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Mikael Carlsson
Uppsala University, UCLS and Sveriges Riksbank

Iida Häkkinen Skans
National Institute of Economic Research

Oskar Nordström Skans
Uppsala University, UCLS and IZA

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Wage Flexibility in a Unionized Economy with Stable Wage Dispersion*

The paper estimates how wages respond to changes in regional unemployment using detailed Swedish micro data. The study is set in an economy with close to complete union coverage where real wages have grown continuously in all parts of the wage distribution for the past 15 years, and where the aggregate wage dispersion has remained constant for the same period. Our results show that this aggregate stability is coupled with non-trivial flexibility in terms of wage adjustments to changes in regional unemployment. Accounting for the fluctuations in composition of the employees is important for the estimated elasticity of wages. Wage adjustments are larger for employees with high unemployment risk and for new hires entering from unemployment.

JEL Classification: J5, J3
Keywords: wage flexibility, unions, unemployment, wages

Corresponding author:
Oskar N. Skans
Department of Economics
Uppsala University
Box 513
SE-751 20 Uppsala
Sweden
E-mail: oskar.nordstrom_skans@nek.uu.se

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1 Introduction

Since the onset of the great recession, much research in the intersection of macro and labor economics has explored the association between wage rigidity and macroeconomic performance. From a theoretical perspective, it has been argued (see in particular Pissarides, 2009), that the wage flexibility of new hires is key for understanding the role of wage rigidities for business cycle outcomes. This observation has spurred a very active theoretical and empirical literature, see e.g. Carneiro et al (2012), Haefke et al (2013), Gertler et al (2016) and Carlsson and Westermark (2016). This literature is to a large extent set in a framework where collective agreements are ignored. But other strands of the macro-labor literature, such as Olivei and Tenreyro (2007, 2010) and Björklund et al (2018) for Sweden, have shown that the structure of collective agreements may in fact be crucial for the impact of shocks on the real economy. Given the prevalence and cross country differences of such contractual arrangements across Europe, it seems crucial to provide evidence of wage flexibility for new hires and ongoing workers under different institutional settings. The purpose of this paper is to provide such evidence for a Sweden, a country with near universal coverage of collective agreements.

Judging from aggregate statistics, Sweden comes across as a country with remarkably successful wage setting institutions. During the past 15 years, all parts of the wage distribution have seen substantial real wage increases. In fact, very little changes in wage dispersion have taken place since 2000. This apparent stability has been achieved alongside employment rates that consistently remain at the top of the EU. But in recent years it has been argued that the stable wage evolution may mask considerable real and nominal wage rigidities which prevent relative wages from adjusting when market conditions change. Such rigidities may explain both why the nominal wage increases have been relatively small despite reported labor shortages in many sectors during the current economic boom, and why the relative wages of low skilled workers do not seem to adjust downwards despite increasingly poor employment opportunities for the least skilled workers.[5] Despite the first-order policy relevance of the question,[6] very little evidence exists on the degree of wage flexibility in Sweden (and in Europe in general) during the past two decades. This study therefore estimates the degree of regional wage flexibility in Sweden using rich micro data covering the period since the most recent overhaul of Swedish wage setting institutions in 1997.

We study wage flexibility in the form of responsiveness of actual wages to regional unemployment. In doing so, we follow in the tracks of the Wage Curve literature, see e.g. Blanchflower and Oswald (1994) and Bell et al (2002). This literature was primarily motivated by the concern that lack of flexibility may contribute to persistently high unemployment rates. For a recent contribution, see Gregg et al (2014) for the UK. In this paper we merge the wage curve approach with modern high-quality micro data to provide deeper insights into the evolution of the actual wage distribution in a unionized setting. In doing so, we relate to a recently more active research literature on other aspects of wage adjustments, where the focus has been on documenting the

[5] See e.g. Arbetsmarknadsekonomiska Rådet (2017) for a discussion.

[6] In recent years, wage setting institutions have been one of the most heavily discussed policy issues in Sweden. The same is true in Finland, where adopting Swedish institutions (described Section 2) have been presented as a one possible policy option for the future.

impact of changing macroeconomic conditions on wages of new hires entering from unemployment, wages of job changers and wages in ongoing employment relationships.[7] Related studies have explored how wages adjust to aggregate productivity shocks[8], or firm or sector level productivity shocks.[9]

The older wage curve literature settled on a consensus estimate with an elasticity from regional unemployment to actual wages of −0.1 (or −0.07 according to the survey by Nijkamp and Poot, 2005). However, the Scandinavian economies appeared as somewhat of an outlier with much lower elasticities, often close to zero (see e.g. Albaek et al, 2000). As alluded to above, these studies mostly cover historical institutions, and many countries have seen non-trivial recent changes in formal institutions and wage setting practices. In the Swedish case, the current "Industrial Agreement" (IA) wage-setting model has been in place since 1997 and no previous study has assessed the degree of regional wage flexibility during this period. The IA-wage setting model lets the manufacturing industries set their wages first, generating a "benchmark" rate of wage increases that other parts of the economy should follow. If indeed the benchmark has a deterministic relationship to actual wages, we should see a balanced aggregate rate of wage growth *and* stable aggregate wage dispersion, but without relative wage adjustments within the distribution.

Our study uses detailed microeconomic panel data to estimate the empirical relationship between actual wages and regional unemployment within this setting. We begin from individual-level data in order to adjust wages for individual composition effects. This is potentially important as the composition of the employed individuals tends to vary over the business cycle.[10] We use a regional differences-in-differences approach that controls for all time-invariant region-specific factors through region fixed effects and for all aggregate time-varying factors through year fixed effects. The approach thus precisely isolates the relative wage adjustments that we are interested in. The approach easily lends itself to studying variations in flexibility between different groups of workers. This is particularly important since the de facto risk of unemployment may vary substantially between different groups of workers.[11] In order to isolate the wage responses to demand-side changes (thus handling the threat of reverse causality from wages to unemployment) we use an instrumental variable approach drawing on the logic of shift-share instruments as in Bartik (1991, 2002).

Our findings show that there is indeed non-trivial actual flexibility within the IA model. Despite the institutional rigidities generated by the IA benchmark, regional wages do in fact respond to changes in regional unemployment. Our preferred specification shows a long-run elasticity of −0.075, thus not far from the consensus estimate of the earlier literature. Using more conventional methods (i.e. ignoring the endogeneity of wages) gives a slightly lower, but still economically and statistically significant elasticity of −0.035. We also show that adjusting for endogenous employee composition is important (but there is no evidence of compositional biases on the firm side). Overall,

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[7] See e.g. Pissarides (2009), Carneiro et al (2012), Gertler et al (2016).

[8] See e.g. Haefke et al (2013).

[9] Carlsson et al (2016).

[10] See e.g. Bils (1985) and Solon et al (1994).

[11] See e.g. Morchio (2016).

our results point to non-trivial wage flexibility in Sweden, albeit somewhat below the international consensus rate. In addition, these aggregate numbers hide some crucial heterogeneity. We show that employees with a higher-than-average risk of job-loss into unemployment and new hires from unemployment have a higher response to changes in regional unemployment than low unemployment risk employees. These results differ from estimates by Gertler et al (2016) for the US who find that wages of new hires are no more cyclical than those of existing workers in the US. Our effects are more pronounced once sectors where formal wage agreements contain very little local autonomy are excluded from the analysis.

