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## **Dynamic private-public wage gap: Return to experience, education level and city effect \***

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\* We appreciate discussions at the 2017 European Meeting of the Urban Economics Association in Copenhagen, the 2017 Urban Economics Association Meeting in Vancouver, and the 2018 Congress of the European Regional Science Association in Cork, and comments from Stefan Leknes, Frank Neffke, Olmo Silva, and Bjarne Strøm, and in particular Jorge De la Roca for his suggestion of studying heterogeneity with respect to places with high and low shares of public sector employment. We are grateful for the cooperation of Statistics Norway and funding from the Research Council of Norway (grant number 255509).

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## Abstract

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Keywords: Private-public wage gap; Worker experience; Worker fixed effects; Education; City;

JEL codes: J31, J45, R23

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A large literature estimates the static private-public wage gap, but due to lack of data, not much is known about the dynamic gap resulting from different returns to work experience accumulated in the two sectors. This analysis applies Norwegian register data observing experience of individuals by sector. Selection on observable and unobservable worker characteristics is handled in panel models with workers fixed effects. The robustness of the results is investigated by instrumenting experience using the Altonji-Shakotko method. The dynamic experience effect adds to the static private wage premium for high-educated workers and counts for 2/3 of the total wage gap. The low educated gain less from shifting to the private sector and on average, they have no additional return to private sector experience. Both static and dynamic gains from shifting to the private sector are higher in cities, and for the low educated, the dynamic effect is a pure city phenomenon. The public sector does not add dynamic effects to the urban wage premium.

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## 1. Introduction

The static private-public wage gap varies across countries with different wage institutions and public sector wage policies. Broad overviews such as Giordano et al. (2014) and Lausev (2014) show some common characteristics – the public sector has relative wage compression, the public employee winners are the low educated at the bottom of the wage distribution, and the losers are the high educated at the top. We add to this literature by addressing the dynamic component of the private-public wage gap resulting from different returns to work experience accumulated in the two sectors. Based on register data with observation of sector-specific experience of workers over time, we estimate the dynamic experience effect. The approach is inspired by the dynamic urban wage gap developed by De la Roca and Puga (2017) and extended to analyze the role of education by Carlsen et al. (2016).

A few studies of the private-public wage gap include potential or actual work experience as a control variable, and Maczulskij and Pehkonen (2011) estimate the return to aggregate experience for workers in the two sectors. The broader life-cycle perspective of sectoral differences is studied by Postel-Vinay and Turon (2007). They estimate a structural model to calculate differences in lifetime earnings between workers in the private and the public sectors and include other dynamic aspects such as income volatility and job risk. Dickson et al. (2014) apply the structural model for several European countries and show large variation in the gap in return to experience between private and public employees. These analyses are not based on observation of experience by sector over the working life of the individuals and cannot provide an analysis of sectoral returns.

Longitudinal data allow for observation of experience and handling of selection issues. We apply standard panel analysis including worker fixed effects. Recent studies investigate the importance of unobserved worker characteristics in panel models, notably Disney and Gosling (1998) and Bargain and Melly (2008). Given this design, we identify the static private-public wage gap based on shifters between the sectors. The estimation of the dynamic experience effect is based on all workers (stayers and shifters). It should be noted that the use of longitudinal individual data does not solve the identification problem related

to endogenous choice of sector. Handling this choice in a panel analysis is difficult, since you must account for both who is shifting job and when. Dustmann and van Soest (1998) address these problems for the static gap in ‘switching models’ including parent characteristics and other family descriptives as instruments. They find that accounting for selection in the choice of sector affects the results, while the endogeneity of other individual choice variables such as education and hours worked have little impact. Recent attempts include Disney and Gosling (2003) studying contracting-out reforms and Maczulskij (2013) comparing twins. In this paper, we rely on panel models with worker fixed effects and concentrate on the endogeneity of experience important for the dynamic effect.

We benefit from methodological advances in the study of return to experience and tenure in labor markets. The modern approach was developed as part of a controversy of the upward sloping wage-tenure profiles estimated. Altonji and Shakotko (1987) introduce instruments to deal with unobserved heterogeneity. Further important contributions include Parent (2000) emphasizing that industry-tenure generate general human capital and Dustmann and Pereira (2008) investigating different experience profiles for different education groups. The broad understanding today is that occupation and industry are important to explain variation in the return to experience.

Our contribution is based on rich register data where we observe the individual experience by sector over time. Following the suggestion of De la Roca and Puga (2017) for the dynamic urban wage gap, we calculate the dynamic private-public gap as the different return to accumulated experience between private and public sectors for the average length of experience. The data allow for the study of portability dependent on the sector where the experience is currently used. Heterogeneity is investigated with respect to education, geography and importance of the public sector in local labor markets. Education groups have different wage profiles and dynamic private sector wage premiums. Geography matters for the gap since public sector wages typically are uniform across the country while private sector wages vary with regional labor market conditions. Labor markets with high share of public employees may be influenced by public sector monopsony power.

To estimate the private-public wage gap, we use register data for Norway covering hourly wages and worker characteristics from 2001 to 2010, with information on actual work experience dating back to 1993. Work experience in public administration is compared to experience in private business, and we separate between private stayers, public stayers, and shifters between sectors (both directions). We concentrate on native, male full-time workers aged 22–65. The dataset includes approximately 4.65 million observations and 0.7 million different workers. The experience variables include overall experience, experience by type of sector (private and public), experience by type of region (cities vs. the rest of the country, regions with high vs. low public employment share), and experience in the worker's present firm (job tenure).

The analysis shows that experience accumulated in the private sector is more valuable than experience accumulated in the public sector. In the worker fixed effect model, the first-year return to public sector experience is 7.9%, while first-year return to private sector experience adds one percentage point. The experience premium curves are concave, consistent with the broad literature on work experience. The dynamic gap is calculated for the average level of experience of 8.8 years for all workers. The experience effect adds to the private wage premium for high-educated workers and counts for 2/3 of the combined static and dynamic wage gap of 17.7%. The low educated gain less from shifting to the private sector and have no additional gain in return to experience. The robustness of the result is studied using the standard Altonji-Shakotko instrumentation of experience and tenure. The magnitude of the dynamic experience effect for high-educated workers is consistent with the fixed effect model. Further analysis shows that the additional value of experience accumulated for high-educated workers in the private sector is portable across sectors.

We investigate the importance of geography and share of public employment in local labor markets. The static private-public wage gap is largest in cities (above 150,000 inhabitants), and the dynamic effect is mainly a city phenomenon. Overall, the combined static and dynamic wage gap equals 12.5% in cities compared to about 4% in the rest of the country. The share of public employees in the local labor market matters, but the result is opposite to the monopsony hypothesis. The additional return to private experience for low-educated

workers is lower in regions with high share of public employment. Public employment is more important in regions with weak private labor markets.

The econometric approach and the dataset are described in section 2. Section 3 estimates the static private-public wage gaps in a panel analysis including worker fixed effects. We estimate and calculate the dynamic private-public wage gap in section 4, including a robustness check of the dynamic component based on instrumentation of experience and tenure. Section 5 analyzes the variation of the private-public gap with respect to the degree of urbanization and the importance of public sector presence in the local labor market. Concluding remarks are given in section 6.

## **2. Econometric approach and data**

To estimate the private-public wage gap, we use register data on hourly wages and worker characteristics from 2001 to 2010, with information on work experience dating back to 1993. The dataset is computed from three administrative registers: employment, tax, and education. The employment register links workers and firms and gives information on work contracts for all employees. It includes the length of the contract, the type of contract<sup>1</sup>, and the exact number of hours worked per week. We calculate the number of hours worked per year, which is combined with data on annual wage income from the tax register to give a measure of hourly wages for all employees. Information about work contracts dating back to 1993 is used to calculate actual full-time experience for each worker. We separate between overall experience, experience by type of sector (private and public), experience by type of region (cities vs. the rest of the country, regions with low vs. high public employment share), and experience in the worker's present firm (job tenure). The experience variables are calculated in days and expressed in years. The education register covers the entire adult population and gives detailed information about workers' level and field of education. We also have information on the age, gender, immigrant status, industry affiliation, firm affiliation, and home region of all individuals.

