff		t
ln unemployment rate in 2001	-0.033	***	-2.23	-0.031	*	-1.74	0.011		0.76
ln population density in 2001	0.017	***	4.40	0.022	***	4.85	0.023	***	6.13
ln average years of education in 2001	2.312	***	10.77						
ln average years of education of males, 2001				2.814	***	10.70			
ln average years of education of females, 2001							1.847	***	13.67
constant	14.103	***	7.12	10.892	***	4.49	16.604	***	14.17
ρ (spatial lag parameter)	-0.921	***	-5.04	-0.709	***	-3.26	-1.100	***	-10.16
LM Test for spatial dependence, chi^2 stat. (p-value)	22.6		(0.00)	10.919		(0.00)	79.47		(0.00)
robust LM Test for spatial depend., chi^2 stat.(p-value)	28.526		(0.00)	12.800		(0.00)	93.800		(0.00)
Pseudo R^2	0.806			0.807			0.857		
Log-likelihood	187.4			164.8			220.2		
				OLS results					
	coeff		t	coeff		t	coeff		t
ln unemployment rate in 2001	-0.017		-1.19	-0.018		-0.83	0.043	***	2.52
ln population density in 2001	0.022	***	5.69	0.026	***	5.53	0.030	***	6.98
ln average years of education in 2001	2.496	***	10.73						
ln average years of education of males, 2001				2.973	***	14.83			
ln average years of education of females, 2001							2.137	***	12.88
constant	4.178	***	7.60	3.117	***	6.73	4.923	***	13.01
Adj-R^2	0.809			0.806			0.856		

Notes: The dependent variable is the average annual earnings of full-time workers excluding temporary or seasonal employees for the year 2002.The number of observations is 121. ***,(**),(*) denote significance at the 1%, (5%) and (10%) level. The R^2 is calculated as the squared. value of the correlation between the observed and predicted ln annual earnings. The cutoff point in the distance matrix is 100 km. t-values are based on heteroscedastically consistent standard errors.

Turning to the control variables, we find that the elasticity of the level of earnings with respect to population density is highly significant and positive. The coefficient on average years of education is also positive and significant. The coefficient implies that an increase in the average years of education by 1 percent increases the level of annual earnings by 2.3 percent.

In order to allow for a more flexible functional form we provide estimates of the spatial lag model including spline functions for the unemployment rate. Table 3 shows the estimations results for three different specifications of the spline function (i.e. two, three and four segments of the unemployment rate distribution). We find that the null hypothesis of a log linear functional form is significantly rejected in any of the three specifications. Furthermore, we find that spline functions based on three knots resulting in four different segments give the best fit in terms of the log likelihood value. In this case we find that earnings are highly elastic above the top quartile threshold but the coefficient is close to zero in the other quartiles. In other words, the wage curve does not exist in districts with unemployment rates equal to or lower than 7.3 percent. Separate estimates for females suggest that the wage curve is also significant and negative for the top quartile of the unemployment rate.

Table 3: ML estimates of the spatial lag model for the wage equation including spline functions

	spline function results with one knot								
	total			males			females		
	coeff		z	coeff		z	coeff		z
ln unemployment rate in 2001 [2.2 < U <= 5.4][a]	0.002		0.08	0.010		0.38	0.052		2.70
ln unemployment rate in 2001 [5.4 < U <= 13.0][a]	-0.083	**	-2.07	-0.093	*	-1.89	-0.046		-1.35
ln population density in 2001	0.022	***	3.93	0.028	***	4.16	0.029		5.49
ln average years of education in 2001	2.177	***	10.12						
ln average years of education of males, 2001				2.647	***	9.73			
ln average years of education of females, 2001							1.703		10.90
constant	14.705	***	7.69	11.645	***	4.97	17.129		14.95
ρ (spatial lag parameter)	-0.940	***	-5.33	-0.733	***	-3.50	-1.107		-11.04
Log likelihood	188.5			166.0			223.1		
	spline function results with two knots								
	total			males			females		
	coeff		z	coeff		z	coeff		z
ln unemployment rate in 2001 [2.2 < U <= 4.6][a]	-0.009		-0.24	0.019		0.45	0.036		1.36
ln unemployment rate in 2001 [4.6 < U <= 6.6][a]	-0.002		-0.05	-0.032		-0.56	0.044		1.28
ln unemployment rate in 2001 [6.6 < U <= 13.0][a]	-0.150	**	-2.53	-0.137	*	-1.86	-0.105	**	-2.13
ln population density in 2001	0.026	***	4.19	0.030	****	4.15	0.031	***	5.72
ln average years of education in 2001	2.030	***	8.35						
ln average years of education of males, 2001				2.546	***	7.93			
ln average years of education of females, 2001							1.590	***	9.62
constant	16.050	***	7.38	12.459	***	4.50	18.058	****	15.30
ρ (spatial lag parameter)	-1.041	***	-5.38	-0.786	***	-3.32	-1.180	***	-11.71
Log likelihood	189.6			166.5			224.5		
	spline functions results with three knots								
	total			males			females		
	coeff		z	coeff		z	coeff		z
ln unemployment rate in 2001 [2.2 <= U <= 4.3][a]	-0.006		-0.15	0.023		0.48	0.033		1.04
ln unemployment rate in 2001 [4.3 < U <= 5.4][a]	-0.026		-0.29	-0.043		-0.41	0.047		0.87
ln unemployment rate in 2001 [5.4 < U <= 7.3][a]	-0.007		-0.09	-0.024		-0.26	0.016		0.31
ln unemployment rate in 2001 [7.3 < U <= 13.0][a]	-0.181	***	-2.61	-0.169	*	-1.90	-0.128	**	-2.39
ln population density in 2001	0.026	***	4.35	0.030	***	4.29	0.031		5.86
ln average years of education in 2001									
ln average years of education of males, 2001	1.986	***	7.65	2.492	***	7.09			
ln average years of education of females, 2001							1.561	***	9.54
constant	16.430	***	7.21	12.945	***	4.48	18.232	***	15.67
ρ (spatial lag parameter)	-1.067	***	-5.40	-0.818	***	-3.43	-1.191	***	-11.90
Log likelihood	190.0			166.6			225.2		

