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Regional payroll tax cuts and individual wages: Heterogeneous effects across education groups*

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Abstract

The empirical evidence on the incidence of payroll taxation is primarily based on the wage bill of firms. This paper applies matched employer-employee register data on individual wages for all private sector workers in Norway. Exploiting a payroll tax reform and using the difference-in-difference approach, I find that 1% reduction in labor costs generates 0.5% wage increase. Among low educated workers the degree of tax shifting equals 50%, while the wage response for highly educated is insignificant. Lower payroll taxes have limited effects on employment. The findings imply that the absolute value of the labor demand elasticity decreases with the level of education.

Keywords: Payroll tax cut, individual wages, heterogeneous effects, education

JEL codes: H22, J23, J31, J38

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1. Introduction

This paper exploits a payroll tax reform in Norway and applies matched employer-employee register data on individual wages to identify labor market effects of reduced payroll taxes. Existing empirical evidence on the incidence of payroll taxation is primarily based on firm-level data on the average wage bill rather than individual wages. The broad finding in the literature is that payroll tax reductions are partly shifted to employees through higher wages, while the employment response is limited. My contribution is to investigate heterogeneous wage effects of payroll tax cuts across education groups. To my knowledge, this is the first analysis of individual wage effects of lower payroll taxes based on workers' level of education.

In a study of payroll tax reform in Chile, Gruber (1997) documents full shifting of payroll taxes to wages and no significant effect on employment. Cruces et al. (2010) take advantage of regionally differentiated payroll taxes in Argentina, and find only partial tax shifting but still without any effect on employment. Based on a sample of large firms in Finland, Korkeamäki and Uusitalo (2009) find evidence of about 50% tax shifting in services and no wage effect in manufacturing. Bohm and Lind (1993) apply the difference-in-difference approach and document the lack of employment effects following a payroll tax reform in northern Sweden. In a more recent study based on Swedish firm-level data, Bennmarker et al. (2009) find that 1 percentage point reduction in the payroll tax rate increases the average wage bill per employee by about 0.25%. When accounting for entry and exit of firms, they find indications of positive employment effects while the wage effect becomes insignificant. Studies using tax variation across firms and states in the US (Gruber 1994; Anderson and Meyer 1997, 2000; Murphy 2007) find that taxes are mainly passed on to employees through wages and with limited effects on employment. Some contrarian evidence is provided by Saez et al. (2012), who take advantage of a cohort-based payroll tax reform in Greece and find that higher employer-paid payroll taxes are fully carried by the employer rather than being shifted to employees.

Existing analyses of payroll taxes in Norway include Johansen and Klette (1997), Dyrstad and Johansen (2000), Carlsen and Johansen (2005), and Gavrilova et al. (2015). Both Johansen and Klette (1997) and Gavrilova et al. (2015) are based on firm-level data and focus on the manufacturing sector. Johansen and Klette (1997) find that about 80% of payroll tax changes are shifted to employees, while the recent study by Gavrilova et al. (2015) documents 40-80% tax shifting with highest effect in large firms and in high-wage firms. Dyrstad and Johansen (2000) and Carlsen and Johansen (2005) include the payroll tax rate as control variable in regional wage equations for

manufacturing. Based on their long-run estimates, changes in payroll taxes are not shifted to employees, while short-run estimates are more mixed and indicate some degree of tax shifting.

A different literature studies the long-run impact of fiscal policies based on calibrated migration equilibrium models in the Rosen (1979) – Roback (1982) tradition. Tax reforms affect the migration incentives of households and firms, and have important implications for the long-run regional allocation of population and factors of production. Albouy (2009) has calibrated the quantitative effects of the US income tax system and documents that nominal income taxation distorts the resource allocation to the disadvantage of high-cost regions. Rattsø and Stokke (2015) follow the approach of Albouy (2009) and extend the analysis to include tax distortions due to regional variations in quality of life. The analysis documents how the income tax system in Norway distorts the regional allocation of employment and holds back urbanization. The short-run effects of payroll tax reform estimated in econometric analyses must be seen in light of the longer term effects consistent with migration equilibrium.