The paper is structured as follows: Section 2 outlines the key features of Swedish wage setting institutions and other relevant institutional aspects. Section 3 presents the data and descriptive statistics. Section 4 presents the empirical methods. Section 5 contains our results and Section 6 concludes.

2 Institutions

In this section, we provide an overview of wage setting institutions in Sweden. The exposition is by necessity somewhat stylized and we try to emphasize the aspects of the institutions that we believe are relevant for the empirical analysis.[12]

2.1 Industry-level national agreements

Wage setting in Sweden is entirely left to the social partners. There are, for instance, no legislated minimum wages. Instead, the wage setting system relies on high collective agreement coverage. This is achieved through rules stipulating that agreements cover all employees (also non-members) at workplaces with signed collective agreements. As a consequence, around 85 percent of Swedish private sector employees were estimated to be covered by collective agreements in 2015, although the membership rates were around 64 percent (Kjellberg, 2017).[13] The share of the private sector employees covered by collective agreements has been remarkably stable during the past 15 years.

Collective wage agreements are, since the demise of central wage negotiations in the 1980s, signed at the industry level.[14] White- and blue-collar workers within each industry have separate agreements. Since 1997, the wages are set according to a "pattern bargaining" structure embedded in a model usually referred to as the "Industrial Agreement" (IA).[15] Unions and employers within manufacturing and mining industries, i.e. the industries that are perceived as most heavily exposed to international competition, negotiate first and sign a set of coordinated agreements. These agreements define a percentage wage increase referred to as "the benchmark" (*märket*).

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[12] The presentation draws on Forslund et al (2012) and Forslund et al (2014).

[13] In contrast to other Nordic countries, collective agreements in Sweden are never turned into laws that non-covered firms have to adher to. Instead unions are able to coerce establishments into signing agreements by preventing members in covered firms from dealing with uncovered firms (e.g. not collecting garbage, not deliver goods and so forth). Such "embargos" are possible even toward firms without union members.

[14] There are some exceptions where agreements instead are occupation specific, such as for electricians.

[15] The IA was introduced on the surprise initiative of the blue collar unions after a turbullent round of industry-level wage negotiations in the aftermath of the deep Swedish recession in the early 1990s.

Other sectors follow and sign agreements at, or around, this benchmark. The National Mediation Office, which oversees negotiations, is instructed to assist in centering the agreements towards the industrial benchmark. Different agreements have very different means to reach the benchmark. Elements that can vary include the contract duration (between 1 and 3 years), the time path of wage increases, and the allocation of wage increases across the worker collective (e.g. across different groups, through minimum wages, or wage increases in percent, or fixed amounts).

2.2 Local negotiations

Industry-level negotiations are in most cases followed by some form of individual or collective local wage negotiations. These local negotiations follow a set of rules and protocols determined within each industry-level national agreement. There are large variations in these rules and protocols, which implies that the means through which the industry-level agreements (are intended to) affect actual wages also vary substantially between agreement areas. Some agreements are intended to have a very direct impact on actual wages, others are more indirect. During industry level negotiations, industrial conflicts (i.e. strikes and lockouts) are allowed and do occasionally take place. However, such measures are not allowed during local negotiations.

Local procedures vary across the widest possible range. Some industries have centrally determined "tariff wages" (mostly transportation agreements) stipulating detailed wage levels depending on the exact type of performed tasks. Other sectors (such as hotels and restaurants, retail, call centers) have less complex industry-level agreements, but instead have (negotiated) minimum wages with substantial bite. The majority of agreements, however, have minimum wages with a low actual bite and formal procedures with scope for local negotiations. These local negotiations can be constrained by guaranteed wage increases at the individual or group level, and/or fallback outcomes in the case of failed local negotiations. The most decentralized agreements (mostly white-collar public sector, and managerial) are purely procedural, i.e. they do not stipulate any guaranteed wage increases or minimum wages. Instead, wages are entirely set during local negotiations according to procedures specified in the industrial agreements.

To get a sense of the relative magnitudes, the National Mediation Office (2016) estimates that 10 percent of all employees in the private sector were covered by agreements that leave wage setting entirely up to local negotiations and 15 percent by agreements that have a centrally agreed increase with no local variations. This means that for the majority of the private sector employees the wages are set in a combination of industry and local negotiations. This is often done through a centrally agreed increase on the total pay bill, with local negotiations on its distribution, sometimes with individual supplements linked to performance.

2.3 The evolution of real wages and wage dispersion

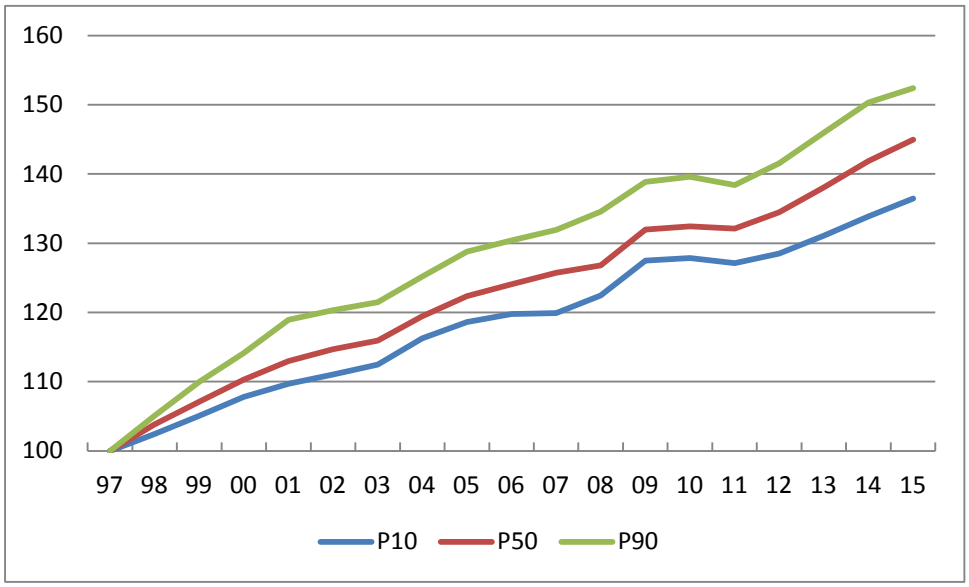
Since the introduction of the IA in 1997, aggregate real wages have grown dramatically across the distribution, as shown in Figure 1. The first few years saw a continuation of

the growth in wage dispersion that had begun in the early 1980s.[16] However, since 2000, wage dispersion has remained almost constant and real wages have grown at a similar pace in all parts of the wage distribution.

Taken at face value, Figure 1 can be interpreted in two very different ways. Ideally, relative wages have been able to adapt to changing economic conditions within the aggregate distribution. In the worst case, however, the aggregate stability may be the results of real-wage rigidities. In the extreme, if all wages have grown according to the IA benchmark, we could see a wage structure in the end of the period that has conserved the economic logic of 1997. In this case, current wage differences may be distorting the allocation of workers across different segments of the labor market.

