Stimulating employment growth with higher wages? A new approach to address an old controversy

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Abstract

This paper analyses the impact of wages on employment growth of regional industries in West Germany (1993-2002). It addresses the tension between neoclassical cost push effects, and potentially offsetting demand side repercussions. In a wage regression we construct a neutralised regional wage level that detaches average earnings from various productivity influences. A positive value implies "overly high" labour costs, but also high purchasing power of local consumers. In a subsequent employment growth regression we find a significantly negative effect associated with this wage indicator. This suggests that cost push effects dominate on balance. The magnitude of the short-run elasticity of labour demand is somewhat lower than previous estimates from the literature, which suggests that demand side repercussions have a mitigating effect. Furthermore there is considerable variation of this elasticity across industries. But in no case we find a positive employment reaction in the short run.

Keywords: Employment Growth, Regional Wages, Purchasing Power Argument, Wage Elasticity, Labour Demand.

JEL-Classification: J23, E24
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I. INTRODUCTION

The connection between wages and employment growth is among the most fundamental macroeconomic relations. According to the standard neoclassical textbook argument, labour demand is downward sloping. Hence, higher labour costs will reduce equilibrium employment. This argument can be extended to a dynamic setting and to open economies, where it would state that a permanent increase in domestic labour costs should reduce the subsequent employment growth rate of an economy, because firms substitute labour with capital, or – in the context of globalization – they outsource production to low wage countries. Yet, even a brief look at commonly repeated public discussions makes clear that there is no general consensus in the society about the *direction* of the impact of wages on employment growth, let alone a common sense about the *quantitative size* of the effect (Jerger and Landmann, 2002). Trade unionists even frequently argue that higher wages will actually lead to *stronger* employment growth. The basis for this viewpoint, which would obviously leave quite some room for an active wage policy, is the "purchasing power argument" (PPA). According to the PPA, a higher labour share will increase aggregate demand, which in turn can speed up employment growth if supply side impacts are not too pervasive.

Most economists disregard the PPA out of hand and emphasise only the supply-side effects of labour costs. Yet, the direction of the impact of wages on employment growth is in fact ambiguous from a theoretical point of view once demand side repercussions are taken into account. This is shown, for example, by Jerger and Michaelis (2003) who model an economy where workers have higher marginal propensity to consume than entrepreneur households. Increasing the labour share by means of a wage hike will increase aggregate demand. When the capital stock adjusts slowly, and if prices are sticky, the employment growth rate can actually *increase* in the short run, although in the medium- and long-run where capital stock and prices become flexible, demand side repercussions are put under strain.

Ultimately, it is an empirical question if a trade-off between wages and employment growth exists, and if yes, how strong it actually is. But given the real world relevance of this debate there is a surprising lack of serious empirical work that is directly concerned with this question. There is a substantial literature on related themes that has not come to definite conclusions, however. Hamermesh (1993) provides an extensive overview of studies on the elasticity of labour demand, which have usually focussed on individual firms or aggregate economies. He concludes that "*the absolute value of the constant-output elasticity of demand for homogenous labour for a typical firm, or for the aggregate economy in the long run, […] is probably bracketed by the interval [0.15, 0.75], with 0.30 being a good best guess*" (p.135).[1] As the estimated labour demand elasticity is negative, this would suggest also a negative relation between wages and employment growth. One the other hand, macroeconomic studies or country comparisons have often failed to confirm a clear-cut relation between downward wage flexibility and a country's success in terms of job creation (Blanchard/Wolfers, 2000; Card et al., 1999; Krueger/Pischke, 1997; Freeman, 1995).

In the present paper we aim to shed light on the relation between wages and employment growth from a new perspective. The main idea is to set up an empirical framework which explicitly acknowledges that wages can influence employment growth via a supply *and* a demand sided channel. More specifically, we will exploit the intra-national variation of wages and employment across 28 different industries and 326 (NUTS3-) regions in West Germany over the time period from 1993-2002, thereby combining the advantages of economy-wide studies with a high degree of intra-national variation and a large number of observations.

We examine the relation between a neutralised regional wage level that is detached from various productivity influences, and the employment growth rate of the different industries in that district. A wage increase might induce consumers to spend more on locally provided

[1] More recent estimates for Germany that belong to this strand of the literature lie within this range. In a sectoral panel analysis with observation period 1975-1995, Pfeiffer (2004) obtains an elasticity of –0.49 that refers to the "wage sweep up", which is defined as the degree to which wage decreases are prevented by nominal rigidities. Using German firm level data from 1993-1996, Koelling (1998) estimates an elasticity of around –0.20.

goods, such as visits to restaurant, leisure-related services, etc. Employment growth might be stimulated through this channel to the extent that purchasing power of local consumers is relevant for the respective industries. Since regions are very open economies, export oriented firms are unlikely to benefit from the local demand stimulus, because considerable parts of the induced purchasing power will drain out. These industries are left with the higher labour costs. However, demand side repercussions might be important for locally oriented firms and the *strength* of the trade-off between wage rates and employment growth might vary across industries. To the best of our knowledge we are the first to systematically explore such industry-specific employment growth reactions to "overly high" wages, which can serve to identify if empirical support for the PPA exists at least for some cases.

The analysis consists of two steps. In the first step, we run a wage regression and isolate regional fixed effects as a "neutralised" wage indicator. A "high wage region" is, thus, not a region with high wages per se, but a region where wages are higher than they "should be" given a variety of characteristics. In the second stage we estimate a panel model of local industries. We find that an increase in (neutralised) wages significantly reduces employment growth of the industries in the same region. Supply side effects dominate demand side effects on balance, which reassures neoclassical expectations, but demand side effects have a moderating impact. There is considerable variation across industries. The employment effect is significantly negative only in some cases; particularly, in export oriented manufacturing industries. However, for no industry – not even for the most locally oriented ones – we find evidence for a positive employment reaction. Lastly, we also take spatial demand spillovers into account. They have a mitigating impact, because a region benefits when wages increase everywhere else in the country but not in the region itself, but a negative net effect remains.

The rest of the paper is organised as follows. In section 2 we introduce our data set. The estimation approach is described in section 3, and the regression results are presented in section 4. Section 5 provides some concluding remarks.