Notes: The dependent variable is the average annual earnings of full-time workers excluding temporary or seasonal employees for the year 2002.The number of observations is 121. ***,(**),(*) denote significance at the 1%, (5%) and (10%) level. t-values are based on heteroscedastically consistent standard errors. [a]The coefficients are the slope parameters of the spline function. The knots are equal to the level of unemployment of about 5.4 percent in first panel, 4.6 and 6.6 in the second panel and 4.3, 5.4 and 7.3 in the last panel.

The estimated pay-unemployment elasticities for the top quartile are -0.182 for the pooled sample, -0.169 for males and -0.128 for females. For the spline functions with one knot the wage elasticity is not significantly different from zero in districts with a lower than median value of the logarithm of the unemployment rate. In contrast, for regions with a higher than median unemployment rate we find an elasticity of -0.08. The specification of the spline functions with three segments show that the wage curve does not exist for districts with unemployment rates below or equal the 66th percentile. Again, this indicates that the wage elasticity is increasing in the level of the unemployment rate for the total sample and for males.

The results that the wage curve elasticity (in absolute terms) is increasing with the unemployment rate stands in contrast with previous studies. Based on district data for Germany for the period 1987-1994, Buettner (1999) find that the relation between the level of pay and the local unemployment rate is less elastic with a higher level of unemployment. Similarly, Longhi et al. (2006) find that the wage curve elasticity becomes less negative at higher unemployment rates. However, the results of the different studies are difficult to compare since they differ in the data used, time period, country coverage and empirical methodology.

Furthermore, it has to be pointed out that the Austrian labour market is characterised by low unemployment. The highest unemployment rate that we observe in our data is 13.0%, well below the values for Germany included in the studies by Buettner (1999) and Longhi et al. (2006). Using quantile regressions, Sanz-de Galdeano and Turunen (2006) also find that the wage curve elasticity exhibit some non-linearities. In particular, the wage curve elasticity is decreasing along the wage distribution indicating that wages of workers at the bottom of the distribution are more responsive to the local unemployment rate.

To test further for the robustness of our results, we estimate the wage curve equation including interaction terms between the dummy variable for Vienna regions and the surrounding regions and the unemployment rate. This is justified by the empirical findings of Longhi et al. (2006) that the wage curve is less elastic in regions that are located close to highly agglomerated areas. However, unreported results show that the interaction terms are not significant at the 5 percent level.

5. Conclusions

In this paper we have looked at the relationship between annual earnings and the unemployment rate in Austria’s 121 administrative districts. Our analysis provides (further) evidence on the importance of accounting for spatial factors when looking at regional wages and unemployment. In line with our prior expectations, we find an estimated elasticity of pay with respect to unemployment of about -0.03

using the spatial lag model estimated by Maximum likelihood. OLS estimates suggest there is a negative but insignificant association between pay and the unemployment rate. However, OLS estimates are biased and inconsistent when spatial effects are neglected. Furthermore, the estimates show that unemployment elasticity of pay is less elastic for females than that for males.

The estimated impact of regional unemployment on the level of pay of about -0.03 is quite small compared to the average elasticity corrected for publication bias calculated by Nijkamp and Poot (2005). This might indicate that the dominant role of collective bargaining at the sectoral level and the high coverage rate of collective agreements set a constraint on firms in their adjustment of wages to local labour market conditions.