Figure 1 Real wage evolution for different parts of the distribution, 1997–2015

Index 1997=100



Note: Wage distribution is based on the full-time equivalent wage. The wage data include 18–64-year-olds for the years 1997–2013 and 18–66-year-olds for the years 2014–2015. The nominal wages have been deflated with the consumer price index. The lines are for the 10th, median (P50) and 90th percentile in the wage distribution each year.

Source: Statistics Sweden

2.4 Other institutions and the economic environment

Although our empirical analysis will focus on documenting the degree of relative wage adjustments to local shocks, we wish to highlight some other major changes in the economic environment during the period under study (1998–2013). During this period, several other aspects of the economic environment have changed quite substantially. The *de facto* replacement rate in the unemployment insurance (UI) system has dropped dramatically, primarily since the maximum remuneration has remained constant in nominal terms for a long period[17] and through an extensive in-work tax credit. The economic incentives to work and (as a flip side) economic inequality in the lower

[16] See e.g. Skans et al (2009).

[17] This is true both for the UI system and other support systems.

end of the earnings distribution have increased dramatically, despite of the stable wage distribution.

During the period analyzed, the economic environment in Sweden as elsewhere has seen dramatic changes due to technology and trade.[18] However, the impact of the financial crisis outside of manufacturing industries was muted in Sweden compared to most other countries (there was, e.g., much less need for fiscal consolidation). Instead, the country has seen a more dramatic growth in the number of refugees than most other comparable countries, generating a gradual increase in the share of low-skilled individuals among the unemployed.

3 Data

The two main data sources used in this study are Statistics Sweden's LISA database and the Swedish Wage Structure database. Both data sources are used for the years 1998−2013. LISA is an individual level panel database which includes the whole Swedish population aged 16 years or more. In this study, we focus on employees aged 20−64 years. LISA includes rich information on individuals' characteristics (e.g. gender, age, region of origin, level and type of education, marital status, number and ages of children, family type, county of residence). The database also includes information on whether the individual was registered as unemployed at the Public Employment Services (PES) in November and the number of unemployment days each year as well as register-based information on the employment status in November. In addition, there is information on employer characteristics (e.g. number of employees and industry) for the employed. Our data do not contain any indicators of the type of collective agreement for the simple reason that this information is lacking in all publicly available Swedish registers.

LISA includes information on the annual income as reported to the tax authorities by the employers. However, these data do not record working hours, or hourly/monthly wages. Annual labor earnings largely depend on the number of hours worked during the year, which is highly correlated with economic conditions. In order to study effects of economic conditions on actual wages, we thus need a wage measure that accounts for hours worked. For this reason, we use data on wages from the Swedish Wage Structure database and merge these with the individual background information from LISA. The wage measure we use is the "full-time equivalent" monthly wage (hourly wages times monthly full-time working hours). This measure includes basic monthly wages as well as some stable supplementary payments such as compensation for inconvenient working hours (night shifts) and compensations for managerial duties. However, the measure does not include overtime supplements.

The wage data should be very accurate since they are reported directly by the employers (who are legally required to report). A drawback is that coverage is incomplete for parts of the private sector. For the private sector, wages are collected each year in September from all employers with at least 500 employees and from a stratified sample of smaller employers.[19] In total, the wage data cover roughly 50 percent of all the

[18] See Adermon and Gustavsson (2015) or Goos et al (2014) for evidence on the shifting occupational structure (polarization).

[19] The strata are based on industry and employer size. In 2013, about 8 000 employers were included in the private sector wage sample.

private sector employees each year. Thus, there is a large panel element in the wage data.

The data on the private sector employees consist of between 800,000 and 1 million individuals each year, adding up to 14 million observations 1998−2013.[20] However, we perform our empirical analysis at the regional level (21 counties) and therefore construct regional wage measures by aggregating the wage measures after purging them of compositional changes (see below).

All other regional variables are constructed from the LISA database.[21] The regional unemployment rate is the number of individuals registered as unemployed in November at the PES as a percent of the regional labor force (registered unemployed + employed according to tax registers).[22] Other regional variables include the population shares of women, foreign-born, and for each level of education. Each industry's fraction of the total employment in the county is calculated based on the two-digit industry classification (SNI2007) of the employees' main employer.

3.1 Subsample categories

To provide some deeper insights into the origin of the wage flexibility we use our micro data to specify sub-categories of employees. One key feature is the distinction between stayers and movers. Are wages flexible within ongoing employment relationships, or does wage flexibility occur for employees who change employer? We define stayers as employees who remain in the same job as they had in the year before. Job-to-job movers are employees who changed jobs without an intervening unemployment spell. The final group consists of hires from unemployment or inactivity. We define these categories by using the universal tax records, which implies that we can identify the variables correctly also in cases where the firm was out of the wage sample in the previous year.

In the case of stayers, we are interested in the extent to which wages adjust differently for employees with a high vs. a low risk of unemployment. To this end, we estimate a linear probability model on the population of employees where the outcome is the probability that they experience at least one day of registered unemployment in the coming year. The model controls for gender, marriage status, immigration status, industry and sector as well as the interaction of age-groups (<25, 25−49, 50−64), level of education (2-digit ISCED) and field of education (2-digit ISCED). The model also includes fixed effects for the interaction between year and region. We predict the un-

[20] To ensure that the results are not driven by outliers we have excluded individuals with very high (>99th percentile) or very low (<1th percentile) wages from the first stage composition correction of the regional wages. This restriction does not change the results.

[21] Thus, unemployment and employment measures are register based. The reason for not using Labor Force Survey (LFS) measures for unemployment and employment is that we do not have access to consistent regional LFS series before a major data revision in 2005.

[22] Register based employment as defined in LISA database. For details, see http://www.scb.se/Statistik/_publikationer/AM9901_1990I09_BR_AM76BR1104.pdf

employment risk based on all these variables except the region-year fixed effects and split the data by the median predicted risk into high-risk and low-risk employees.[23]

Some industries have agreements with relatively little scope for local flexibility due to the design of the national level wage contracts (see Section 2). These agreements are either of the "tariff" form with no or very little formalized scope for local wage adjustments or stipulate very high minimum wages that cover a substantial part of the workforce (again, leaving very little room for local flexibility). According to the National Mediation Office's classification, these industries include transportation, hotels and restaurants, some business services, and retail.[24] Since these industries have little formal scope for wage flexibility, they weigh down the wage elasticities for the rest of the private sector with more flexible wage agreements. Therefore, we also estimate the models excluding these low-flexibility industries.