II. DATA

The primary data source for this study is the employment statistics provided by the German Federal Employment Agency (Bundesagentur für Arbeit). It contains the complete population of all full-time employment relationships (≥ 35 regular working hours per week) subject to social security, i.e. excluding civil servants and the self-employed.[2] Data is aggregated to the level of local industries. We can observe employment in 28 different (manufacturing and service) sectors, and in the 326 West German NUTS3-regions ("Landkreise" and "kreisfreie Staedte", excluding West Berlin), referring to the *workplace location*. We have annual observations for the period from 1993 to 2002, out of which we lose one year for constructing employment growth rates and one for including time lags of control variables. Our balanced panel therefore has 8 years * 326 districts * 28 industries = 73024 units.[3] We not only know the total employment level in each local industry and year, but we can also distinguish the employment shares of three skill categories (without formal vocational qualification, completed apprenticeship, higher education), and three firm size classes (firms with fewer than 20, 20-99, and more than 100 employees). Additionally we know the average age of the employees, and the fraction of men.

We also obtain the wage income for each full time employee, including all bonus and extra payments. Since individual social security contributions are calculated on the basis of this official information the data is highly reliable. With this information we compute the average wage income per employee and calendar day in each industry, region and year.

Two problematic aspects should be noted with respect to income data. First, income levels that exceed the threshold for social security contributions are reported with this value. Our

[2] We focus on full time employment, because there are data problems for part-time employment relationships due to the change in the data basis in 04/99. In particular, wages and actual working hours for part-time employees are measured less accurately. Below we will also check the robustness of our estimation results when part-time employees are included in form of "full time equivalents".

[3] We must treat 2728 cells as missing observations, because employment is equal to zero in all years or at least in some years of the observation period (e.g., coalmining in most northern districts). In the employment growth regression, temporal absence causes the problem of infinite growth rates when the industry re-appears.

data set is therefore likely to understate wage dispersion in West Germany. Second, although we deflate wages and work with prices of 1993, we are restricted to use a common price deflator for all districts (the CPI for West Germany), because regional price indices are not available. This is a bit unfortunate because high nominal wages reflect –at least partly– a high regional costs of living (see e.g. Tabuchi, 2001). To ameliorate this data problem, we group the West German districts in nine different *area types*[4] ranging from "central city in agglomeration area" to "rural district in rural area". In the wage regression the area types will at least partly control for unobserved cost-of-living differentials, because systematic wage disparities between central cities and rural districts are filtered out.

The second data source that we use is provided by the German Federal Statistical Office ("Statistik regional"). It covers the time period 1995-2002 and entails information at the district level about regional GDP, residence population, area size in km^2, land prices, and several other regional characteristics. This data will be used for the "neutralisation" of regional wage levels, as we shall describe below.

III. EMPIRICAL APPROACH

Our empirical analysis consists of two stages. In the first stage we construct an indicator for the regional wage level that is detached from various productivity influences (section 3.1.). In the second stage of the regression we address the impact of this neutralised regional wage level on the employment growth rate of the different industries in that region (section 3.2.). We also allow for spatial demand spillovers by analyzing what happens to employment growth in a region when wages increase everywhere else in the country, but not in the region itself (section 3.3.). Methodological aspects of the estimation will be discussed in section 3.4.

[4] The common classification scheme is due to the research unit of the German Federal Office for Building and Regional Planning (BBR). It captures both, the density and the economic centrality of districts.

1. "Neutralised" and "super-neutralised" regional wages

In the first stage we regress the (log) daily average income in industry i, district r, and year t ($\ln W_{irt}$) on all available control variables from the primary data set, including complete sets of dummies for every industry (α'_{it}), district (W'_{rt}), and area type (δ'_{yt}):

$$\ln W_{irt} = \beta_{0,t} + W'_{rt} + \alpha'_{it} + \delta'_{yt} + \beta'_t \cdot X_{irt} + \varepsilon'_{irt} \qquad (1)$$

X_{irt} are time-varying characteristics of the local industries (qualification, firm size, age and gender structure), $\beta_{0,t}$ is a constant term, and ε'_{irt} is the error term. The most important variable for our purpose is the regional fixed effect W'_{rt} that shows how wages in region r differ from a level that "should" prevail in period t, given the area type and the industry, qualification, firm size, age and gender structure of that district. Positive (negative) values of W'_{rt} indicate that region r is a "high wage" ("low wage") region in our interpretation.

A potential problem with this "neutralised" regional wage level W'_{rt} is that it is estimated in a regression with local industries as the unit of observation. We can not include purely region-specific variables in eq. (1) because their impact could not be distinguished from regional fixed effects in a year-by-year regression. However, features that are identical for all local industries might explain parts of the wage level as well. Hence, we consider also a further neutralisation step. We regress W'_{rt} on additional regional characteristics of district r that are available from the secondary data set ("Statistik regional"). We estimate an equation of the form $W'_{rt} = a_t + \rho_t Y_{rt} + \mu_{rt}$ for every year t, where Y_{rt} is a vector of region-specific control variables such as land prices, number hospital beds, intensity of traffic etc. The theoretical rationale for including such variables is that workers from region r will have to be compensated for regional dis-amenities (like high land prices), or – respectively – are willing to accept lower wages in exchange for local amenities like, for example, a good medical infrastructure which is proxied by the number of hospital beds.

We then construct another wage indicator $W''_{rt} = a_t + \mu_{rt}$ that is detached from even more influences, and which we consequently call the "super-neutralised wage level" of district r. Due to data availability we can conduct this neutralisation procedure only for the years from 1995 onwards. Further details about this intermediate regression are deferred to appendix 1.

2. Effects of (super-) neutralised wages on employment growth

In the second stage of the analysis we estimate the following panel model:

$$wn_{irt} = \kappa_r + \alpha_i + \lambda_t + \delta_y + \beta^N \cdot N_{ir(t-1)} + \beta \cdot X_{ir(t-1)} + \sum_{i=1}^{28} \beta_i^W X_m W'_{r(t-1)} + \varepsilon_{irt} \qquad (2)$$

The dependent variable is the annual employment growth rate of a local industry, $wn_{irt} = \left(N_{ir(t+1)} - N_{irt}\right) / N_{irt}$. On the right hand side we analogously use sector, region, area type and time period fixed effects (α_i, κ_r, δ_y, and λ_t), the (time-lagged) control variables $X_{ir(t-1)}$, and the initial employment level, $N_{ir(t-1)}$.[5] The central variable is the *district-specific* wage indicator $W'_{r(t-1)}$ (respectively, $W''_{r(t-1)}$). With this specification we allow for demand spillovers within a region but across industries. Thereby we explicitly try to model the tension between cost push effects and mitigating demand side influences: A wage increase in a region might induce consumers to spend more on locally provided goods, which can have a positive secondary effect on employment at least for some industries. To explore the variation of the employment reaction across industries we include the interaction term X_m, with X_m=1 if m=i and X_m=0 otherwise. In another variant we estimate eq. (2) without the interaction term and capture the overall effect of the wage indicator when all industries are lumped together.[6]

[5] In regional economics, this type of analysis that disentangles employment growth of local industries into regional, sectoral and time components is also known as "shift-share regression". This is reminiscent of the deterministic shift-share method. The regression analytical analogue was pioneered by Patterson (1991) and later extended by Moeller/Tassinopoulos (2000) and Blien/Wolf (2002). A methodological contribution of the present paper is the augmentation with the wage analysis in the first stage.