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<sup>1</sup> The employment register separates between three contract types: full-time contracts with at least 30 hours of work per week, part-time contracts with 20–29 hours of work per week, and part-time contracts with fewer than 20 hours of work per week.

We concentrate on native, male full-time workers aged 22–65 employed in the private sector or in public administration.<sup>2</sup> We separate between workers that remain in the private sector during 2001–2010 ('private stayers'), workers that remain in the public sector ('public stayers'), and workers that change sector during the period ('shiffters'). Shiffters are required to be in the dataset for at least three consecutive years: the year before the sector shift, the shift-year, and the year after the sector shift. Workers that are out of the labor market the year before the shift, as well as workers that shift back to the original sector within a year, are excluded. As long as workers do not change sector on January 1<sup>st</sup>, the wage in the shift-year represents a mix of private and public sector wages. We therefore exclude the shift-year, and compare the year before the shift to the year after the shift. The final dataset includes 4,655,281 observations and 733,460 different workers. Private sector stayers include 661,272 workers, while public sector stayers and shiffters account for 56,683 workers and 15,505 workers, respectively. The workers are allocated to 54 industries, 89 labor market regions, and approximately 140,000 firms.

Table 1 reports the observable characteristics of the workers, separating between private stayers, public stayers, and shiffters (from the private to the public sector, and vice versa). The average worker in our dataset has an hourly wage of 288 NOK in constant 2010 prices (log wage of 5.583). In the aggregate, the wage differences between the four groups of workers are not large. Private stayers have on average 1.4% lower hourly wage than public stayers, and this negative raw private-public wage gap is similar to most European countries. A comparison of private and public sectors must take into account the education level of the workforce. We separate between low-educated workers (high school and below) and high-educated workers (college and above). The low educated have about the same wage in the

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<sup>2</sup> We exclude workers in the primary industries (agriculture, fishing, and forestry), as well as public sector workers in education and health care industries. This gives a dataset of about 7 million worker-year observations. The tax register gives information on total annual earnings, rather than separate earnings for each work contract. Workers with more than two contracts during a year, as well as workers with one full-time and one part-time contract, are excluded. For workers with two full-time contracts, we allow for a maximum of three months of overlap between the contracts. We also exclude workers whose contract length is less than three months during a year. These restrictions reduce the dataset by about 0.7 million observations. Missing data on hours worked, annual earnings, level/field of education, or industry affiliation, together with exclusion of workers that change education level after entering the labor market as full-time employees, further excludes approximately 1.4 million observations. To avoid extreme observations, we exclude the top and bottom 1% of the wage distribution.



two sectors, but high-educated workers are much better paid in the private sector. The raw private-public wage gap is 15% for the high educated. The composition of the workforce with respect to education is very different in the two sectors. In the private sector, 77% of workers are low educated, while in the public sector, low-educated workers are in minority and account for about 45% of all workers. The high educated earn much less in the public sector, but there are many of them. This explains the higher relative public wage overall. The relative wage compression in the public sector is primarily about lower wages at the top.

The average worker is 42 years old and has 8.8 years of work experience. The average job tenure is 4.5 years. The public sector has somewhat older workers with longer work experience and job tenure. Economic geography is an interesting dimension related to the education level. We define cities as regions with more than 150,000 inhabitants in 2010, which accounts for 7 out of 89 regions. Overall, 41% of all workers live in city regions, and there is not much difference between the sectors. However, 57% of high-educated workers in the private sector live in cities, compared to only 45% of those in the public sector. The private-public gap also reflects geography. The high-educated part of the public sector is less concentrated to urban areas than the private, and the higher wage level in the cities (to be analyzed in section 5) helps explain the private-public wage gap among the high educated.

The main difference between the shifters relative to private and public sector stayers is the level of education. The high educated are more mobile, and the share of low-educated workers is lower among shifters than the corresponding stayers. When we consider industries within the private sector, we find that shifters are overrepresented in business services and to some extent in construction, while they are underrepresented in manufacturing and retail (compared to private stayers). There are some differences between shifters from private to public compared to those shifting from public to private. On average, workers shifting from the public to the private sector are younger, have less work experience and job tenure, and are more likely to live in cities.

Table 1 about here

The analysis estimates the static and dynamic private-public wage premium. The return to work experience is allowed to differ between the private and the public sector. To compare with the existing literature, we begin with a simple analysis of the static private-public wage gap. We run a hedonic regression of individual hourly wages for the period 2001–2010 that controls for time-varying observable worker characteristics (work experience and job tenure), and includes year, regional, and worker fixed effects:

$$\ln w_{ijrt} = \alpha \cdot \text{priv}_{it} + \beta_1 \cdot \text{Exp}_{it} + \beta_2 \cdot T_{ijt} + \gamma_t + \mu_r + \eta_i + \varepsilon_{ijrt} \quad (1)$$

where  $w_{ijrt}$  is the hourly wage income for worker  $i$  employed in firm  $j$  in region  $r$  in year  $t$ , and  $\text{priv}_{it}$  is a dummy that equals one if the worker is employed in the private sector in year  $t$ . Year, regional, and worker fixed effects are represented by  $\gamma_t$ ,  $\mu_r$ , and  $\eta_i$ , respectively.  $\text{Exp}_{it}$  represents years of work experience acquired by worker  $i$  up until time  $t$ , and  $T_{ijt}$  refers to years of experience acquired by worker  $i$  up until time  $t$  in firm  $j$  (the worker's present job).<sup>3</sup> The static private wage premium is given by the coefficient  $\alpha$  and is estimated based on workers shifting between the private and the public sector. The estimate controls for sorting of workers based on both time-varying observable characteristics and unobservable characteristics (abilities). The error term is given by  $\varepsilon_{ijrt}$ , while  $\beta_1$  and  $\beta_2$  are parameters. The regression is estimated both aggregate and separately for low- and high-educated workers.

We extend the specification in (1) to capture dynamic effects of work experience, where the value of experience is allowed to vary between the private and the public sector:

$$\ln w_{ijrt} = \alpha \cdot \text{priv}_{it} + \beta_1 \cdot \text{Exp}_{it} + \beta_2 \cdot T_{ijt} + \beta_3 \cdot \text{Exp}_{- \text{priv}_{it}} + \gamma_t + \mu_r + \eta_i + \varepsilon_{ijrt} \quad (2)$$

where  $\text{Exp}_{- \text{priv}_{it}}$  is work experience acquired by worker  $i$  up until time  $t$  in the private sector. If  $\beta_3 > 0$ , work experience is more valuable in the private compared to the public sector. The immediate static private wage premium is still given by the estimated coefficient

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<sup>3</sup> The regressions include quadratic experience and tenure terms.

on the private dummy ( $\alpha$ ), while the wage premium after  $\tau$  years of work experience is  $\alpha + \beta_3\tau$ . While we rely on shifters between the two sectors to identify the static premium, the estimation of the dynamic experience effect is based on all workers (stayers and shifters). In an extension of the analysis, we allow the value of experience accumulated in the private sector to vary depending on where it is used (in the public or the private sector). In this way, we can study if the dynamic experience effect is portable across sectors. We capture this by including an interaction term between private sector experience and the dummy variable indicating whether you currently work in the private sector.