3.2 Descriptive statistics

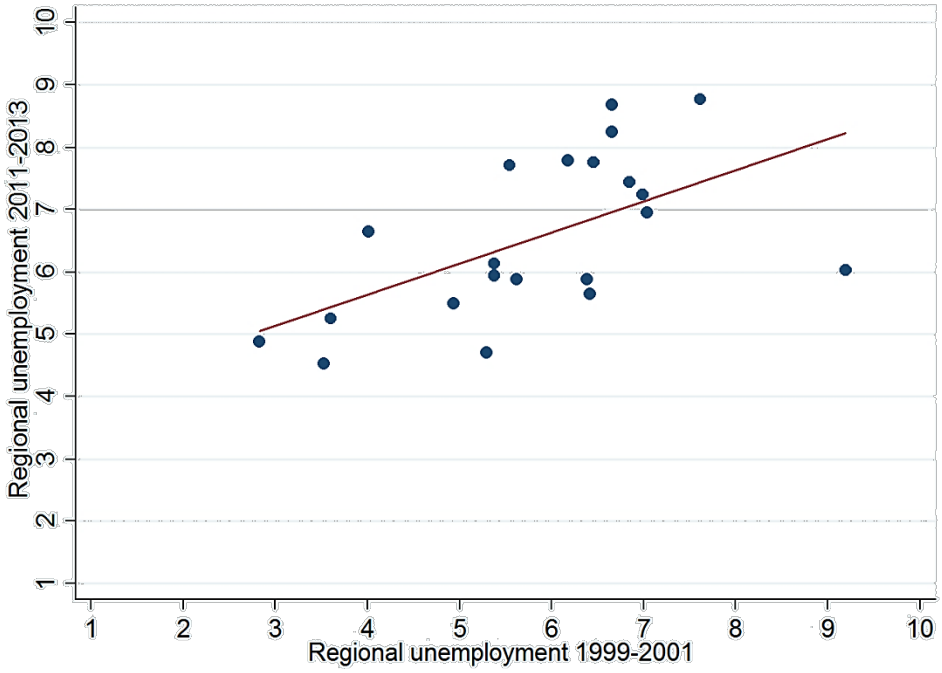
The regional unemployment rates are displayed in Figure 2 and Figure 3. Figure 2 shows the relationship between the regional mean unemployment in 1999−2001 and the corresponding rate in 2011−2013. The ranking of the regions is clearly correlated over time, but there are also substantial idiosyncratic movements across time. A substantial part of this variation is due to differing industrial compositions. As an example, the county with the highest unemployment rate in the initial period (*Norrbotten)* is below the median in the second period, mostly because of an enormous increase in mining-related labor demand. In 1999−2013 the regional unemployment varied between 2.2 and 10.5 percent, with a mean of 5.6 percent and a standard deviation of 1.6. Our empirical analysis will explore the evolution of unemployment after removing year and county fixed effects and Figure 3 therefore depicts this variation. As is evident, there are substantial movements in the relative unemployment rates of the different counties. More detailed descriptive statistics can be found in the Appendix.

[23] The predicted unemployment risk, and hence even the estimated wage flexibility, is about the same whether or not the industry controls are included in the linear unemployment probability model.

[24] The business services include e.g. office cleaning, janitor services and call centers. The National Mediation Office also adds the construction industry to this low-flexibility category since the wages are set according to piece rates, but for our purposes this is not a reasonable justification and we have hence not included the construction industry in the low-flexibility category.

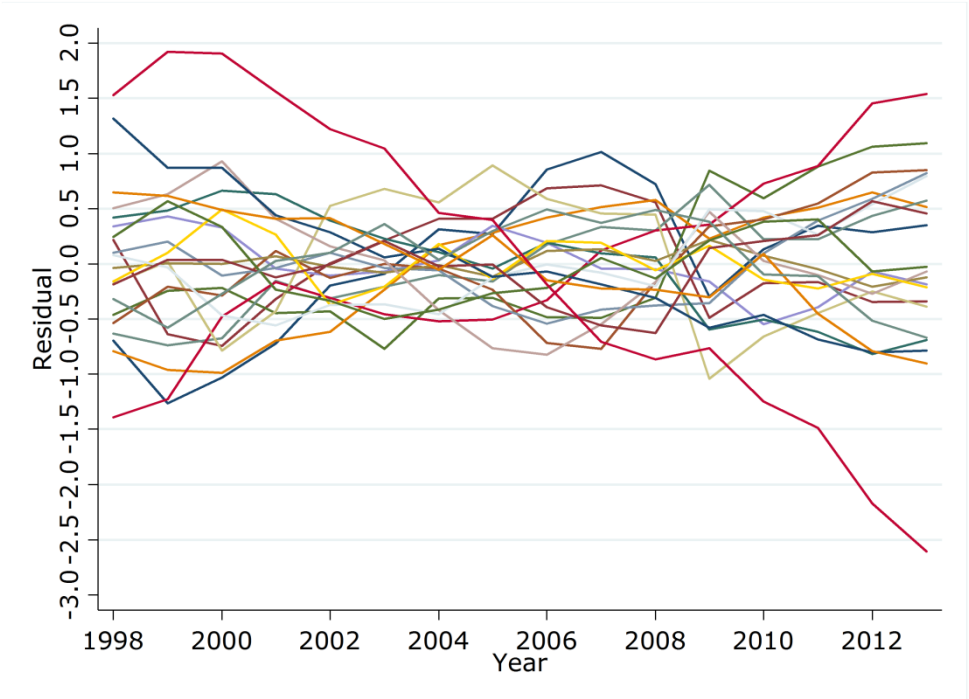
Figure 2 Regional persistence of unemployment

Percent



Note. Register-based unemployment.

Figure 3 Development of regional unemployment after removing year and county fixed effects



Note. The figure shows residual unemployment rates from regressions on year and county fixed effects.

4 Empirical methods

4.1 Overview

First, we correct wages for changes in the composition of employees. We then aggregate these corrected wages to the county-year level and estimate models with county and year fixed effects. To ensure that the results we find arise from demand-side changes, we use an instrumental variable approach drawing on the logic of shift-share instruments as in Bartik (1991, 2002). Each of these three parts is described below.

4.2 Composition-correction

It is well-known that systematic changes in the composition of employees across the business cycle can have a substantial impact on the measured variability of wages across the cycle as already noted by e.g. Bils (1985) and Solon et al (1994). To handle this issue, we adjust our regional wage data for individual composition effects as suggested by, e.g., Card (1995) and Bell et al (2002).[25] Our empirical work is therefore executed in two stages. In the first stage, we remove any time constant individual heterogeneity by estimating the following model:

$$w_{ijt} = \alpha_i + \alpha_{jt} + \sum_k^K X_{ijtk}\beta_{jk} + \varepsilon_{ijt} \qquad (1)$$

where w_{ijt} is the natural logarithm of the monthly wage for individual *i* observed in region *j* year *t*, α_i is an individual fixed effect, α_{jt} is a region specific year effect (year dummy * region dummy), X is a set of *k=1, …, K* time-varying individual characteristics (age, age^2, dummy variables indicating marital status, presence of children aged 0−6 years, 3 levels of education and 16 industries). The composition parameters, β_{jk}, differ across the regions but remain constant over time.

Equation (1) is estimated using individual data for years 1998−2013 for the entire private sector. The estimated region-specific year effects, $\hat{\alpha}_{jt}$, are then used as the composition corrected wages.