[6] Alternatively we could have used a fixed effect for each local industry in the first stage instead. This would not provide for a real test of the PPA, however, because the induced demand side repercussions of overly high wages accruing only in the own local industry are supposedly very small.

3. Demand spillovers across regions

The estimation equation (2) does not allow for demand spillovers across regions. However, small regions like the German districts are extremely open economies and closely interrelated not only through goods exchange, but also via commuting flows. Recall that our labour market data refers to workplace location, hence some workers will live and consume in regions other than their workplace. A wage increase might therefore induce demand effects in surrounding areas, but not in the workplace location itself. To account for cross-district demand spillovers we construct an additional control variable $\hat{W}_{-r(t-1)}$, namely a spatially weighted neutralised wage level of all surrounding districts. This is done in the following way: $\hat{W}_{-rt} = \sum_{s \neq r} \left(c_{rst} \cdot W'_{st} \right)$, where c_{rst} denotes commuter flows between region r and region s in year t, measured as the fraction of total commuting flows between region r and all other regions in West Germany.[7] The necessary data, a commuting matrix for the West German districts is also available for all years t from the Bundesagentur für Arbeit.[8] This additional variable will be considered in some specifications of the empirical model below.

4. Methodological issues

Turning to methodological issues, equation (2) must be estimated with weighted least squares (WLS). Since the cells are very heterogeneous in their size, the same absolute change in employment implies very different changes in employment growth rates. This implies a heteroskedasticity problem that is inherent to the empirical model. We tackle this problem by weighting eq. (2) with the employment of each cell (N_{irt}) divided by the total national

[7] The same spatially lagged control variable can be computed for the super-neutralised wage levels W''_{st}. Furthermore, for commuter flows we have used both, inward or outward commuters. Results turned out to be very similar. Note that the use of commuter flows is generally more accurate than simple spatial contiguity matrices to represent the intensity of economic exchange between two particular regions.

[8] Note that the inclusion of spatial dependencies between regions by using the control variable $\hat{W}_{-r(t-1)}$ in eq. (2) simplifies the econometrics, since no model with spatial lags in the dependent variable or with a complex error structure is required.

employment (N_t) in the respective year.[9] Technically speaking, we weight the covariance matrix of the error terms with a matrix **G** that consists of the elements $g_{irt} = \sum_i \sum_r \sum_t \left(N_{irt} / N_t \right)$ on the main diagonal, so that $\text{cov}(\varepsilon) = \widetilde{\mathbf{\Omega}} = \mathbf{G\Omega G}$.[10]

Another problem is that equations (1) and (2) exhibit perfect multicollinearity, because we use complete sets of dummy variables. The usual strategy is to exclude one fixed effect from each set of dummies. The other fixed effects are then measured in relation to this excluded reference category. However, since we use the regional fixed effects W'_{rt} as regressors in the second stage we are interested in the deviation from the national grand mean, which also greatly eases the interpretation of the estimated fixed effects. If the grand mean is to be used as the reference, one would have to recalculate not only the coefficients (like Krueger/Summers, 1988), but also their level of significance. A more elegant solution is the use of restrictions for the estimated coefficients, which then requires no further recalculations. The constraints are chosen such that the sum of the weighted coefficients is equal to zero, so that we can interpret the coefficients as percentage deviations from the grand mean. The specification of the constraints, which is only a normalisation of the coefficients that does not affect the other estimators, is further described in appendix 2. Our selected econometric procedure then leads to a restricted weighted least squares estimate of a regression model without intercept (see Greene/Seaks, 1991).

A final methodological issue is endogeneity, as one could argue that employment growth drives wages rather than the opposite. This concern is ameliorated to some extent by the findings of Blanchflower/Oswald (1994), who tested both, the impact of unemployment and employment growth on wages. They show that wages are predominantly affected by unemployment. In Germany, this "wage curve" is weaker than in other countries

[9] This is also known as the "*shipbuilding in the midlands*"-problem. A weighted estimation approach similar to the one used in this paper has been proposed initially by Buck/Atkins (1976), and was later extended by Moeller/Tassinopoulos (2000).

[10] A comparable heteroskedasticity problem does not arise in the wage regression (1), because the response variable is not a growth rate. Hence, we do not have to weight the equation.

(Baltagi/Blien, 1998) and thus one would expect the impact of employment growth on wages to be particularly weak. Nevertheless, to address endogeneity we have included the wage indicator W'_r with a time lag of one period in (2), which implicitly defines a recursive system with a clear direction of causality, $\hat{N}_{irt} = f(W'_{r(t-1)}, Z)$ and $W'_{rt} = f(\hat{N}_{irt}, Z)$, where Z are the other exogenous variables. With a rest of endogeneity the causality in this system would be $W'_{r(t-1)} \longrightarrow \hat{N}_{irt} \longrightarrow W'_{rt}$, and there is no simultaneity problem. To check the robustness of our results we have also carried out panel IV estimation, where we use the covariates with one additional time lag for instrumenting the wage indicator W'_{rt}.