While the main analysis is based on the worker fixed effect models above, we check the robustness of the dynamic experience effect using the standard Altonji-Shakotko instrumentation of tenure and experience. This is an alternative approach to handle concerns with unobserved heterogeneity in the estimation of returns to experience. Wage outcomes differ between individuals with the same education and experience – partly because of individual unobserved characteristics and partly because of different matches with employer and occupation. Experience and tenure are correlated with individual ability and match quality. The instrument used for tenure is its deviation from job means,  $DT_{ijt} = T_{ijt} - \overline{T_{ij}}$ , where  $\overline{T_{ij}}$  is the job mean of the tenure variable for individual  $i$  in job/firm  $j$ . The variable has zero mean for each job and is orthogonal to fixed individual and job-match factors. Experience is instrumented with its deviation from individual mean,  $DExp_{it} = Exp_{it} - \overline{Exp_i}$ , where  $\overline{Exp_i}$  is the individual mean of work experience. This variable also has zero mean and is orthogonal to individual fixed effects. Similar, experience acquired in the private sector is instrumented with its deviation from individual mean. Both level and quadratic terms are instrumented.<sup>4</sup> Since worker fixed effects are excluded in the IV estimation of equation (2), we add time-invariant worker characteristics. Public administration has specific occupation groups, and as an alternative to occupation, we control for the level of education and a set of 55 education field groups.

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<sup>4</sup> For the quadratic tenure term, the instrument is  $DT_{ijt}^2 = T_{ijt}^2 - \overline{T_{ij}^2}$ , where  $\overline{T_{ij}^2}$  is the average squared tenure over the duration of job  $j$  for individual  $i$ . Similar for the quadratic experience term.

We return to the worker fixed effects model to study the geographic aspect of private-public wage gaps. To investigate the geographical dimension of the private-public wage gap, we separate between cities with at least 150,000 inhabitants and the rest of the country. The static private wage premium and the dynamic experience effect are allowed to vary across region types:

$$\begin{aligned} \ln w_{ijt} = & \alpha_1 \cdot \text{priv}_{it} + \alpha_2 \cdot \text{priv}_{it} \cdot \text{city}_{it} + \alpha_3 \cdot \text{city}_{it} + \beta_1 \cdot \text{Exp}_{it} + \beta_2 \cdot T_{ijt} \\ & + \beta_3 \cdot \text{Exp}_{it} \cdot \text{priv}_{it} + \beta_4 \cdot \text{Exp}_{it} \cdot \text{city}_{it} + \beta_5 \cdot \text{Exp}_{it} \cdot \text{privcity}_{it} + \gamma_t + \eta_i + \varepsilon_{ijt} \end{aligned} \quad (3)$$

where  $\text{city}_{it}$  is a dummy that equals one if worker  $i$  is located in a city in year  $t$ ,  $\text{Exp}_{it}$  is work experience acquired by worker  $i$  up until time  $t$  in cities and  $\text{privcity}_{it}$  is private sector experience acquired in cities. If  $\beta_4 > 0$ , work experience is more valuable in cities compared to the rest of the country, and if  $\beta_5 > 0$ , private experience in cities is more valuable than public experience in cities. The private wage premium after  $\tau$  years of work experience is  $\alpha_1 + \alpha_2 + (\beta_3 + \beta_5)\tau$  for workers in cities and  $\alpha_1 + \beta_3\tau$  for workers in the rest of the country.

### 3. Static private-public wage gap

We start by estimating the static private-public wage gap in order to compare Norway relative to other countries and the existing literature. A simple regression including the private sector dummy and year dummies identifies the raw average wage gap between private and public sectors as -1.1%. The public wages are on average higher than private wages, consistent with the raw differences shown for several European countries by Dickson et al. (2014).

We narrow down the private-public comparison by taking into account observable individual characteristics and including regional and education field dummies, as shown in column (1) of Table 2. When similar individuals with respect to location, level and field of education, and years of experience and job tenure are compared, the private-public wage gap turns positive and equals 10.2%. As shown in the descriptive statistics in Table 1, public sector workers are

positively selected in particular with respect to the level of education. The composition of the workforce must be taken into account for a sensible comparison of private and public sector wages. The effect of work experience on wages is non-linear. Wages increase with experience for the first 21 years, and one extra year of experience adds 2.1% to wages calculated at average experience (8.8 years).

Table 2 about here

In a further investigation of the selection, we expand the model to account for unobserved characteristics of the individuals using worker fixed effects. In this case, shown in column (4) of Table 2, the average gap is reduced to 4.4%. Using worker fixed effects, the private-public wage gap is identified by the shifters between the two sectors. The straightforward interpretation of the drop in the wage gap compared to only controlling for observable characteristics is that workers are negatively selected to the public sector with respect to unobservable abilities. However, we must take into account that the wage systems are different and wages in the public sector do not necessarily reflect productivity. Consistent with the literature, the return to experience is much higher when worker fixed effects are included. The standard understanding is that there is a negative correlation between ability and experience.

Given the importance of education, we construct separate analyses of low-educated and high-educated workers. The estimates show that selection effects with respect to other variables than education level are small. The raw wage gap for low-educated workers is 1.2%, consistent with the descriptive statistics in Table 1. When observables are included, the gap increases to 4.8%, as shown in column (2) of Table 2. Adding worker fixed effects, the private-public wage gap is 1.5% (column (5), Table 2). Overall, the low educated earn about the same in the private and the public sector when observables and unobservables are taken into account. For high-educated workers, the raw wage gap equals 15% (consistent with Table 1), and shows that the private sector offers much higher wages than the public sector for this education group. The gap is not much affected by observables, and the corrected gap is 16.5%, given in the third column of Table 2. When selection on unobservables is taken into account using the worker fixed effect model in column 6, the

estimated wage gap is reduced to 6.5%.

As a check of robustness, we study whether the direction of the sector shift matters for the static wage gap (both aggregate and for the two education groups). In aggregate, as well as for high-educated workers, the private-public wage gap is independent of whether it is estimated based on shifters from the public to the private sector, or on shifters going in the opposite direction. The aggregate static wage gap is estimated to 4.3% in both cases. For high-educated workers, the private wage premium is estimated to 6% when shifters go from the public to the private sector and to 6.7% when shifters go from the private to the public sector. For the low educated, the static wage gap is less robust with respect to the direction of the sector shift. The estimates are available from the authors.<sup>5</sup>

#### **4. Dynamic private-public wage gap**

Our contribution is the analysis of dynamic differences between sectors as workers may accumulate more valuable experience in the private sector. The register data allow us to follow workers over time, across the private-public sector divide, and across locations. The static and dynamic components of the private wage premium are estimated taking into account unobserved worker heterogeneity.

The gain from shifting to the private sector is affected by the return to accumulated experience in the private compared to the public sector. To study the dynamic wage gap, we expand the model to allow for different returns to experience in the private and the public sector, based on equation (2) in section 2. The wage equation includes total work experience, and separates out years of private sector experience (all experience variables include quadratic terms), while controlling for job tenure, as well as year, regional, and worker fixed effects. The model is estimated for all workers and separately for low-educated and high-educated workers, as documented in Table 3.

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<sup>5</sup> A set of tables describing alternative model specifications is available as an external online appendix: <https://sites.google.com/site/hildegunnestokke/>.

When we consider all workers, the average immediate economic gain from shifting to the private sector is 4.2%, about the same as the estimated effect without controlling for private sector experience (see column 4, Table 2). First-year return to experience in the public sector is 7.9%, while first-year private sector return to experience adds one percentage point. The effect of having experience from the private sector is of economic importance, and given the average experience of 8.8 years for all workers, the dynamic effect adds to the private wage premium. The total wage gap is 8.2%, consisting of a static effect of 4.2% and an experience effect of 4%. The dynamic effect counts for almost half the total private wage premium.

Table 3 about here

While the calculated dynamic wage gap is based on the average years of experience in the data, Figure 1 shows the trajectories of the private wage premium for workers during the first 10 years after the shift to the private sector. The dotted line measures the average development of the premium for all workers. The starting point of the curve is the static premium of 4.2% and the premium curve is upward sloping and concave. The total gap of 8.2% is calculated at the average 8.8 years of experience.