4.3 The regional-level model

In the second stage, the unit of observation is region/year cells in the spirit of Blanchflower and Oswald (1994), Bell et al (2002) and Gregg et al (2014). Using the regional panel, we estimate a model of the following form:

$$\hat{\alpha}_{jt} = \omega_j + \omega_t + \gamma\hat{\alpha}_{jt-1} + \delta u_{jt} + \sum_k^K Z_{kjt}\,\varphi_k + \nu_{jt} \qquad (2)$$

where ω_j is the region fixed effect, ω_t is the year fixed effect, u_{jt} is the natural logarithm of the regional unemployment rate in percent, and Z_{kjt} are time-varying regional variables (share of population with 3 different levels of education, share of women

[25] In the empirical section we show results from alternative adjustment procedures.

and foreign-born in the population). The year effects, ω_t, take care of all aggregate shocks (e.g. policy changes, price changes and economic growth). The parameter δ gives the short-run elasticity of wages with respect to unemployment, which is the main parameter of interest. As standard in the literature, the model includes the lagged dependent variable in order to assess how much the wages adjust to the regional unemployment in the long-run. The long-run elasticity of wages is given by $\frac{\delta}{1-\gamma}$ where γ is the coefficient of the lagged dependent variable.

It should be noted that when dynamic models are estimated with fixed effects the coefficient of the lagged dependent variable is subject to Nickell (1981) bias of order 1/T. In this case T=15 and the potential bias is thus relatively minor. However, we also estimate models excluding the dynamic component from the equation (2) and the overall wage flexibility estimate remains fairly robust. When exploring differences across mobility groups, we focus on the model without dynamics for easy exposition but report the full set of dynamic results in the Appendix.

To account for the possibility that unobserved labor quality or autonomous wage pressure, for instance arising from variations in rent capture and the extent of product market competition, have different time trends in different regions, we have also estimated equation (2) with regional trends $\sum_{j=2}^{J}(\mu_j' D_j)t$. However, including these regional trends does not alter the results.

For all reported results, standard errors in equation (2) are corrected for clustering on the 21 regions. We acknowledge that this number is somewhat lower than ideal. In practice, however, clustered standard errors are very similar in size (slightly larger) to standard errors without clusters.

4.4 Instrumenting regional unemployment

There is an obvious simultaneity problem when estimating the effect of unemployment on wage levels since high wage levels in a region, all else equal, are likely to contribute to a higher regional unemployment rate. To handle this issue, we use an instrumental variable approach, drawing on Bartik (1991, 2002). The strategy implies using the predicted regional employment growth as a source of exogenous variation in regional labor demand. The predicted regional employment growth is derived from interactions between the region's initial industry mix and the national employment growth of each industry. The idea is that the national employment growth in an industry is dependent on the aggregate demand of the industry's products, and therefore not directly affected by regional wages. The employment level for each region as of year *t* is predicted by allocating each two-digit industry's growth (the national average from 1998 to *t*) according to each region's initial exposure to the industries. Thus, we generate the instrument as:

$$instrument_{jt} = \sum_b \left(\frac{E_{bj98}}{E_{j98}}\right) * E_{bt}^{tot} \qquad (3)$$

where E_{bj98} is the number of employees in industry *b* within region *j* in year 1998, E_{j98} is the total number of employees in region *j* in year 1998, E_{bt}^{tot} is the number of employees at the national level in industry *b* in year *t*.[26]

The instrument ensures that the variation in regional unemployment arise from the labor demand side. However, the IV-strategy cannot ensure that this demand shift only affect the labor market through the regional unemployment per se and not by other factors that are correlated with the labor demand that drive wage moderation, for example vacancies or firms' profits. But under the assumption that such demand shifts primarily affect the labor market directly (i.e. not through wages), we interpret the IV estimates as estimates of demand-induced changes in local labor-market conditions scaled according to the shocks' impact on the regional unemployment rate.

5 Results

The results from estimating equation (2) are presented in this section. To recap, the dependent variable is the composition-corrected monthly wage at the regional level in log form. The coefficient of the regional unemployment rate measures the short-run wage flexibility (elasticity). We also report estimates of the long-run elasticity of wages with respect to the regional unemployment, which is calculated using the estimated coefficients for the short-run elasticity and the estimate for the lagged dependent variable.

5.1 Main results

The results, presented in Table 1, show that the regional unemployment rate affects the private sector wage level. When the regional unemployment rate is treated as exogenous, the short-run elasticity of wages in the private sector varies in the range of -0.012 and -0.016, depending on whether or not the regional trends are included in the models (see columns 1 and 2 in Table 1). The results from the OLS-models indicate that the long-run elasticity of wages is around -0.035.

If we instead treat the regional unemployment as endogenous and instrument it with local labor market shocks, we get a higher estimated wage elasticity. This is as expected since the IV approach removes the counteracting process wherein high regional wage levels may lead to high unemployment. The short-run elasticity in the IV-model is -0.025 (see column 3 in Table 1).[27] Thus, doubling the regional unemployment rate (e.g. from 4 to 8 percent), would lead to 2.5 percent lower regional wage levels in the short-run. In the long-run, the regional wage level would instead be 7.5 percent lower. It should be stressed that, as noted above, the regional unemployment is an indicator for the regional business cycle conditions and it is not possible to distinguish whether it is the regional unemployment per se or some other factors that are correlated with the labor demand that drive the wage moderation, for example vacancies or firms' profits. However, the instrument ensures that the variation in regional

[26] We only use private sector employees when constructing the instrument. The private sector is defined from the employers' sector code in the LISA database which differs somewhat from the definition of the private sector in the wage data.

[27] The first stage estimates are presented in column 3 in Table 11 in the Appendix.

unemployment arises from the labor demand side and not from variations in labor supply.

Table 1 Elasticity of wages in the private sector

Dependent variable: Ln(composition corrected monthly wage in the county)

	1 OLS	2 OLS	3 IV
Ln(regional unemployment rate)	-0.012**	-0.016**	-0.025**
	(0.004)	(0.004)	(0.008)
Ln(regional wage $t-1$)	0.652**	0.475**	0.666**
	(0.037)	(0.086)	(0.040)
Long-run elasticity	-0.035**	-0.030**	-0.075**
Regional trends	No	Yes	No
Number of observations	315	315	315
Number of regions (cluster)	21	21	21

Note: Individuals with very high (>99th percentile) or very low (<1th percentile) wages are excluded from the first stage composition correction of the regional wages. ** p<0.01, * p<0.05, $^{+}$ p<0.1. Standard errors in parentheses are corrected for clustering on region. All models incude time-varying regional controls, regional fixed effects and year fixed effects. The time-varying regional controls are the proportion with compulsory and post-secondary education, female and foreign-born in the population. In the IV-model the regional unemployment is instrumented with local labor demand shocks.