IV. RESULTS

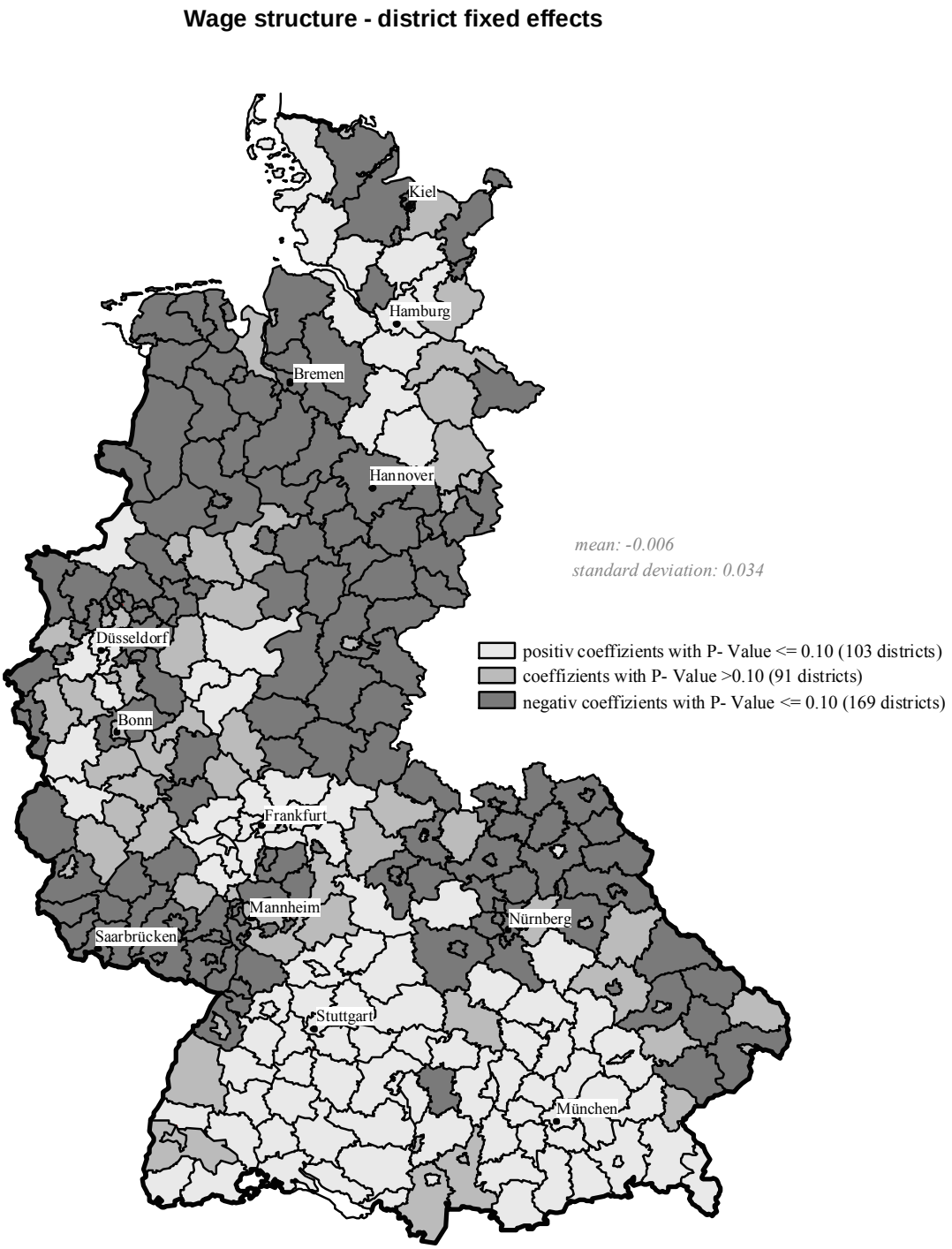
We obtain three sets of results: (i) the regional wage indicators W'_r and W''_r, (ii) the employment growth effects of wages, and (iii) the other results on the time-varying and fixed effects. We shall focus the presentation on (i) and – in particular – on (ii) in the following two subsections, before briefly describing the third set of results in subsection 4.3.

1. "High wage" and "low wage" regions in West Germany

The wage regression, eq. (1), is estimated separately for each time period, so we obtain 326 district fixed effects per year. For expositional purposes we will only document the results of a pooled regression over the whole observation period in form of a map.[11] The areas shaded in light grey are "high wage" regions, whereas the districts in dark grey are "low wage regions" in our definition: Neutralised wages in these districts are significantly different from comparable districts of the same area type. The correlation between the unsettled average and

[11] In this pooled estimation we have included additional time dummies for each year λ_t'. Since we estimate subject to restrictions, the standard R^2 measure is not available. When running an OLS regression that is as close as possible to our actual estimation strategy (by dropping one fixed effect from each set of dummies) we obtain R^2 levels around 0.9.

the neutralised regional wage level is about 0.33, which suggests that a considerable part of the raw differences in wages is due to differences in the underlying economic structure.



Probably the most striking feature is that low-, medium- and high-wage areas are not distributed randomly across space, but there seems to be a coherent spatial structure, namely a clustering of high wage and low wage districts. Districts surrounding Munich, Stuttgart, Frankfurt and Hamburg pay significantly above the average of their respective area type. By and large, the wage level in most Southern districts is significantly above average. But the division scheme is more complex. Firstly, there are at least some "high wage islands" in the North, e.g. the area surrounding Hamburg, and the districts around the Volkswagen headquarters in Wolfsburg. Secondly, not all Southern districts pay overly well. The notable exceptions are the districts in northern and eastern Bavaria. Apart from the north-south-divides, it is striking that border regions mostly tend to be low wage regions, including the former border with East Germany, but excluding the borders with Austria and Switzerland. The correlation between the neutralised wage level W'_{rt} and the super-neutralised wage level W''_{rt} is above 0.83. The R^2 levels in this intermediate regression ranges around 0.3 (depending on the specific year), which suggests that around 70 per cent of the regional wage level remain unexplained by the additional district-specific control variables that were considered in the neutralisation (see appendix 1). The spatial pattern of W''_{rt} is very similar to that of W'_{rt}.

2. Neutralised wages and employment growth

In this sub-section we turn to the central question of this paper: What is the relation between the (super-)neutralised regional wage level and employment growth? At first we consider the global impact of the wage indicators $W'_{r(t-1)}$, $W''_{r(t-1)}$ and $\hat{W}_{-r(t-1)}$ without differentiating across industries via the interaction term X_m. Table 1 summarizes the estimation results.

Table 1: Employment growth reaction to (super-)neutralised regional wages

Variable	(1)	(2)	(3)	(4)
neutralised wage level $W'_{r(t-1)}$	**– 0.0866***** (0.0335)	**– 0.0925***** (0.0337)	--	**– 0.2867***** (0.0827)
super-neutralised wage level $W''_{r(t-1)}$	--	--	**– 0.1593***** (0.0094)	--
Wage level in other regions $\hat{W}_{-r(t-1)}$	--	**0.2460***** (0.0793)	**0.2311***** (0.0791)	--
estimation method	constrained linear regression	constrained linear regression	constrained linear regression	unconstrained IV regression

Standard errors in parentheses; ***: 1% significance level, ** 5% significance level, * 10% significance level.
Note: Estimation results refer to panel estimation of eq. (2) without interaction term X_m. Dependent variable: annual employment growth rate of local industry i, r. Indep. var.: time period, area type, district, and industry fixed effects, time-lagged covariates (qualification, firm size structure and total employment level of local industry i,r).
Instruments for IV regression (specification 4): Covariates with additional time lag.