Figure 1 about here

In the literature about private-public wage gaps, the worker experience is sometimes included as a control variable. Postel-Vinay and Turon (2007) estimate the return to aggregate potential experience for stayers in the two sectors in the UK and find a first-year return of 6.6% in the private sector and 4.3% in the public sector. They use the age of workers to calculate potential experience, while we analyze the effect of actual work experience dependent on the sector where it is accumulated. Morikawa (2016) estimate the return to tenure in Japan and find first-year returns of 2.2% in the private sector and 1.75% in the public sector. In an analysis for Finland, Maczulskij and Pehkonen (2011) find similar return to experience in the two sectors. None of the studies we know of observes individual experience by sector over time or tries to measure the role of the dynamic private-public wage gap.

The return to experience for low-educated and high-educated workers is documented in columns 2 and 3 of Table 3, respectively. The heterogeneity with respect to education is important also for the dynamic gain of the public-private shift. The low educated have an immediate gain of 1.6% by shifting to the private sector, while the dynamic effect is close to zero. For low-educated workers, the return to experience is not higher in the private sector. The high educated have higher return to experience in the private than in the public sector, in addition to the static wage premium from shifting sector. The first-year return to experience is 2.1 percentage points higher in the private sector, while the second order term is negative indicating somewhat lower return over time. The static private wage premium equals 5.9% for high-educated workers, and increases to 17.7% when the more valuable private experience is taken into account. The dynamic effect counts for 2/3 of the private-public wage premium for the high educated. The private wage premium trajectories for the two education groups are shown in Figure 1 and confirm the stark differences of the dynamic gaps with respect to the level of education.

As an alternative approach to unobserved heterogeneity we apply the standard Altonji-Shakotko instrumentation of experience and tenure. In this case, worker fixed effects are excluded, and we add the level and field of education as additional control variables. As explained in section 2, the instruments used for overall experience and experience in the private sector are their deviations from individual means, while job tenure is instrumented by its deviation from job means. Table A.1 in the appendix documents the first stage regressions for all workers, while the second stage results are reported in Table 4 (both aggregate and separately for the two education groups). Since worker fixed effects are excluded, the estimated static private-public gap is higher than in Table 3, and the IV-estimation can be seen as a robustness on the dynamic effect following from higher return to experience accumulated in the private sector. The  $F$ -statistic for the first stage estimation is extremely high and clearly above the rule of thumb for weak instruments in the test suggested by Stock and Yogo (2005). The high  $F$ -value is also seen in other analysis using the Altonji-Shakotko instrumentation (see for instance Sulis, 2014). The LM test with a null hypothesis of underidentification gives a clear rejection, with a  $p$ -value of 0.000.

Table 4 about here



The IV-estimates on the returns to experience and tenure must be compared to the corresponding OLS estimates, which are given in Table A.2 in the appendix. As expected, IV estimation produces higher returns to experience and lower returns to job tenure, compared to OLS estimation. The difference between low-educated and high-educated workers remains the same. Our main result is the additional return to private experience for high-educated workers, estimated to 2.1 percentage points in the fixed effect model in Table 3 (column 3). Using the instruments for experience and tenure, the same estimate is 1.9 percentage points, as seen from column (3) of Table 4 (up from one percentage point with OLS estimation). The magnitude of the dynamic experience effect for high-educated workers is consistent with the fixed effects results. For the low educated, the return to experience is about the same in the private and the public sector, again consistent with the findings in Table 3. The Altonji-Shakotko instruments can have bias when there is correlation between experience and job-match. The understanding of Dustmann and Pereira (2008) is that the estimates give upper bound for return to experience and lower bound for return to tenure.

In an extension of the analysis of the dynamic gap, we investigate whether it matters where the private sector experience is used, or in other words, whether the dynamic experience effect is portable across sectors. An interaction term between years of private experience and an indicator for currently working in the private sector is added (also for the squared experience term). The results are shown in Table 5. We focus on high-educated workers, for whom we have identified a positive dynamic effect from private sector experience.<sup>6</sup> The estimates in column (3) show that the first-year return to private sector experience is 11.2% and 11.7% when used in the public and private sector, respectively. Although the difference of 0.5 percentage points is significant at the 5% level, the findings imply that most of the additional value of experience accumulated in the private sector is portable across sectors. The result is consistent with the analysis of the urban wage premium by De la Roca and Puga (2017, p. 3). They find that ‘where workers acquire experience matters more than where

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<sup>6</sup> For low-educated workers, the estimations in Table 3 show that the return to experience is about the same in the private and the public sector. As seen from column (2) of Table 5, this is still the case as long as the private experience is used in the private sector. When experience accumulated in the private sector is used in the public sector, the return for low-educated workers is lower.

they use it'. While they study the geographical dimension of where experience is used, we emphasize the portability between the private and the public sector.

Table 5 about here

A limitation of our analysis is that we only have worker experience data dating back to 1993, which is not the full history of experience for many workers. The analysis is repeated for a sample of workers for whom we have the full history of experience (workers born after 1967). The main results regarding the higher return to experience in the private sector for the high educated and the lower gain from shifting to the private sector for low-educated workers remain. The extra return to experience in the private compared to the public sector is larger in this sample of young workers. The higher return may reflect a cohort effect or a higher effect early in a worker's career, since the measurement error is expected to overestimate the effect of experience when all workers are included. The estimates are available in the external online appendix (see footnote 5). Future analysis of potential heterogeneities across cohorts are of interest.

## **5. The role of geography and public employment share of local labor markets**

The private-public wage gap typically varies across regional labor markets. Public wages are often based on a national pay scale and are equalized across the country, while private wages reflect regional variation in labor market conditions. Another aspect is the influence of the public sector in the local labor market. When public employment account for a large share of total employment, the public sector as employer may enjoy monopsony power and hold back public wages.

We study the importance of economic geography, separating between private sector wage premium in city regions (above 150,000 inhabitants) and the rest of the country, as documented in Table 6. Overall, the static private-public wage gap is 3.9 percentage points higher in cities (as seen from the first column of Table 6). The public sector wage

compression has a geographical aspect and in cities, private wages are much higher than public wages. The dynamic component of the private wage premium also differs between cities and the rest of the country. Outside the city regions, the aggregate static wage gap equals 2.5%, which increases to 3.8% when the dynamic effect is added (calculated at the average years of experience). In cities, the static wage gap of 6.4% almost doubles to 12.5% when the more valuable private sector experience is taken into account. The dynamic effect is mainly a city phenomenon.

Table 6 about here

Columns (2) and (3) of Table 6 run separate regressions for low- and high-educated workers. Low-educated workers outside the city regions face a static private-public gap of 0.8%, significant at the 10% level, while the return to experience is about the same in the two sectors. For low-educated workers in cities, the static private-public gap is 3.3%, which increases to 5.8% when the higher return to private experience in cities is taken into account. For the high educated, the static private-public gap equals 8.1% in cities compared to 3.7% in the rest of the country. The dynamic component of the private wage premium is also higher in cities. The extra first-year return to private experience for high-educated workers is 1.6 percentage points, and then an additional 0.9 percentage point in the cities. The return to public sector experience does not have this geographical pattern. For high-educated workers, the total private-public wage gap equals 13.1% and 21% in the rest of the country and in city regions, respectively.