5.2 The role of compositional adjustments

Our baseline model (used throughout, if not otherwise noted) accounts for selection on individual characteristics through the individual fixed effects in equation (1). To highlight the importance of this correction, and to explore the role of the demand side (i.e. firms) selection, we have re-estimated the first stage model without individual fixed effects and with different sets of alternative fixed effects. In Table 2, we show that accounting for the composition of the employees is indeed crucial for the estimated elasticity of wages. Without individual effects, the estimated elasticity becomes smaller and statistically insignificant. This result suggests that low-wage workers are more likely to be employed when unemployment is relatively low. Accounting for firm effects (column 2) does not change this picture. However, once individual fixed effects are included (column 3), it does not matter if these instead are specified by each individual-firm combination (the "match effects" of column 4).[28] Thus, the data suggest that selection on the supply side (employees) is important for our conclusions, but that our results are unaffected by the fact that our main model leaves selection on the demand side (firms) out of the model.

[28] Data in Table 2 is restricted to only include individuals with at least two wage observations in order to get comparable samples in different columns. Thus, the estimated coefficient for the lagged dependent variable and the calculated long-run elasticity in column 3 differ marginally from the results presented in column 3 in Table 1.

Table 2 Elasticity of wages with different fixed effects in the first stage composition correction of the regional wages, private sector

Dependent variable: Ln(composition corrected monthly wage in the county)

	1	2	3	4
	IV	IV	IV	IV
Ln(regional unemployment)	-0.004	-0.003	-0.025**	-0.023**
	(0.008)	(0.007)	(0.008)	(0.008)
Ln(regional wage $t-1$)	0.544**	0.551**	0.659**	0.681**
	(0.071)	(0.065)	(0.040)	(0.035)
Long-run elasticity	-0.008	-0.006	-0.073**	-0.073**
1st stage fixed effects:	None	Firm	Employee	Match
Number of observations	315	315	315	315
Number of regions (cluster)	21	21	21	21

Note: ** p<0.01, * p<0.05, + p<0.1. Individuals with only one wage observation and individuals with very high (>99th percentile) or very low (<1th percentile) wages are excluded from the first stage composition correction of the regional wages in order to get comparable samples. Standard errors in parentheses are corrected for clustering on region. All models incude time-varying regional controls, regional fixed effects and year fixed effects. The time-varying regional controls are the proportion with compulsory and post-secondary education, female and foreign-born in the population. The regional unemployment is instrumented with local labor demand shocks.

5.3 Heterogeneity

5.3.1 LAGGED EMPLOYMENT STATUS AND UNEMPLOYMENT RISK

As described in Section 3, we separate between employees depending on their previous status (job-to-job movers, hires from unemployment, employees who stay within a match). Furthermore, we predict the unemployment risk of employees in order to find individuals who remain in continued employment but who are more likely to be directly affected by unemployment. It should be kept in mind that the incidence of mobility changes with the regional cycle; in Table 13 in the Appendix we show that the incidence of job-to-job mobility is, as expected, pro-cyclical.

Since the dynamic model makes little sense for the sample of movers (the lag will be defined by previous movers), we focus on models without the lagged dependent variable.[29] As shown in Table 3, the wage flexibility appears to be higher for more marginal workers. Employees with a higher-than-average risk of job-loss into unemployment and new hires from unemployment have a higher response to changes in regional unemployment than low-risk employees. The point estimate for job-to-job movers is lower than for other groups but it is not statistically significant.

[29] For completeness, we present the corresponding dynamic tables in the Appendix, see Table 14 and Table 15.

Table 3 Wage flexibility by unemployment risk and for transitions, private sector

Dependent variable: Ln(composition corrected monthly group wage in the county)

	1 IV Within match low u risk	2 IV Job-to-job	3 IV Within match high u risk	4 IV Unemployment to job
Ln(regional unemployment)	-0.034+	-0.022	-0.049**	-0.065**
	(0.019)	(0.023)	(0.017)	(0.029)
Number of observations	294	294	294	294
Number of regions (cluster)	21	21	21	21
Share of 1st stage observations	42 %	11 %	41 %	6 %

Note: Individuals with very high (>99th percentile) or very low (<1th percentile) wages are excluded from the first stage composition correction of the group's regional wage. ** p<0.01, * p<0.05, + p<0.1. Standard errors in parentheses are corrected for clustering on region. All models incude time-varying regional controls, regional fixed effects and year fixed effects. The time-varying regional controls are the proportion with compulsory and post-secondary education, female and foreign-born in the population. The regional unemployment is instrumented with local labor demand shocks.

The sample in Table 3 includes the whole private sector and we expect that industries with more centralized wage setting practices absorb less of the local shocks in wages. Thus, these industries weigh down the private sector wage elasticity. Excluding these low-flex industries from the sample results to higher wage elasticities, as shown in Table 4. The low-flex industries have a non-existent wage response to changes in the local unemployment rate, whereas the rest of the private sector has a wage elasticity of 3 percent in the short-run and almost 9 percent in the long-run.

Table 4 Elasticity of wages with different degree of flexibility in wage agreements, private sector

Dependent variable: Ln(composition corrected monthly wage in the county)

	1	2	3	4
	Low-flex industries		Private sector excl. low-flex industries	
	IV	IV	IV	IV
Ln(regional unemployment)	-0.029	-0.017	-0.056*	-0.030**
	(0.040)	(0.011)	(0.022)	(0.008)
Ln(group wage $t-1$)		0.750**		0.661**
		(0.059)		(0.041)
Long-run elasticity		-0.068		-0.087**
Number of observations	336	315	336	315
Number of regions (cluster)	21	21	21	21

Note: ** p<0.01, * p<0.05, + p<0.1. Individuals with only one observation and individuals with very high (>99th percentile) or very low (<1th percentile) wages are excluded from the first stage composition correction of the regional wages. Standard errors in parentheses are corrected for clustering on region. All models incude time-varying regional controls, regional fixed effects and year fixed effects. The time-varying regional controls are the proportion with compulsory and post-secondary education, female and foreign-born in the population. The regional unemployment is instrumented with local labor demand shocks. The first stage IV-estimates are presented in Table 11 in the Appendix.

Excluding the low-flex industries also makes the results for the job-stayers and new hires from unemployment more pronounced, especially for the more marginal workers. Table 5 shows that wages of new hires from unemployment have more than twice

as large response to changes in regional unemployment than wages of low unemployment risk employees.[30]

Table 5 Wage flexibility by unemployment risk and for transitions, private sector excluding low-flex industries

Dependent variable: Ln(composition corrected monthly group wage in the county)

	1 IV Within match low u risk	2 IV Job-to-job	3 IV Within match high u risk	4 IV Unemployment to job
Ln(regional unemployment)	-0.035+	-0.034	-0.061**	-0.084**
	(0.019)	(0.022)	(0.021)	(0.031)
Number of observations	294	294	294	294
Number of regions (cluster)	21	21	21	21
Share of 1st stage observations	45 %	11 %	39 %	6 %

Note: Individuals with very high (>99th percentile) or very low (<1th percentile) wages are excluded from the first stage composition correction of the group's regional wage. ** p<0.01, * p<0.05, + p<0.1. Standard errors in parentheses are corrected for clustering on region. All models incude time-varying regional controls, regional fixed effects and year fixed effects. The time-varying regional controls are the proportion with compulsory and post-secondary education, female and foreign-born in the population. The regional unemployment is instrumented with local labor demand shocks.