In the baseline regression in column 1 we use the time-lagged wage indicator W'_r. With all sectors lumped together we find that an increase of the neutralised regional wage level by one percentage point (holding constant all other structural characteristics) drives down the employment growth rate in that region by 0.0866 percentage points. This effect is highly statistical significant. Quantitatively, the estimated coefficient can be interpreted as a point elasticity of employment, or labour demand, with respect to regional wages, relevant for the "average German local industry" (see appendix 3 for a formal argument). Compared to Hamermesh's rule of thumb for the elasticity of labour demand that was mentioned in the introduction ("*bracketed by the interval [0.15, 0.75], with 0.30 being a good best guess.*"), the size of our basic estimate (-0.0886) thus seems to be somewhat lower than existing ones.

To set this into perspective, note firstly that due to the time structure in eq. (2) our estimate is a short-run, rather than a long-run elasticity. The short-run elasticity of labour demand is typically thought of as being smaller (in absolute terms) than the long-run elasticity. We favour this time structure, because theory tells that the PPA is valid, if at all, only in the short run. Secondly, the lower quantitative size of our estimate is probably due to the fact that we do not consider the employment effects of wages in the own local industry alone, but the effects of the neutralised *regional* wage level. By explicitly allowing for demand spillovers within a district, the small size of the elasticity probably represents the mitigating influence of demand side effects. Given that our estimate refers to the short-run employment elasticity inclusive local demand side repercussions its magnitude actually seems quite large. Other papers found hardly any notable impact of wages on employment with a time horizon of only one or two years (e.g., Pfeiffer, 2004, p. 27). The visibility of adverse employment effects even in the short run is supposedly due to the fact that our elasticity refers to *neutralised* wages, and thus portrays the partial effect of a wage increase that is not associated with *any* change in the underlying economic structure, or the composition of the workforce.

Demand spillovers across regions

Column 2 of table 1 reports the results when the spatially weighted neutralised wage level in other regions, $\hat{W}_{-r}$, is included. We find that employment growth in region r is positively affected by $\hat{W}_{-r}$, whereas the estimated employment growth reaction to wage increases in the own region (the coefficient on W_r') becomes stronger negative as compared to the benchmark specification (–0.0925 instead of –0.0886).

These findings can be interpreted as follows: Consider some West German district A. An increase in the general wage level in all other West German areas, except for region A, will positively affect employment growth in that district. The reason is that negative supply effects

are absent in A, but the region benefits from the induced demand stimulus in other areas. On the other hand, an increase in the wage level in region A will drive down employment growth in that district, because negative supply effects dominate demand side effects as argued above. This effect is stronger when we implicitly hold wages in all other regions constant, compared to a specification where we do not control for wage in other regions.

Our results suggest that demand spillovers across regions play some role for the trade-off between wages and employment growth. It is instructive to calculate the average net effect of a general wage increase in West Germany including all cross-district spillovers. This can be done by calculating the expected net effect for every district r, i.e. $-0.0925 \cdot W'_r + 0.2460 \cdot \hat{W}_{-r}$, where we use the wage indicators from the pooled regression over time (see section 4.1.). Building the weighted sum over all regions we obtain a consolidated net effect equal to -0.0901, which is slightly below the estimated coefficient -0.0925 for the "gross" employment reaction in region r (without correcting for spillovers). In other words, demand spillovers exert a mitigating influence, but the direction of the effect remains unaffected.

Super-neutralised regional wages

In column 3 of table 1 we replace the neutralised wage level $W'_{r(t-1)}$ with the super-neutralised wage level $W''_{r(t-1)}$. We find a stronger negative impact on employment growth in the own region (–0.1593 instead of -0.0925). This is due to the fact that this wage indicator is an even purer measure for "overly high" regional wages. Consequently, an increase in "super-neutralised" wages should induce stronger adverse employment growth reactions in the own region. Still the estimated labour demand elasticity remains quite low compared to Hamermesh's interval of usual coefficients (see the discussion above). All other qualitative conclusions remain unchanged, notably the effect of cross-district demand spillovers. The consolidated net effect inclusive spillovers is now calculated as -0.1489.

Robustness checks

We have checked if potential repercussions between wages and employment growth influence our results by performing IV estimation. As instruments we use covariates with an additional time lag. We obtain a highly significant and somewhat stronger negative coefficient (–0.2867), see column 4 of table 1. This suggests a stronger negative employment reaction. Qualitatively, however, we find that the impact of wages on employment growth turns out to be quite robust, and our original empirical approach is therefore apparently not flawed by endogeneity problems.

In our analysis we have carefully distinguished between raw and neutralised regional wages. To highlight the pitfall of including raw wages directly in the employment growth regression, we re-estimated the basic specification 1 with the unsettled average regional wage instead of the wage indicator $W'_{r(t-1)}$. We obtain a small, yet significantly *positive* short-run elasticity (0.00274). Conclusions based on this estimation are flawed, however. Let us illustrate this with an example: Both, the unsettled average wage, and the average annual employment growth rate in the Bavarian district Dingolfing-Landau, where the local employment structure is dominated by a large automobile plant, are significantly above the West German average. However, the high wage level in this district can be explained well by the local qualification, firm size and industrial structure. This leads to the fact that the neutralised wage indicator for this district is insignificant, and thus, wages are not "too high". Employment regressions that include unsettled wages do not take this fact into account, even if the regression still controls for workforce and industry-specific effects, because these characteristics can affect wages in a different way than they affect employment growth.

Finally, our analysis has been limited to full time employees so far. One might argue, however, that firms respond to high regional wages in the short run by hiring additional part time instead of full time workers, or by substituting the former for the latter group. Maybe positive reactions of part time employment even compensate the negative impact in the full

time segment. To check this possibility, we have constructed a second data set that includes part time employees in form of "full time equivalents".[12] When repeating our estimation specification 1 we receive an overall effect of neutralised wages on employment growth that is somewhat weaker, namely –0.0775. This suggests that the consolidated employment effects of neutralised wages are less adverse when part time employees are included, but there seems to be no principal change in conclusions.

Industry specific employment reactions

We now look at the variation of the employment effect across industries, which we obtain by estimating the employment growth regression with the interaction term X_m. We use the specification with the neutralised regional wage level $W'_{r(t-1)}$ as indicated in eq. (2). Table 2 reports the estimated coefficients β_i^W sorted by their strength.

The range of the estimates goes from –0.4 to +0.37. For 11 out of 28 industries we find negative employment effects that are statistically significant at least at the 10% level. Particularly clear negative employment effects which are highly statistically significant and stronger negative than the average reaction are found for important sectors of the German economy such as the chemical industry, motor vehicles, "IT & office supplies", "information & transportation", commerce or "building & construction". Negative employment reaction are also found in traditional sectors such as mining, "food & tobacco", "leather & apparel", or "synthetic material", although the coefficients for these industries are only weekly significant. In the social services we also obtain a weekly significant negative coefficient.