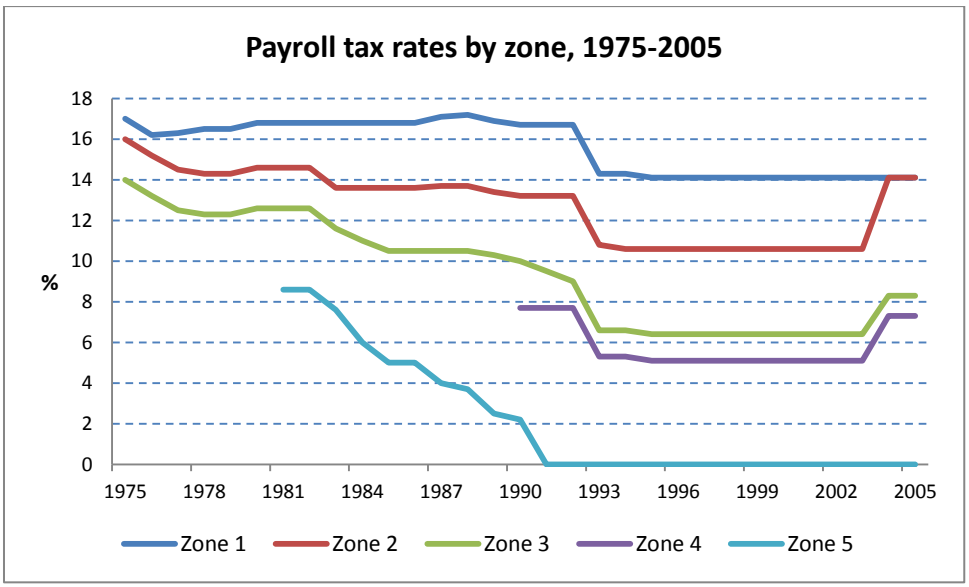
Based on matched employer-employee data during 1995-2003, I use the difference-in-difference approach to estimate the incidence of payroll taxation. I exploit the Norwegian payroll tax reform in 2000, where treatment regions face a 4.2 percentage point cut in the payroll tax rate. While the aggregate results indicate that about half the reduction in labor costs is shifted to employees through higher wages, there are important differences across sectors and education groups. Low educated workers benefit from the payroll tax reform through higher wages and the magnitude of the effect is consistent with the aggregate results. Interestingly, there is no significant wage effect among workers with tertiary education. The degree of tax shifting is estimated to about 75% in industry, while large parts of services have no significant wage effect from lower payroll taxes. This contradicts the findings by Korkeamäki and Uusitalo (2009) for Finland. Finally, the potential employment response to payroll tax cuts is investigated through analyses of firm size, number of firms, and aggregate regional employment level. Overall, employment effects are limited. The heterogeneous wage response across education groups combined with modest employment response implies that the absolute value of the labor demand elasticity decreases with the level of education.

The rest of the paper is organized as follows. Section 2 discusses the Norwegian payroll tax reform, the administrative register data on individual wages and the econometric strategy. Section 3 presents the wage effect of reduced payroll taxes, including heterogeneous effects based on workers' level of education and sector affiliation, and across firms of different sizes. Potential employment effects are investigated in section 4, while section 5 offers concluding remarks.

2. The Norwegian payroll tax reform, data and econometric strategy

Since 1975, Norway has had regionally differentiated payroll taxes at the local government level, with the intention of stimulating employment growth in the periphery. Payroll taxes are levied on employers alone, and the tax zone is determined by the employees' resident municipality, not by the firm's location. Figure 1 illustrates the development in payroll tax rates by zone during 1975-2005. Initially, there were three different zones with tax rates varying from 14% to 17%. The degree of differentiation increases over time, both with respect to number of zones and variation in tax rates. Since 1990, municipalities are divided into five different payroll tax zones, and during 1995-2003 the tax rates within each zone are constant[1]. The tax rate varies from 0% in peripheral municipalities in the most northern parts of Norway (zone 5) to 14.1% in cities in the south (zone 1). Municipalities in zones 2-4 face tax rates of 10.6%, 6.4% and 5.1%, respectively.

Figure 1: Norwegian payroll tax rates by zone, 1975-2005



I exploit a payroll tax reform enforced by the Norwegian government effective from January 1st 2000, where 53 municipalities changed tax zone.[2] I focus on 32 municipalities that went from zone 2 to zone 3 facing a 4.2 percentage point reduction in the payroll tax rate. Since municipalities are small

[1] During 2004-2006 tax rates increased gradually in zones 2-4 due to European Economic Area (EEA) regulations. In 2007, payroll taxes were again allowed to differ across regions. At the same time, the differentiation was extended to 7 regional zones and the determination of tax zone changed from employees' resident location to the firm's location.

[2] In 2000, Norway consisted of 435 municipalities. Of the 53 municipalities affected by the reform, 14 municipalities faced an increase in the payroll tax rate (moving from zone 2 to zone 1), while the remaining 39 municipalities moved to a zone with lower tax rate.

and part of larger economic regions that constitute common labor markets the analysis is performed with labor market regions as the local government level.[3] Based on information about commuting flows between municipalities, Statistics Norway divides Norway into 89 travel-to-work areas, capturing functional regions understood as common labor markets. I consider a region to be affected by the payroll tax cut if all municipalities in the region, or at least 2/3 of the region's population, are part of the change from payroll tax zone 2 to zone 3 in 2000. This gives 6 regions covering 24 of the 32 municipalities affected by the payroll tax cut.[4] The analysis focuses on the years 1995-2003, since no other payroll tax reform occurred during this period, neither to tax rates within zones or to the definition of zone borders. Importantly, no other modifications of regional policies were observed in this period, and no compensations were offered to regions not affected by the payroll tax cut.