A consequence of these findings is that the private sector wage premium trajectories depend on the geographical location of workers. While the calculated wage gaps above are based on the average years of experience in the data, Figure 2 shows the trajectories of the private wage premium for workers in cities and the rest of the country during the first 10 years after the shift to the private sector. For high-educated workers outside cities, the private wage premium starts at 3.7% (the static private sector effect) and increases gradually to 13.7% after 10 years, whereas the private wage premium of high-educated workers in cities increases from 8.1% to 21.4% (calculated based on the estimated coefficients of experience in column 3 of Table 6). The static private-public wage gap is higher in cities and

the difference between city regions and the rest of the country increases over time. The return to experience is higher in the private sector, and in particular when the experience is accumulated in cities. For low-educated workers in cities, the private wage premium increases from 3.3% initially to 5.6% after 10 years. The return to experience is higher in the private sector, but the magnitude of the effect is much smaller than for high-educated workers. When it comes to low-educated workers outside cities, the static private wage premium is close to zero, and the return to experience is somewhat higher in the public than in the private sector, leading to a small decrease in the private wage premium over time.

Figure 2 about here

The analysis adds to the understanding of the heterogeneity of the urban wage premium by sector. The static city wage premium in the private sector is 5.9% measured in this way – the higher wage in city regions above 150,000 inhabitants compared to the rest. Since worker fixed effects are included, the identification is based on movers between cities and the rest of the country. The urban premium is comparable with an analysis of the dynamic urban wage premium for Norway (Carlsen et al., 2016), but somewhat higher when industry fixed effects are excluded in this analysis of the private-public difference. The static city premium is lower for the low educated (5.1%) compared to the high educated (6.6%), also consistent with the literature. Public sector workers experience a static city wage premium of 2% on average, higher for low-educated (2.6%) than high-educated (2.2%) workers. The dynamic urban wage premium shown by De la Roca and Puga (2017) and Carlsen et al. (2016) is reproduced here for the private sector (which they study). The public sector does not add dynamic effects to the urban wage premium.

We have chosen to estimate the geographical aspect of the private wage premium by distinguishing between seven city regions with population above 150,000 and the rest of the economy. We investigate the robustness of this definition by introducing an alternative cutoff population size of 100,000 giving a city group with 13 regions. The main findings remain. Static and dynamic gains from shifting to the private sector are significantly higher in cities, both for low- and high-educated workers. The magnitude of the effects is marginally lower than with the base-run city group. The additional first-year return to private sector

experience accumulated in cities decreases from 0.8 to 0.6 percentage points for the low educated and from 0.9 to 0.8 percentage points for the high educated. As a second check of robustness, we include a separate group of small cities (between 65,000 and 150,000 inhabitants) in addition to the original city group with population above 150,000. The small city group consists of 13 regions. The static private-public wage gap in small cities lies in between the wage gap in cities and the rest of the economy. The extra gains of having private sector experience in cities are not affected by the inclusion of small city experience in the regression. For the low educated, we find no extra gain of having private sector experience in small cities. For high-educated workers, the additional first-year return to private experience is much lower when accumulated in small cities compared to cities (0.3 vs. 1 percentage point), and the small city effect is only significant at the 10% level. The findings imply that the additional return to private experience accumulated in cities is primarily concentrated to the largest cities. The estimates are available in the external online appendix (see footnote 5).

In a further study of spatial differences, we analyze whether the relative size of the public sector in local labor markets matters for the wage differences between the two sectors. The public sector employment share measures the relative size effect separately for low- and high-educated workers. For the high educated, the regional public employment share varies from 10% to 60% (except one outlier region with 80% share). The seven city regions all have public shares below 20%, while the average public employment share outside cities is 26.3%. Among regions outside cities, we define the public share as 'high' in regions with above-average public employment share, which accounts for 31 regions. The correlation between the public sector employment share and the population level is relatively low,  $-0.29$ . Several periphery regions with low population levels have public shares below 20% (typically regions with strong private labor markets related to shipping or aluminum). Among low-educated workers, the public employment share is much lower. The public share varies from 2% to 20% (except one outlier region with 40% share). The city regions have public shares in the range 4–6%, and the average share in the rest of the country is 6.1%. We define 'high' public employment share as regions with above-average public share, which includes 26 regions. For the low educated, the correlation between the public employment share and the population level equals  $-0.07$ .

We extend the analysis in Table 6 to allow the static and dynamic private-public wage gap to differ according to the public sector employment share of the local labor market. The estimation results are given in Table 7, separating between low- and high-educated workers. For both education groups, the static private wage premium is still highest in city regions (where the public employment share is low). In the rest of the country, the static wage gap is significantly lower in regions with above-average public share than in regions with below-average public share. For low-educated workers, the static private-public wage gap equals 3.3% in cities, while in the rest of the country, the wage gap equals 2.2% and -1.5% in regions with low and high public employment share, respectively. This implies that for low-educated workers in regions with high public share, the private-public wage gap is in favor of public sector workers. For high-educated workers, the static private-public wage gap equals 8.2%, 4.7% and 1.4% in cities, rest of country regions with low public employment share and rest of country regions with high public employment share, respectively. For the high educated, there is no significant difference in public sector wages between regions with high and low public employment share, which implies that the lower private-public wage gap in regions with high public share is due to relatively lower private wages in these regions (weak private labor market).

Table 7 about here

For high-educated workers, the share of public employment in the local labor market does not affect the dynamic component of the private wage premium (conditional on allowing the return to experience to vary between city regions and the rest of the country). The additional return from private experience is still higher in cities than in the rest of the country, and among regions outside cities, the additional return from experience accumulated in the private sector is similar in regions with low and high share of public employment. For low-educated workers, the dynamic private-public wage gap depends on the share of public employment in the local labor market. In cities (where the public share is low), the additional first-year return to private sector experience equals 0.7 percentage points (consistent with the findings in Table 6). In regions outside cities with low public share, the return to private and public sector experience is about the same, while in regions

with high public share, experience accumulated in the private sector offers 0.5 percentage points lower first-year return compared to public sector experience. In these regions, the static private-public wage gap is negative (as discussed above), and taking the different returns to experience into account, the wage difference between private and public sector workers increases over time, but now in favor of public employees. Calculated at the average years of experience, the total private-public gap among low-educated workers in regions with high public share equals  $-5.7\%$  (when the dynamic effect is added). The implied trajectories of the private wage premium the first 10 years after the shift to the private sector are illustrated in Figure 3, separating between cities, regions outside cities with low public share, and regions outside cities with high public share.

Figure 3 about here

We investigate the robustness of the results by varying the threshold level of the public employment share that defines a region to have ‘high’ public share. There is no exact cutoff point, but alternative classifications of high public share produce the same results. We start out separating below- and above-average public shares and then study alternatives. For both education groups, the static private-public wage gap is lowest in regions with high public employment share under a broad set of thresholds. In regions outside cities with heavy public sector presence, low-educated workers have higher return to experience accumulated in the public sector compared to the private sector. In the base-run regression, the threshold is set at the average public share of 6.1% (giving 26 regions with high share). Increasing the threshold to 7% (16 regions remaining) or 8% (14 regions remaining) does not affect the magnitude or significance of the effect. Setting the threshold at 9% (12 regions remaining), the effect is cut in half and is no longer significant. For the high educated, the additional return from experience accumulated in the private sector is similar in regions with low and high share of public employment. In the base-run regression, the threshold is set at the average public share of 26.3% (giving 31 regions with high share), while the robustness is checked for thresholds at 20% (52 regions), 30% (21 regions), and 35% (13 regions). The estimates related to threshold levels of 8% and 30% for low- and high-educated workers, respectively, are available in the external online appendix (see footnote 5).

We conclude that high public employment share in local labor markets reduces the static private-public gap for both education groups and the dynamic gap for the low educated. The result is contrary to the monopsony hypothesis. Our understanding is that the public employment share is high in areas with weak private labor markets.

## 6. Concluding remarks

We investigate the private-public wage gap using rich register data for Norway. The starting point is a panel analysis extended to include dynamic effects of experience. Corrected for individual observable and unobservable characteristics and taking into account the return to experience for average length of experience, we find that the experience effect represents 2/3 of the combined static and dynamic wage gap of 17.7% for high-educated workers. The low educated gain less from shifting to the private sector and have no additional gain in return to experience. Instrumentation of experience and tenure based on the Altonji-Shakotko method confirms the size of the dynamic effects. We further allow the value of private experience to vary depending on the sector where it is currently used. The estimated returns show that for high-educated workers, the additional value of experience accumulated in the private sector is portable across sectors.