[12] Data on part time employment relationships has the principal problem that information on actual working hours is not accurate (cf. footnote 2). To tackle this issue, we have categorised the part time employees in two classes, with "short" and "medium" weekly working time, where weekly working hours of 18 and 24 have been assumed to compute average daily earnings. "Full-time equivalents" are then calculated on this basis.

Table 2: Industry-specific employment reactions to neutralised regional wages

Industry	Wage elasticity of employment (β_i^W)
Agriculture & forestry	-0.4077 (.2895)
Jewelry, toys, musical instruments	-0.3533 (.3922)
Chemical industry	**-0.3461***** (.0625)
Nonmetallic mineral mining	-0.3329 (.2523)
Mining	**-0.3144**** (.1623)
Information & transportation	**-0.2641***** (.0422)
Food & tobacco	**-0.2489***** (.0789)
Building & construction	**-0.2121***** (.0434)
Leather & apparel	**-0.1993*** (.1136)
Synthetic material	**-0.1975*** (.1113)
Motor vehicles	**-0.1331***** (.0436)
Social services	**-0.1309*** (.0750)
Commerce	**-0.1100***** (.0363)
IT, optics, office supplies	**-0.1029***** (.0412)
Utilities & electric industry	-0.1020 (.1222)
Education	-0.0613 (.0721)
Health care	-0.0567 (.0418)
Business-related services	-0.0545 (.0372)
Paper & printing	-0.0518 (.1055)
Wood-working	0.0069 (.1114)
Leisure-related services	0.0099 (.0995)
Finance & insurance	0.0119 (.0442)
Hotels & gastronomy	0.0261 (.0791)
Primary metal manufacturing	0.0359 (.0567)
Machinery	0.0396 (.0572)
Household-related services	0.0677 (.2499)
Public sector	0.1154 (0.0980)
Glass & ceramics	0.3769 (.2527)

Standard errors in parentheses; ***: 1% significance level, ** 5% significance level, * 10% significance level.
Note: Panel estimation of eq. (2) with interaction term X_m, neutralised regional wages. Dependent variable: annual employment growth rate of local industry i, r. Indep. var.: time period, area type, district, and industry fixed effects, time-lagged covariates (qualification, firm size structure and total employment level of local industry i,r).

In 9 industries we obtain positive coefficients, including “finance & insurance”, “hotels & gastronomy”, “leisure-related services”, and “household-related services”. In the cases where we obtain a positive point estimate, however, it is far from significant. Not for a single industry we find reliable support for the claim that it is actually possible to raise employment growth via higher wages in the short run.

There seem to be plausible reasons why industries differ in their reaction to the regional wage level. Sectors like gastronomy or service sectors in general, tend to have a stronger focus on local consumers than export-oriented manufacturing industries. These locally oriented branches might be stronger affected from demand side repercussions that accrue in the own region. Even though higher regional wages imply higher labour costs in gastronomy, they also imply higher purchasing power of local consumers. This can raise demand and, ultimately, employment (i.e., more people visit restaurants, and more waiters are hired despite the higher labour costs). The purchasing power of local consumers will be almost meaningless for the chemical or automobile industry, because these sectors are focussed on national or even world markets. Considering purely supply-side characteristics, industries can differ in the elasticity of substitution between labour and other production factors. Production in some sectors might require almost fixed proportions in the short run, which would indicate a low responsiveness of employment to wages (provided that production is not ceased completely). In other industries, substitution and adjustment possibilities are substantially better, and employment might be more responsive to wages.

Although our quantitative results for the industry-specific wage elasticity must be treated cautiously, our estimates are consistent with these considerations. We find employment effects to be less adverse in locally oriented service industries (including gastronomy and household-related services) because in these cases no evidence exists for a significantly negative employment reaction (the coefficients tend to be statistically indistinguishable from zero). The cases where we find evidence for a clear and significantly negative employment

reaction are all manufacturing industries, for which the respective local market supposedly has a low importance.

3. Other regression results

The other regression results yield some additional insights about the disaggregated structure of wages and employment growth in West Germany. They are not in the centre of interest for this paper, hence the results tables are deferred to appendix 4 and we will only briefly comment on the main qualitative findings.

We find that the average wage in a local industry increases with the average age of the employees, the share of qualified workers, the employment share in large firms, and the fraction of men. All variables are significant at the 1%-level. The signs of these coefficients are in line with the standard literature, e.g. on the skill and firm size wage premium. A large share of high skilled workers also significantly increases employment growth of local industries. Holding constant all other factors, including wages, more qualified workers raise productivity, which invokes a growth stimulus. A significantly positive effect is also found for the share of small and medium sized firms, whereas a setting with many large firms tends to reduce employment growth. These findings are consistent with the empirical growth literature, where firm sizes have been used as a proxy for product market competition, and suggests that an intermediate scenario seems to be most growth friendly (see Motta 2002, ch. 2 for a survey).

The results for the area type fixed effects document that core cities and directly surrounding districts pay wages 2.5 to 3 percent above, whereas rural districts (area type 9) pay more than 7 per cent below average. One must note, however, that these wage differences between centre and periphery also reflect unobserved differences in costs-of-living. With respect to employment growth, the most interesting finding is that city districts (area types 1 and 5) significantly lose employment, whereas adjacent but also more rural district types gain. This

spatial employment de-concentration is a long-term development that has been pointed out also in earlier studies, e.g. by Moeller/Tassinopoulos (2000).

We also report the results for the industry-specific fixed effects from the wage and the employment growth regression, α_i and α_i'. These coefficients must be distinguished clearly from the wage elasticities β_i^W which have been described above, because they describe purely industry-specific disparities irrespective of the neutralised regional wage level.[13] We find clear evidence for a process of structural change in West Germany. Many advanced service sectors like "finance & insurance", or the "business-related services" significantly gain employment. Traditional industries like "mining", "construction", or "leather & apparel" disappear. At the same time there are substantial structural differences in neutralised wage levels across industries. For example, the "finance & insurance" sector pays more than 23 percent above average, even after controlling for characteristics like qualification, firm sizes, etc. Other well paying sectors are "utilities & electronic industry" and "health care". Wages in the "household-related services", "agriculture", or "gastronomy" are particularly low.

V. CONCLUSION

This paper has offered a new approach to address an old controversy, which is still heavily disputed in the general public and among economists: Does a higher wage level reduce or increase employment growth? We have exploited the intra-national variation across regions and industries in West Germany to set up a framework where the equilibrium relation between employment growth and the neutralised regional wage level can be studied.