5.3.2 BASIC DEMOGRAPHICS

The estimated wage elasticities are very similar for employees with different levels of education (see Table 6) as well as for native-born and foreign-born employees (see Table 7). The results show that in the private sector the wages of men are more flexible than the wages of women (see Table 7). This probably reflects the fact that women in the private sector to a larger extent than men have jobs that are similar to public sector jobs, for instance jobs in privately provided health care and education. Wages in these sectors can plausibly be assumed to be anchored by local public-sector wages in the same sectors, and these local public-sector wages are more likely to be determined by non-market factors such as local budget constraints.[31]

[30] Results for low-flex industries are shown in the Appendix in Table 16. None of the estimated elasticitites is statistically significant.

[31] Estimating the model for public sector wages provide much smaller estimates, as expected. See Table 12 in the Appendix.

Table 6 Elasticity of wages for individuals with different education level

Dependent variable: Ln(composition corrected monthly wage for the group in the county)

	(1) IV Compulsory education	(2) IV Secondary education	(3) IV Post-secondary education
Ln(regional unemployment rate)	-0.020*	-0.025**	-0.019
	(0.008)	(0.008)	(0.012)
Ln(regional wage t−1)	0.540**	0.621**	0.730**
	(0.072)	(0.044)	(0.043)
Long-run elasticity	-0.043*	-0.065**	-0.070
Number of observations	315	315	315
Number of regions (cluster)	21	21	21

Note: Individuals with very high (>99th percentile) or very low (<1th percentile) wages are excluded from the first stage composition correction of the regional wages. ** p<0.01, * p<0.05, $^{+}$ p<0.1. Standard errors in parentheses are corrected for clustering on region. All models incude time-varying regional controls, regional fixed effects and year fixed effects. The time-varying regional controls are the proportion with compulsory and post-secondary education, female and foreign-born in the population. The regional unemployment is instrumented with local labor demand shocks.

Table 7 Elasticity of wages for women, men, native-born and foreign-born

Dependent variable: Ln(composition corrected monthly wage for the group in the county)

	(1) IV Women	(2) IV Men	(3) IV Native-born	(4) IV Foreign-born
Ln(regional unemployment rate)	-0.017*	-0.031**	-0.027**	-0.031*
	(0.008)	(0.009)	(0.008)	(0.015)
Ln(regional wage t−1)	0.669**	0.625**	0.670**	0.580**
	(0.064)	(0.043)	(0.040)	(0.082)
Long-run elasticity	-0.051*	-0.083**	-0.081**	-0.074*
Number of observations	315	315	315	315
Number of regions (cluster)	21	21	21	21

6 Conclusions

In this paper, we have analyzed the impact of regional unemployment rates on actual wages on the Swedish labor market. The setting is one where the aggregate wage distribution has remained remarkably stable across almost 20 years, with steadily growing real wages in all parts of the distribution. The stability is consistent with the institutional environment with the Swedish pattern bargaining system where all sectors are expected to follow the industrial agreement benchmark. Despite these institutional rigidities and the aggregate stability, we find evidence of substantial local wage flexibility. Our preferred estimates which account for differential selection of employees and which isolates demand induced movements in unemployment suggest a wage-unemployment elasticity of −0.025 in the short run and −0.075 in the long run. These numbers are well in line with the international evidence. Using models that are more in line with the previous international models provide responses of about half this magnitude, which we still interpret as non-trivial local flexibility. Thus, our results suggest that it is possible to combine stable wage dispersion with local flexibility.

The wage elasticities are larger for more marginal workers, i.e. new hires from unemployment and employees with high risk of job loss into unemployment. This result

differs from recent evidence for the US. The results are more pronounced when industries with wage agreements that have little scope for local adjustments are excluded from the sample.

Overall, our results suggest that the Swedish-style pattern bargaining model can be combined with substantial relative wage adjustments. The results do not support the view that the structure is rigid enough to prevent local labor markets adjusting wages when local labor demand shifts. Thus, the institutions do not appear to be a major reason as to why there have been relatively small nominal wage increases despite of labor shortages in many sectors during the recent economic boom.

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Appendix

Table 8 Descriptive statistics on the regional panel data

	N	Mean	SD	Min	Max
County employment rate	336	76.29	2.58	69.47	83.20
Share of women in the county	336	0.49	0.01	0.48	0.50
Share of foreign born in the county	336	0.12	0.05	0.04	0.29
Share with basic education in the county	336	0.18	0.04	0.09	0.29
Share with secondary education in the county	336	0.52	0.04	0.40	0.57
Share with post-secondary education in the county	336	0.31	0.06	0.20	0.48
County unemployment rate	336	5.70	1.66	2.16	10.54
Instrument	336	76716.59	4880.67	63705.81	87107.11
CPI inflation (annual)	336	1.26	1.07	-0.30	3.40
Ln wage for all private sector employees	336	10.23	0.25	9.79	10.70
Ln wage for low-flex industries	336	9.76	0.20	9.41	10.11
Ln wage for all other industries in the private sector	336	10.69	0.30	10.17	11.26

Table 9 Descriptive statistics, employees in low-flex industries

Individual level data

	N	Mean	SD	Min	Max
Monthly wage	2622117	22622.77	7243.08	11916.00	90783.00
Ln monthly wage	2622117	9.99	0.27	9.39	11.42
Age	2622117	40.26	12.62	20.00	64.00
Woman	2622117	0.54	0.50	0.00	1.00
Foreign born	2621837	0.18	0.38	0.00	1.00
Basic education	2610077	0.21	0.41	0.00	1.00
Secondary education	2610077	0.59	0.49	0.00	1.00
Post-secondary education	2610077	0.20	0.40	0.00	1.00
Married	2622116	0.37	0.48	0.00	1.00
Children aged 0−6	2622117	0.17	0.37	0.00	1.00

Table 10 Descriptive statistics, private sector employees excluding low-flex industries

Individual level data

	N	Mean	SD	Min	Max
Monthly wage	14100056	27134.91	10346.32	11916.00	90798.00
Ln monthly wage	14100056	10.15	0.33	9.39	11.42
Age	14100056	42.16	11.40	20.00	64.00
Woman	14100056	0.35	0.48	0.00	1.00
Foreign born	14099540	0.11	0.31	0.00	1.00
Basic education	14060125	0.14	0.35	0.00	1.00
Secondary education	14060125	0.52	0.50	0.00	1.00
Post-secondary education	14060125	0.33	0.47	0.00	1.00
Married	14100056	0.46	0.50	0.00	1.00
Children aged 0−6	14100056	0.20	0.40	0.00	1.00

Table 11 First-stage IV-estimation results

Dependent variable: Ln(regional unemployment)