There is also a geographical aspect of the private wage premium. Overall, the static private-public wage gap is about 4 percentage points higher in cities than in the rest of the country and the dynamic private premium (following higher return to private sector experience) is also higher in cities. High public employment share in local labor markets is shown to reduce the private-public gap by holding back private wages.

The private-public wage gap is important to understand wage inequality and regional labor markets. The public sector compresses the wage distribution by holding down wages for high-educated workers and reduces regional wage inequalities by allowing higher private-public gaps in cities.

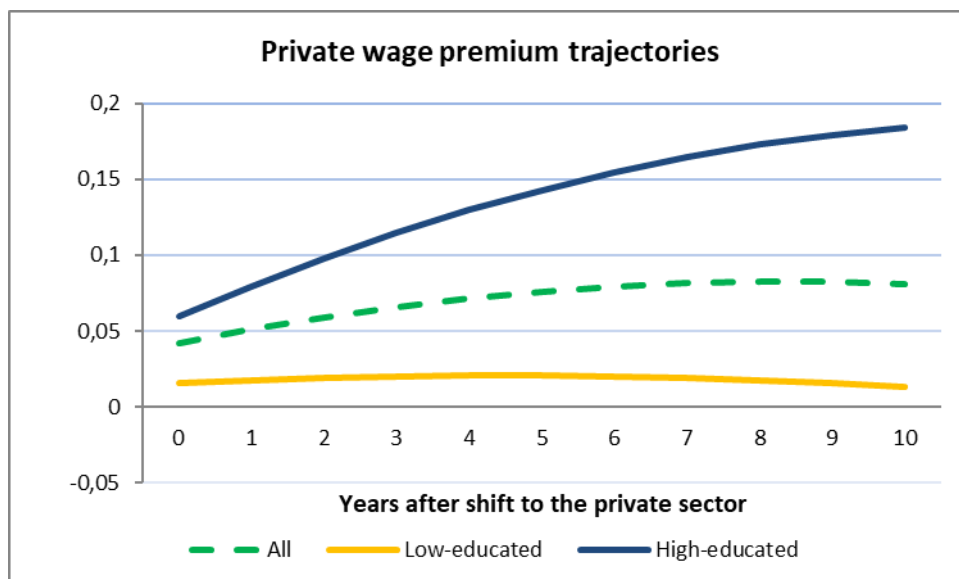


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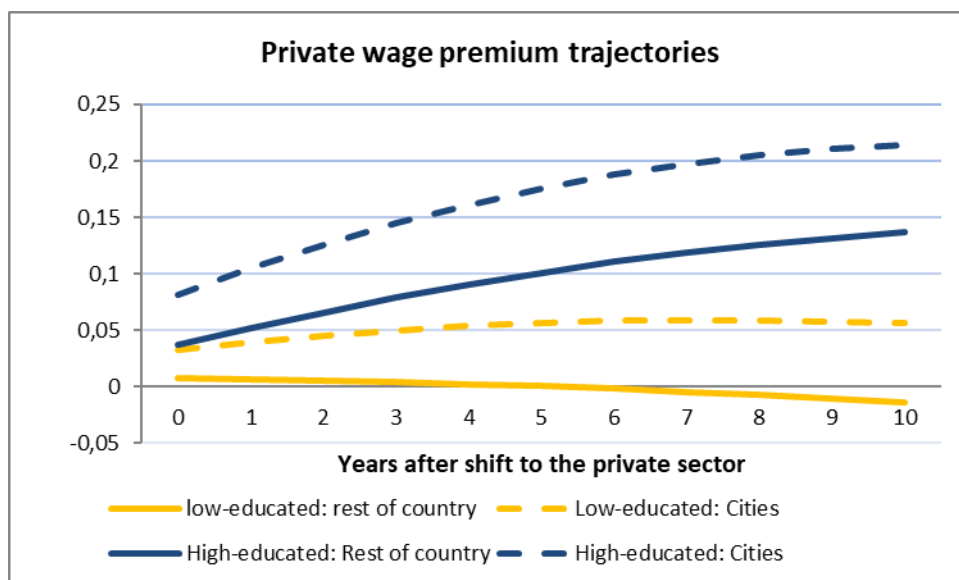
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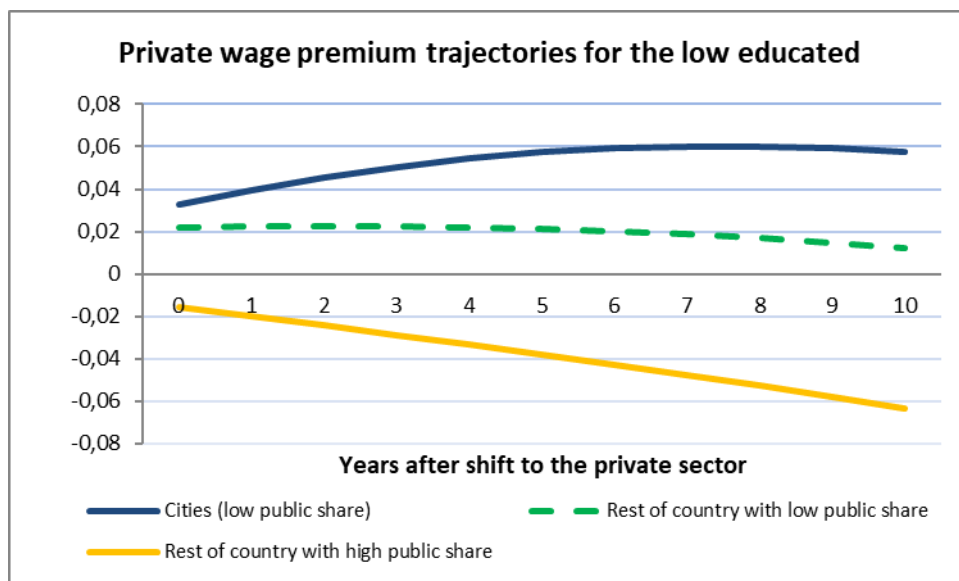
**Figure 1.** Private sector wage premium trajectories for low- and high-educated workers, years after shift to the private sector



**Figure 2.** Private sector wage premium trajectories for low- and high-educated workers in cities and the rest of the country, years after shift to the private sector



**Figure 3.** Private sector wage premium trajectories for low-educated workers dependent on the public employment share in the local labor market, years after shift to the private sector



**Table 1.** Descriptive statistics

	All workers	Private stayers	Public stayers	Shifters private → public	Shifters public → private
Mean log hourly wages (in 2010 NOK)					
All workers	5.583	5.581	5.595	5.575	5.613
Low-educated workers	5.506	5.507	5.496	5.462	5.487
High-educated workers	5.794	5.825	5.675	5.683	5.703
Work experience (in years)					
All workers	8.8	8.7	9.9	9.9	8.6
Low-educated workers	8.8	8.7	10.2	10.1	8.7
High-educated workers	8.8	8.6	9.7	9.7	8.5
Job tenure (in years)					
All workers	4.5	4.4	5.7	4.1	2.9
Low-educated workers	4.6	4.6	6.4	4.1	3.0
High-educated workers	4.2	4.1	5.2	4.1	2.8
Age (in years)					
All workers	42.0	41.6	45.6	43.9	39.7
Low-educated workers	42.0	41.7	47.3	44.0	40.6
High-educated workers	41.8	41.4	44.2	43.8	39.1
City resident (share)					
All workers	0.409	0.409	0.399	0.414	0.454
Low-educated workers	0.359	0.360	0.340	0.363	0.341
High-educated workers	0.548	0.573	0.446	0.462	0.535
Low-educated (share)					
All workers	0.734	0.767	0.446	0.490	0.416

Notes: We separate between workers that remain in the private sector during 2001–2010 ('private stayers'), workers that remain in the public sector ('public stayers'), and workers that change sector during the period ('shifters'). Work experience and job tenure are calculated based on actual days worked from 1993 onwards (overall and at the worker's present firm), expressed in years. Low-educated workers have high school education or less, while high-educated workers have at least one year at college or university. City residents are defined as workers that are located in a city region with at least 150,000 inhabitants in 2010 (which includes 7 out of 89 regions).