Allowing for a more flexible functional form by estimating a spline function reveals that an uniform wage curve across the regions can be rejected. In particular, the wage elasticity is not significantly different from zero in districts with unemployment rates lower than or equal to the third quartile (i.e. 7.3 percent). In contrast, for regions with high unemployment rates (i.e. greater than or equal to the third quartile) we find an elasticity of -0.18. The finding that the wage curve elasticity is higher for males than that for females holds whether the relationship is assumed to be linear or non-linear.

References

Anselin, L. and A. K. Bera (1998), Spatial dependence in linear regression models with an introduction to spatial econometrics. In: Hullah A. and Gelis D.E.A (eds.) *Handbook of Applied Economic Statistics*, New York. 237-290.

Baltagi, B. H., and U. Blien (1998), The German wage curve: evidence from the IAB employment sample, *Economics Letters* 61, 135-142.

Baltagi, B. H., U. Blien and K. Wolf (2000), The East German wage curve: 1993-1998, *Economics Letters* 69, 1, 25-31.

Baltagi, B. H., U. Blien and K. Wolf (2008), New Evidence on the dynamic wage curve for Western Germany: 1980-2004. Center for Policy Research, Working Paper No. 103, *Labour Economics* forthcoming.

Blanchflower, D. G., and A. J. Oswald (1990), The wage curve, *Scandinavian Journal of Economics* 92, 215-35

Blanchflower, D. G., and A. J. Oswald (1992), *International wage curves*, NBER Working paper 4200.

Blanchflower, D. G., and A. J. Oswald (1994), *The wage curve*, MIT Press: Cambridge.

Blanchflower, D. G. and A. J. Oswald (2005), *The wage curve reloaded*, National Bureau ofEconomic Research Working Paper #11338, Cambridge, MA.

Buettner, T. (1999), The effect of unemployment, aggregate wages, and spatial contiguity on local wages: An investigation with German district level data, *Papers in Regional Science* 78, 1, 47-67.

Card, D. (1995), The wage curve: A review, *Journal of Economic Literature* 33, 2, 758-799.

De la Fuente, A., and R. Doménech (2002), *Educational attainment in the OECD*, 1960-95. CEPR Discussion Papers 3390.

Elhorst, J.P., U. Blien and K. Wolf (2007), New evidence on the wage curve: A Spatial Panel Approach, *International Regional Science Review* 30, 2, 173-19.

Golden M., M. Wallerstein and P. Lange (2007), *Unions, employers, collective bargaining and industrial relations in 16 OECD countries between 1950 and 1992: Union centralization among advanced industrial societies - An empirical study*, UCLA working paper.

Greene W. H. (2003), Econometric Analysis. Fifth Edition, New Jersey, Prentice-Hall.

Janssens, S. and J. Konings (1998), One more wage curve: the case of Belgium, *Economics Letters* 60, 2. 223-227

Kennedy, S. and J. Borland (2000), A wage curve for Australia? *Oxford Economic Papers* 52, 774-803.

Longhi, S., P. Nijkamp and J. Poot (2006), Spatial heterogeneity and the wage curve revisited, *Journal of Regional Science* 46, 4, 707-731.

Nijkamp, P. and J. Poot (2005), The last word on the wage curve? A meta-analytic assessment, *Journal of Economic Surveys* 19, 421-450.

Poot, J. and M. Doi (2005), National and regional wage curves in Japan 1981-2001, *Review of Urban and Regional Development Studies* 17, 3, 248-270.

Sanz-de-Galdeano, A. and J. Turunen (2006), The euro area wage curve, *Economics Letters* 92, 93-98.

Traxler, F. (ed.) (2000), *European Employment and Industrial Relations Glossary: Austria*, Sweet and Maxwell, London.

Traxler, F. and M. Behrens (2002), *Collective bargaining coverage and extension procedures*, EIROnline, http://www.eurofound.europa.eu/eiro/2002/12/study/tn0212102s.htm.

Winter-Ebmer, R. (1996), Wage curve, unemployment duration and compensating differentials, *Labour Economics* 3, 4, 425-434.

Appendix

Table 4 : Spatial autocorrelation tests

	Moran's I	z	p-value
ln average annual earnings in 2002 in EUR	-0.155	-25.082	0.00
ln average annual earnings of males in 2002 in EUR	-0.132	-21.289	0.00
ln average annual earnings of females in 2002 in EUR	-0.228	-37.323	0.00
ln unemployment rate in 2001	-0.113	-17.66	0.00
ln population density in 2001	-0.133	-21.069	0.00
ln average years of education in 2001	-0.086	-13.324	0.00
ln average years of education of males in 2001	-0.079	-12.194	0.00
ln average years of education of females in 2001	-0.092	-14.349	0.00