	(1) Low-flex industries	(2) Private sector excl. low-flex industries	(3) Private sector
Instrument	-0.00008** (0.00002)	-0.00008** (0.00002)	-0.00009** (0.00002)
Ln(regional wage *t*−1)	0.336 (1.403)	2.059+ (1.019)	2.156+ (1.091)
Year dummies:			
2000	0.181 (0.110)	0.052 (0.147)	0.063 (0.145)
2001	0.175 (0.155)	-0.080 (0.226)	-0.054 (0.215)
2002	0.231 (0.214)	-0.146 (0.298)	-0.106 (0.280)
2003	0.318 (0.255)	-0.179 (0.362)	-0.120 (0.333)
2004	0.575+ (0.324)	-0.020 (0.442)	0.050 (0.409)
2005	0.580 (0.381)	-0.120 (0.506)	-0.036 (0.466)
2006	0.503 (0.432)	-0.310 (0.584)	-0.206 (0.537)
2007	0.405 (0.505)	-0.514 (0.667)	-0.397 (0.614)
2008	0.572 (0.566)	-0.475 (0.747)	-0.339 (0.687)
2009	0.904 (0.609)	-0.308 (0.802)	-0.148 (0.726)
2010	1.068 (0.669)	-0.234 (0.879)	-0.058 (0.798)
2011	1.120 (0.731)	-0.261 (0.949)	-0.073 (0.864)
2012	1.223 (0.790)	-0.276 (1.019)	-0.070 (0.926)
2013	1.235 (0.858)	-0.380 (1.086)	-0.158 (0.986)
County population shares of			
–Women	5.707 (9.748)	1.172 (10.398)	1.965 (10.147)
–Individuals with compulsory eduction	8.321** (2.701)	6.762* (2.482)	6.749* (2.542)
–Individuals with post-secondary education	-0.408 (3.715)	-1.937 (3.343)	-1.861 (3.511)
–Foreign-born	7.285* (3.380)	7.206* (3.365)	7.104+ (3.456)
Number of observations	315	315	315
Number of regions (cluster)	21	21	21
R-squared	0.895	0.899	0.898

Note: ** p<0.01, * p<0.05, + p<0.1. Standard errors in parentheses are corrected for clustering on region.

Source: NIER.

Table 12 Elasticity of wages in the public sector

Dependent variable: Ln(composition corrected monthly wage in the county)

	1	**2**	**3**
	OLS	OLS	IV
Ln(regional unemployment rate)	-0.002	-0.004+	-0.015**
	(0.002)	(0,002)	(0.005)
Ln(regional wage *t*−1)	0.667**	0.361**	0.730**
	(0.049)	(0.086)	(0.074)
Long-run elasticity	-0.006	-0.006+	-0.057**
Regional trends	No	Yes	No
Number of observations	315	315	315
Number of regions (cluster)	21	21	21

Note: Individuals with very high (>99th percentile) or very low (<1th percentile) wages are excluded from the first stage composition correction of the regional wages. ** p<0.01, * p<0.05, $^{+}$ p<0.1. Standard errors in parentheses are corrected for clustering on region. All models incude time-varying regional controls, regional fixed effects and year fixed effects. The time-varying regional controls are the proportion with compulsory and post-secondary education, female and foreign-born in the population. In the IV-model the regional unemployment is instrumented with local labor demand shocks.

Table 13 Probability to change job without unemployment

Dependent variable: Changed employer since the previous year

	Low-flex industries	Private sector excl. low-flex industries	All private sector employed
Ln(regional unemployment)	–0.006** (0.0006)	–0.009** (0.0002)	–0.009** (0.0002)
Number of observations	2,214,418	11,742,193	13,956,611
Number of employed	570,447	2,203,978	2,605,926

Note: ** p<0.01, * p<0.05, $^{+}$ p<0.1. Standard errors in parentheses are corrected for clustering on region. The estimated models are linear probability predictions with individual and year fixed effects controlling for age, age^2, dummy variables för married, children aged 0−6 years and industry.

Table 14 Wage flexibility by unemployment risk and for transitions, private sector

Dependent variable: Ln(composition corrected monthly group wage in the county)

	1	2	3	4
	IV	IV	IV	IV
	Within match low u risk	Job-to-job	Within match high u risk	Unemployment to job
Ln(regional unemployment)	-0.030**	-0.013	-0.031**	-0.043+
	(0.009)	(0.012)	(0.008)	(0.024)
Ln(group wage *t*−1)	0.541**	0.314**	0.561**	0.219**
	(0.037)	(0.061)	(0.056)	(0.076)
Long-run elasticity	-0.065**	-0.019	-0.070**	-0.054+
Number of observations	273	273	273	273
Number of regions (cluster)	21	21	21	21
Share of 1st stage observations	42 %	11 %	41 %	6 %

Note: Individuals with very high (>99th percentile) or very low (<1th percentile) wages are excluded from the first stage composition correction of the group's regional wage. ** p<0.01, * p<0.05, $^{+}$ p<0.1. Standard errors in parentheses are corrected for clustering on region. All models incude time-varying regional controls, regional fixed effects and year fixed effects. The time-varying regional controls are the proportion with compulsory and post-secondary education, female and foreign-born in the population. The regional unemployment is instrumented with local labor demand shocks.

Table 15 Wage flexibility by unemployment risk and for transitions, private sector excluding low-flex industries

Dependent variable: Ln(composition corrected monthly group wage in the county)

	1 IV Within match low u risk	2 IV Job-to-job	3 IV Within match high u risk	4 IV Unemployment to job
Ln(regional unemployment)	-0.032**	-0.019+	-0.036**	-0.063**
	(0.009)	(0.011)	(0.009)	(0.022)
Ln(group wage $t-1$)	0.538**	0.324**	0.593**	0.191**
	(0.037)	(0.065)	(0.048)	(0.066)
Long-run elasticity	-0.069**	-0.028+	-0.089**	-0.078**
Number of observations	273	273	273	273
Number of regions (cluster)	21	21	21	21
Share of 1st stage observations	45 %	11 %	39 %	6 %

Note: Individuals with very high (>99th percentile) or very low (<1th percentile) wages are excluded from the first stage composition correction of the group's regional wage. ** p<0.01, * p<0.05, + p<0.1. Standard errors in parentheses are corrected for clustering on region. All models incude time-varying regional controls, regional fixed effects and year fixed effects. The time-varying regional controls are the proportion with compulsory and post-secondary education, female and foreign-born in the population. The regional unemployment is instrumented with local labor demand shocks.

Table 16 Wage flexibility by unemployment risk and for transitions, low-flex industries

Dependent variable: Ln(composition corrected monthly group wage in the county)

	1 IV Within match low u risk	2 IV Job-to-job	3 IV Within match high u risk	4 IV Unemployment to job
Ln(regional unemployment)	-0.028	-0.0003	-0.038	-0.046
	(0.027)	(0.029)	(0.040)	(0.037)
Number of observations	294	294	294	294
Number of regions (cluster)	21	21	21	21
Share of 1st stage observations	26 %	12 %	51 %	11 %

Note: Individuals with very high (>99th percentile) or very low (<1th percentile) wages are excluded from the first stage composition correction of the group's regional wage. ** p<0.01, * p<0.05, + p<0.1. Standard errors in parentheses are corrected for clustering on region. All models incude time-varying regional controls, regional fixed effects and year fixed effects. The time-varying regional controls are the proportion with compulsory and post-secondary education, female and foreign-born in the population. The regional unemployment is instrumented with local labor demand shocks.