**Table 2.** Estimation of static private-public wage gap

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Log hourly wage	Log hourly wage	Log hourly wage	Log hourly wage	Log hourly wage	Log hourly wage
Education group	All	Low-educated	High-educated	All	Low-educated	High-educated
Estimation method	OLS	OLS	OLS	FE	FE	FE
Private	0.102*** (0.0012)	0.048*** (0.0017)	0.165*** (0.0018)	0.044*** (0.0024)	0.015*** (0.0037)	0.065*** (0.003)
Experience	0.035*** (0.0002)	0.029*** (0.0003)	0.055*** (0.0004)	0.088*** (0.0007)	0.077*** (0.0008)	0.112*** (0.0015)
(Experience) <sup>2</sup>	-0.0008*** (0.0000)	-0.0007*** (0.0000)	-0.0014*** (0.0000)	-0.0015*** (0.0000)	-0.0013*** (0.0000)	-0.0022*** (0.0000)
Job tenure	-0.003*** (0.0002)	-0.003*** (0.0002)	-0.001*** (0.0003)	-0.005*** (0.0001)	-0.005*** (0.0002)	-0.005*** (0.0003)
(Job tenure) <sup>2</sup>	0.0000 (0.0000)	0.0001*** (0.0000)	-0.0001*** (0.0000)	0.0002*** (0.0000)	0.0002*** (0.0000)	0.0003*** (0.0000)
Secondary education	0.149*** (0.0016)	0.149*** (0.0016)				
Short higher edu.	0.368*** (0.002)					
Long higher edu.	0.509*** (0.0022)		0.141*** (0.0016)			
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Edu. field dummies	Yes	Yes	Yes	No	No	No
Worker fixed effects	No	No	No	Yes	Yes	Yes
Observations	4,655,281	3,416,899	1,238,382	4,655,281	3,416,899	1,238,382
Workers	733,460	541,286	192,174	733,460	541,286	192,174
Public stayers	56,683	25,870	30,813	56,683	25,870	30,813
Private stayers	661,272	508,374	152,898	661,272	508,374	152,898
Shifters	15,505	7,042	8,463	15,505	7,042	8,463
R <sup>2</sup>	0.26	0.15	0.27	0.77	0.73	0.79

Notes: Robust standard errors (clustered by workers) are given in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10 percent level, respectively. All regressions include a constant term.

**Table 3.** Estimation of static and dynamic private-public wage gap

	(1)	(2)	(3)
Dependent variable	Log hourly wage	Log hourly wage	Log hourly wage
Education group	All	Low-educated	High-educated
Estimation method	FE	FE	FE
Private	0.042*** (0.0024)	0.016*** (0.0037)	0.059*** (0.003)
Experience	0.079*** (0.0009)	0.075*** (0.0012)	0.095*** (0.0017)
(Experience) <sup>2</sup>	-0.001*** (0.0000)	-0.001*** (0.0000)	-0.0016*** (0.0000)
Private experience	0.01*** (0.0006)	0.002** (0.0009)	0.021*** (0.0008)
(Private experience) <sup>2</sup>	-0.0006*** (0.0000)	-0.0003*** (0.0000)	-0.0009*** (0.0000)
Job tenure	-0.005*** (0.0001)	-0.005*** (0.0002)	-0.005*** (0.0003)
(Job tenure) <sup>2</sup>	0.0002*** (0.0000)	0.0002*** (0.0000)	0.0004*** (0.0000)
Year dummies	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes
Observations	4,655,281	3,416,899	1,238,382
R <sup>2</sup>	0.77	0.73	0.79

Notes: Robust standard errors (clustered by workers) are given in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10 percent level, respectively. All regressions include a constant term.

**Table 4.** Robustness on the dynamic experience effect: Instrumenting experience and tenure

	(1)	(2)	(3)
Dependent variable	Log hourly wage	Log hourly wage	Log hourly wage
Education group	All	Low-educated	High-educated
Estimation method	IV	IV	IV
Private	0.091*** (0.003)	0.064*** (0.0051)	0.098*** (0.0037)
Experience	0.035*** (0.0007)	0.031*** (0.0011)	0.053*** (0.0008)
(Experience) <sup>2</sup>	-0.0009*** (0.0000)	-0.0009*** (0.0000)	-0.0015*** (0.0000)
Private experience	0.007*** (0.0007)	-0.001 (0.0011)	0.019*** (0.0009)
(Private experience) <sup>2</sup>	-0.0005*** (0.0000)	-0.0002*** (0.0000)	-0.0008*** (0.0000)
Job tenure	-0.004*** (0.0002)	-0.003*** (0.0002)	-0.004*** (0.0003)
(Job tenure) <sup>2</sup>	0.0002*** (0.0000)	0.0001*** (0.0000)	0.0004*** (0.0000)
Secondary education	0.15*** (0.0007)	0.151*** (0.0007)	
Short higher education	0.369*** (0.0009)		
Long higher education	0.509*** (0.001)		0.147*** (0.0008)
Year dummies	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes
Edu. field dummies	Yes	Yes	Yes
Worker fixed effects	No	No	No
F-value first stage	69,662	39,289	22,112
P-value LM test underident.	0.000	0.000	0.000
Observations	4,655,281	3,416,899	1,238,382
R <sup>2</sup>	0.26	0.15	0.27

Notes: The regressions give the second stage IV estimations when experience, private experience and tenure are instrumented. The first stage estimations are given in Appendix Table A.1. Standard errors are given in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10 percent level, respectively. All regressions include a constant term.



**Table 5.** Portability of the dynamic experience effect

Dependent variable	(1) Log hourly wage	(2) Log hourly wage	(3) Log hourly wage
Education group	All	Low-educated	High-educated
Estimation method	FE	FE	FE
Private	0.009* (0.0049)	-0.062*** (0.0087)	0.034*** (0.0056)
Experience	0.079*** (0.0009)	0.074*** (0.0012)	0.095*** (0.0017)
(Experience) <sup>2</sup>	-0.001*** (0.0000)	-0.001*** (0.0000)	-0.0015*** (0.0000)
Private experience	0.004*** (0.0017)	-0.016*** (0.0027)	0.017*** (0.0021)
(Private experience) <sup>2</sup>	-0.0006*** (0.0001)	0.0004** (0.0002)	-0.0009*** (0.0002)
Private experience x now in private	0.006*** (0.0016)	0.019*** (0.0025)	0.005** (0.0021)
(Private experience) <sup>2</sup> x now in private	-0.0000 (0.0001)	-0.0007*** (0.0002)	0.0000 (0.0002)
Job tenure	-0.005*** (0.0001)	-0.005*** (0.0002)	-0.005*** (0.0003)
(Job tenure) <sup>2</sup>	0.0002*** (0.0000)	0.0002*** (0.0000)	0.0004*** (0.0000)
Year dummies	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes
Observations	4,655,281	3,416,899	1,238,382
R <sup>2</sup>	0.77	0.73	0.79

Notes: Robust standard errors (clustered by workers) are given in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10 percent level, respectively. All regressions include a constant term.