Our analysis shows that the impact of neutralised regional wages on employment growth is significantly negative, which suggests an overall dominance of negative supply side effects

[13] The coefficients can be interpreted in the following way: Sector i with average values of all covariates, and no time- and location-specific effects (i.e. with $\lambda_t=\lambda_t'=\delta_y=\delta_y'=\kappa_r=0$, and regional wages in accordance with statistical expectation, $W_r'=0$) grows α_i % faster, and pays wages α_i' % above the West German average. β_i^W then denotes the partial effect on industry employment growth if the regional wage indicator W_r` rises to 0.01 (point elasticity, see appendix).

over demand side repercussions. However, the size of the adverse employment reaction is somewhat smaller "than usual", which suggests that moderating demand side effects within and across regions play some role in the trade-off between wages and employment growth. This should be properly taken into account, and arguments like the PPA should not be disregarded "out of the blue". At the same time our analysis reveals that demand side repercussions only moderate the negative impact of the wage level on employment growth, but they do not yield a positive overall reaction. This insight becomes particularly visible by differentiating the effect across industries. We find substantial variation in the estimated elasticity. There are strongly adverse employment effects in export oriented manufacturing industries. For many locally oriented service industries the employment effects are weak or even absent. On the other hand, not even for the most locally oriented industries we find support for the view that it is actually possible to raise employment growth via high wages.

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APPENDIX 1: SUPER-NEUTRALISED WAGES

The intermediate regression step for further wage neutralisation has the form

$$W'_{rt} = \alpha_t + \rho_t X_{rt} + \varepsilon_{rt}$$

which is estimated for every year t=1995,…,2002. The independent variables are taken from the "Statistik regional" data base for West Germany. We have chosen the following 9 meaningful region-specific control variables:

1. density – population density in region r and year t (total population/area size in km^2)
2. beds – number of hospital beds in t per capita
3. school – number of high-school graduations in t per capita
4. tourists – number of tourist overnight stays in t per capita
5. traffic – number of traffic accidents in t per capita
6. land price – average price per m^2 of raw building land (based on transactions from year t)
7. houses – number of existing residential buildings per capita
8. tax – assessment rate in region r for local corporate taxes (Hebesatz der Gewerbesteuer)
9. GDP – Gross domestic product per capita in region r and year t

Variables 2-8 capture usual regional (dis-) amenities that might influence wages in form of compensating differentials. Variables 1 and 9 measure market potential which can be an important co-founding determinant of wages. The table below illustrates the results of this intermediate OLS regression, exemplified for the year 2000. As expected, wages positively covary with GDP/market size and population density. Workers are compensated for high local land prices, but are willing to accept lower wages in exchange for two regional amenities: hospital beds and residential buildings.

Wage neutralisation for year 2000 (NOBS: 326. $R^2 = 0.3897$)

Variable	Coefficient
Density (log)	**-0.0215***** (.0042)
Beds	**-1.3639**** (.7115)
School	-0.5094 (2.2594)
Tourists	-0.0003 (0.0003)
Traffic	-0.0472 (1.7431)
Land price (log)	**0.0249***** (.0030)
Houses	**-0.1059*** (.0596)
Tax	-0.0002 (.00066)
GDP (log)	**0.0428***** (.0080)

Standard errors in parentheses; ***: 1% significance level, ** 5% significance level, * 10% significance level

APPENDIX 2: DEFINITION OF CONSTRAINTS

For the definition of constraints a time invariant weighting scheme is needed. We use the employment proportions for the year 1997, the middle of the observation period. For the industry fixed effects in the employment growth regression (2) we impose the following constraint (a tilde indicates that the variable is weighted according to $\text{cov}(\varepsilon) = \widetilde{\mathbf{\Omega}} = \mathbf{G\Omega G}$):

$$\sum_{i=1}^{28} g_i \cdot \tilde{\alpha}_i = 0$$

g_i is the employment share of sector i in 1997. The estimated coefficient $\tilde{\alpha}_i$ then shows by how many percentage points industry i grows faster than the average due to idiosyncratic industry effects. Analogously, we restrict the coefficients for the three skill categories, and the three establishment size classes to sum up to zero. For the district fixed effects $\tilde{\kappa}_r$ and the area type fixed effects $\tilde{\delta}_y$ we use a slightly different restriction. We impose:

$$\sum_{r=1}^{326} \sum_{y=1}^{9} g_r \tau_y \tilde{\kappa}_r = 0,$$

where $\tau_y = 1$ if district r belong to area type y, and $\tau_y = 0$ otherwise. Additionally we centre the weighted area type fixed effects on zero, $\sum_{y=1}^{9} g_y \tilde{\delta}_y = 0$. We can then interpret the coefficients $\tilde{\kappa}_r$ as percentage deviations from the mean growth rate in the respective area type y, and the coefficients $\tilde{\delta}_y$ as percentage deviations of area type y from the West German average. Analogous restrictions are imposed for the wage regression (1), only without the weighting procedure that tackles the heteroskedasticity problem described above. The estimated district fixed effects W'_{rt} can then be interpreted as percentage deviations from the mean wage of the respective area type.

APPENDIX 3: INTERPRETATION OF THE WAGE COEFFICIENT

Since the employment growth regression (2) is estimated without an intercept, the predicted growth rate of a local industry irt with average values of the covariates is

$$\hat{wn}_{irt} = \alpha_i + \kappa_r + \delta_y + \lambda_t + \beta^W W'_{r(t-1)} \tag{3}$$

Assuming that the local industry is not exposed to any time-, industry-, or location specific developments, and assuming a wage indicator $W_r'=0$, the predicted growth rate $\left(N_{irt} - N_{ir(t-1)}\right)\big/N_{ir(t-1)}$ is equal to zero. This observation would be the hypothetical "average German local industry", where the predicted absolute wage is given by $\omega_{ir(t-1)} = \exp(\beta_0)$. The coefficient β^W then describes the partial effect on the (predicted) annual employment growth rate if the wage indicator rises from zero to W'_{rt}, i.e. if absolute wages rise from $\omega_{ir(t-1)} = \exp(\beta_0)$ to $\omega_{irt} = \exp(\beta_0 + W'_{rt})$.

$$\beta^W \equiv \frac{\Delta \hat{wn}_{irt}}{\Delta W'_{r(t-1)}} = \frac{1}{\left(W'_{rt} - W'_{r(t-1)}\right)}\left[\frac{N_{ir(t+1)} - N_{irt}}{N_{irt}} - \frac{N_{irt} - N_{ir(t-1)}}{N_{ir(t-1)}}\right] = \frac{1}{W'_{rt}}\left[\hat{wn}_{irt}\right] \tag{4}$$

Baring in mind that the predicted growth rate prior to the regional wage increase is zero, the partial effect can also be expressed as an elasticity of labour demand

$$\varepsilon_{irt} \equiv \frac{\Delta N_{irt}}{\Delta \omega_{ir(t-1)}} \cdot \frac{\omega_{ir(t-1)}}{N_{irt}} = \frac{\left(N_{ir(t+1)} - N_{irt}\right)\big/N_{irt}}{\left(\omega_{irt} - \omega_{ir(t-1)}\right)\big/\omega_{ir(t-1)}} \tag{5}$$

where the growth rate of absolute wages is given by

$$\frac{\left(\omega_{irt} - \omega_{ir(t-1)}\right)}{\omega_{ir(t-1)}} = \exp(W'_{rt}) - 1 \tag{6}$$

To use the standard interpretation of an elasticity, suppose absolute wages to rise by one per cent. This implies $\exp(W'_{rt}) = 1.01 \Leftrightarrow W'_{rt} = 0.00995 \cong 0.01$. The elasticity ε_{irt} can thus be understood as $\varepsilon_{irt} = 100 \cdot \hat{wn}_{irt}$. Inserting this and $W'_{rt} = 1/100$ into (4), we immediately find

$$\beta^W = \varepsilon_{irt} = \varepsilon \tag{7}$$

The estimated coefficient β^W can be interpreted directly as a point elasticity of employment with respect to regional wages, referring to the hypothetical "average German local industry".

APPENDIX 4: OTHER REGRESSION RESULTS

The estimation results reported in this appendix refer to the estimation of the wage regression (eq. 1) and the employment growth regression (eq.2) without interaction term X_m.
We report the estimated coefficients for the time-varying structural characteristics of the workforces in the local industries (table a), the area type fixed effects (table b) and industry fixed effects (table c). For the employment growth regression we use the specification with the neutralised wage level $W'_{r(t-1)}$. The time period and district fixed effects from this regression are omitted because they are of minor interest.

a) Structural characteristics of the workforces

Variable	Wage Regression	Employment growth regression
Low qualification	**-0.2125*** ** (.0022)	-0.0046 (.0039)
Medium qualification	**0.0131*** ** (.0009)	**-0.0044*** ** (.0015)
High qualification	**0.5477*** ** (.0067)	**0.0567*** ** (.0055)
Firm size 1-19	**-0.1570*** ** (.0011)	**0.0064*** (.0037)
Firm size 20-99	**0.0181*** ** (.0012)	**0.0373*** ** (.0037)
Firm size > 100	**0.0730*** ** (.0006)	**-0.0220*** ** (.0013)
Fraction of men	**0.4307*** ** (.0032)	--
Average age	**0.0086*** ** (.0001)	--
Employment level (lagged)	--	**0.00001*** ** (.0000)
constant term β_0	**4.4497*** ** (.0065)	--

Standard errors in parentheses; ***: 1% significance level, ** 5% significance level, * 10% significance level

b) Area type fixed effects

	Area type	Wage regression	Employment growth Regression
1	Agglomeration region - Core city	**0.0295***** (.0008)	**-0.0094***** (.0005)
2	Agglomeration region – Highly urbanised distr.	**0.0237***** (.0009)	**0.0048***** (.0006)
3	Agglomeration region - Urbanised districts	**-0.0076***** (.0012)	**0.0058***** (.0015)
4	Agglomeration region - Rural districts	**-0.0284***** (.0017)	**0.0068**** (.0035)
5	Conurbational region - Central city	**-0.0122***** (.0012)	**-0.0076***** (.0010)
6	Conurbational region - Urbanised district	**-0.0182***** (.0007)	**0.0059***** (.0008)
7	Conurbational region - Rural district	**-0.0393***** (.0009)	**0.0103***** (.0016)
8	Rural region - Urbanised district	**-0.0518***** (.0009)	**0.0050***** (.0016)
9	Rural region - Rural district	**-0.0734***** (.0013)	0.0044 (.0029)

Standard errors in parentheses; ***: 1% significance level, ** 5% significance level, * 10% significance level

c) Industry fixed effects

Industry	Fixed effects – wages α_i'	Fixed effects – employm. growth α_i
Agriculture & forestry	**-0.1505***** (.0018)	0.0098 (.0088)
Jewelry, toys, musical instruments	**-0.1251***** (.0018)	**-0.0370***** (.0139)
Chemical industry	**0.0510***** (.0016)	**-0.0267***** (.0019)
Nonmetallic mineral mining	**0.0389***** (.0018)	**-0.0358***** (.0068)
Mining	**0.0463***** (.0028)	**-0.0607***** (.0035)
Information & transportation	**-0.0624***** (.0017)	**0.0053***** (.0008)
Food & tobacco	**-0.0853***** (.0016)	**-0.0181***** (.0021)
Building & construction	**-0.0328***** (.0017)	**-0.0335***** (.0012)
Leather & apparel	**-0.0754***** (.0018)	**-0.0628***** (.0038)
Synthetic material	**-0.0338***** (.0016)	0.0031 (.0030)
Motor vehicles	**-0.0355***** (.0016)	**0.0132***** (.0011)
Social services	**0.0205***** (.0017)	**0.0036*** (.0021)
Commerce	**0.0040***** (.0014)	**-0.0100***** (.0009)
IT, optics, office supplies	**0.0065***** (.0015)	-0.0005 (.0010)
Utilities & electric industry	**0.0986***** (.0018)	**-0.0116***** (.0040)
Education	**0.0864***** (.0021)	-0.0031 (.0023)
Health care	**0.0936***** (.0020)	**0.0207***** (.0009)
Business-related services	**0.0152***** (.0016)	**0.0617***** (.0011)
Paper & printing	**0.0485***** (.0016)	**-0.0113***** (.0031)
Wood-working	**-0.0596***** (.0018)	**-0.0227***** (.0029)
Leisure-related services	**0.0688***** (.0017)	**0.0234***** (.0022)
Finance & insurance	**0.2368***** (.0017)	**0.0159***** (.0011)
Hotels & gastronomy	**-0.2626***** (.0020)	**0.0098***** (.0029)
Primary metal manufacturing	**-0.0423***** (.0017)	**-0.0126***** (.0015)
Machinery	**-0.0199***** (.0017)	-0.0023 (.0016)
Household-related services	**-0.2703***** (.0023)	-0.0124 (.0082)
Public sector	**-0.0233***** (.0017)	**-0.0040***** (.0012)
Glass & ceramics	**-0.0750***** (.0017)	**-0.0151**** (.0072)