**Table 6.** The role of geography

Dependent variable	(1) Log hourly wage	(2) Log hourly wage	(3) Log hourly wage
Education group	All	Low-educated	High-educated
Estimation method	FE	FE	FE
Private	0.025*** (0.0027)	0.008* (0.0042)	0.037*** (0.0034)
Private x city	0.039*** (0.0029)	0.025*** (0.0053)	0.044*** (0.0036)
City	0.02*** (0.0028)	0.026*** (0.0052)	0.022*** (0.0033)
Experience	0.078*** (0.001)	0.076*** (0.0013)	0.094*** (0.0018)
(Experience) <sup>2</sup>	-0.001*** (0.0000)	-0.0011*** (0.0000)	-0.0016*** (0.0000)
Private experience	0.005*** (0.0007)	-0.001 (0.0011)	0.016*** (0.001)
(Private experience) <sup>2</sup>	-0.0004*** (0.0000)	-0.0001*** (0.0000)	-0.0006*** (0.0000)
Experience in city	0.003*** (0.001)	-0.003 (0.0017)	0.002 (0.0012)
(Experience in city) <sup>2</sup>	-0.0001 (0.0000)	0.0001* (0.0001)	0.0000 (0.0001)
Private exp. in city	0.009*** (0.001)	0.008*** (0.0017)	0.009*** (0.0013)
(Private exp. in city) <sup>2</sup>	-0.0004*** (0.0000)	-0.0004*** (0.0001)	-0.0005*** (0.0001)
Job tenure	-0.005*** (0.0001)	-0.005*** (0.0002)	-0.005*** (0.0003)
(Job tenure) <sup>2</sup>	0.0002*** (0.0000)	0.0002*** (0.0000)	0.0004*** (0.0000)
Year dummies	Yes	Yes	Yes
Regional dummies	No	No	No
Worker fixed effects	Yes	Yes	Yes
Observations	4,655,281	3,416,899	1,238,382
R <sup>2</sup>	0.77	0.72	0.79

Notes: The city group is defined as regions with more than 150,000 inhabitants in 2010, which includes 7 out of 89 regions. Robust standard errors (clustered by workers) are given in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10 percent level, respectively. All regressions include a constant term.

**Table 7.** The role of public sector employment share

Dependent variable	(1)	(2)
Education group	Log hourly wage	Log hourly wage
Estimation method	Low-educated	High-educated
	FE	FE
Private	0.022*** (0.0048)	0.047*** (0.0039)
Private x City	0.011* (0.0059)	0.035*** (0.004)
Private x High public share	-0.037*** (0.0067)	-0.033*** (0.0057)
City	0.034*** (0.0059)	0.024*** (0.0037)
High public share	0.017** (0.0066)	0.003 (0.0049)
Experience	0.075*** (0.0015)	0.096*** (0.0018)
(Experience) <sup>2</sup>	-0.0011*** (0.0001)	-0.0016*** (0.0000)
Private experience	0.001 (0.0014)	0.015*** (0.0012)
(Private experience) <sup>2</sup>	-0.0002*** (0.0001)	-0.0005*** (0.0001)
Experience in city	-0.002 (0.0018)	0.000 (0.0012)
(Experience in city) <sup>2</sup>	0.0001 (0.0001)	0.0000 (0.0001)
Private exp. in city	0.007*** (0.0018)	0.01*** (0.0014)
(Private exp. in city) <sup>2</sup>	-0.0003*** (0.0001)	-0.0006*** (0.0001)
Experience in regions with high public share	0.001 (0.002)	-0.005*** (0.0015)
(Experience in regions with high public share) <sup>2</sup>	-0.0001 (0.0001)	0.0002** (0.0001)
Private exp. in regions with high public share	-0.005** (0.0021)	0.002 (0.0019)
(Private exp. in regions with high public share) <sup>2</sup>	0.0001 (0.0001)	-0.0001 (0.0001)
Job tenure	-0.005*** (0.0002)	-0.005*** (0.0003)
(Job tenure) <sup>2</sup>	0.0002*** (0.0000)	0.0004*** (0.0000)
Year dummies	Yes	Yes
Regional dummies	No	No
Worker fixed effects	Yes	Yes
Observations	3,416,899	1,238,382
R <sup>2</sup>	0.73	0.79

Notes: The public share is defined as 'high' in regions with public employment share above the average 6.1% for the low educated (26 regions) and the average 26.3% for the high educated (31 regions). All city regions have low public employment share. Robust standard errors (clustered by workers) are given in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10 percent level, respectively. All regressions include a constant term.

## APPENDIX: Additional tables

**Table A.1**

First stage regressions (all workers), corresponding to column (1) of Table 4

Dependent variable	(1) Experience	(2) (Experience) <sup>2</sup>	(3) Private exp	(4) (Private exp) <sup>2</sup>	(5) Tenure	(6) (Tenure) <sup>2</sup>
DExp	1.825*** (0.0065)	8.703*** (0.1043)	0.969*** (0.0065)	10.771*** (0.101)	0.627*** (0.0066)	6.244*** (0.0877)
DExpsq	0.0003 (0.0003)	1.017*** (0.0044)	-0.0051*** (0.0003)	-0.056*** (0.0042)	-0.018*** (0.0003)	-0.173*** (0.0037)
DPrivExp	0.072*** (0.0063)	1.011*** (0.1016)	0.881*** (0.0063)	-1.344*** (0.0984)	0.198*** (0.0064)	2.336*** (0.0854)
DPrivExpsq	-0.0029*** (0.0003)	-0.0417*** (0.0044)	0.004*** (0.0003)	1.047*** (0.0043)	-0.01*** (0.0003)	-0.112*** (0.0037)
DTenure	-0.054*** (0.0021)	-0.557*** (0.0341)	-0.052*** (0.0021)	-0.618*** (0.033)	1.305*** (0.0021)	2.834*** (0.0286)
DTenuresq	0.0001 (0.0001)	-0.001 (0.002)	-0.0003*** (0.0001)	-0.0029 (0.0019)	0.0106*** (0.0001)	1.111*** (0.0017)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Edu. field dummies	Yes	Yes	Yes	Yes	Yes	Yes
Worker fixed effects	No	No	No	No	No	No
Observations	4,655,281	4,655,281	4,655,281	4,655,281	4,655,281	4,655,281

Notes: The regressions include the private dummy, as well as controls for level of education. Standard errors are given in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10 percent level, respectively. All regressions include a constant term.

**Table A.2**

Estimation of static and dynamic private-public wage gap without worker fixed effects

Dependent variable	(1) Log hourly wage	(2) Log hourly wage	(3) Log hourly wage
Education group	All	Low-educated	High-educated
Estimation method	OLS	OLS	OLS
Private	0.055*** (0.0018)	0.003 (0.0026)	0.08*** (0.0023)
Experience	0.029*** (0.0004)	0.027*** (0.0006)	0.046*** (0.0006)
(Experience) <sup>2</sup>	-0.0008*** (0.0000)	-0.0009*** (0.0000)	-0.0015*** (0.0000)
Private experience	0.006*** (0.0004)	0.002*** (0.0006)	0.01*** (0.0006)
(Private experience) <sup>2</sup>	0.0000 (0.0000)	0.0003*** (0.0000)	0.0001*** (0.0000)
Job tenure	-0.003*** (0.0002)	-0.004*** (0.0002)	-0.002*** (0.0003)
(Job tenure) <sup>2</sup>	0.0000 (0.0000)	0.0001*** (0.0000)	-0.0001** (0.0000)
Secondary education	0.15*** (0.0016)	0.15*** (0.0016)	
Short higher education	0.369*** (0.002)		
Long higher education	0.511*** (0.0022)		0.146*** (0.0016)
Year dummies	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes
Edu. field dummies	Yes	Yes	Yes
Worker fixed effects	No	No	No
Observations	4,655,281	3,416,899	1,238,382
R <sup>2</sup>	0.26	0.15	0.27

Notes: Robust standard errors (clustered by workers) are given in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10 percent level, respectively. All regressions include a constant term.