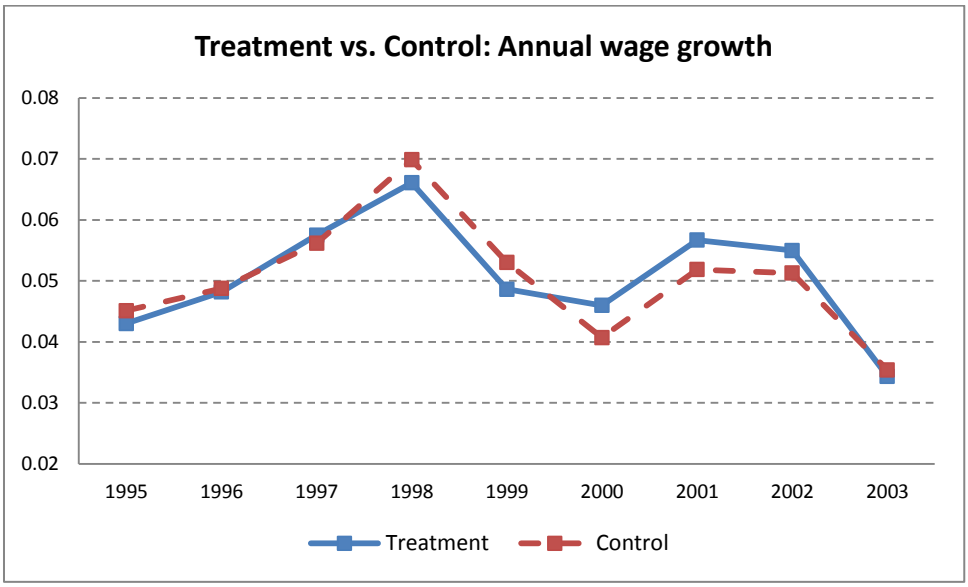
To identify the impact of the payroll tax cut, I apply administrative register data of individual wages covering all workers. The employment register links workers and firms and gives information on work contracts for all employees. It includes the number of days worked each year, which is combined with data on annual wage income from the tax register to give a measure of daily wages. I concentrate on workers between 25 and 65 years old with full-time contracts (at least 30 hours per week).[5] Workers in public and primary sectors are excluded. Worker characteristics include age, gender, level of education, immigrant status, resident location, as well as sector and firm affiliation.

The main methodological challenge is that regions affected by the payroll tax cut are not randomly chosen, but follow from a political process targeting lagging regions. Factors determining a region's tax zone include geography (distance to cities), demography (population growth, female/youth shares) and regional development (income p.c., unemployment rate). It is hard to find valid instruments for such policy changes. My approach is to use difference-in-difference estimation, where the control group is defined as regions remaining in tax zone 2 during the entire period of study (12 regions). Prior to the reform in 2000, both treatment and control regions have a payroll tax rate of 10.6%, while in the post-reform years the treatment group faces 4.2 percentage point lower tax rate than the control group. The methodological approach relies on treatment and control regions being comparable in other aspects. Figure 2 documents that the two groups of regions follow similar trends in the main outcome variable during the pre-reform period (1995-1999). The average annual wage growth varies from 4.3% to 7%, but the differences between the treatment and control

[3] As a robustness check, the analysis is also performed at the municipal level, and the findings are broadly consistent.
[4] The remaining 8 municipalities are excluded from the analysis.
[5] Workers with more than two contracts, as well as workers with one full time and one part time contract are excluded. Workers with two full time contracts are excluded if the number of days worked exceeds 455 days. This means that a maximum of 3 months overlap between the two contracts is allowed.

regions are minor. On average, pre-reform wage growth is around 0.2 percentage point higher in the control group, indicating that the estimated wage effects of reduced payroll taxes could be downward biased.

Figure 2: Average annual wage growth 1995-2003, treatment vs. control municipalities



As seen from Table 1, treatment and control regions are equal along other dimensions as well, both with respect to demography, labor market characteristics, firm size and worker characteristics. The two groups consist of sparsely populated peripheral regions facing outmigration in the years prior to the reform. The average unemployment rate during 1995-1999 is about 3% in both groups. The age and ethnic compositions of the labor force is similar across treatment and control regions, and the share of male workers is about 80% in both groups. Further, the level of education is remarkably similar; about 22-24% with primary education, 66% with secondary education, and 10-12% highly educated. The only minor difference between treatment and control regions is with respect to the sector composition. Mining and manufacturing account for a larger share of workers in the control group, while the treatment group has relatively more workers in wholesale and retail trade. But overall, the control regions seem to represent a valid counterfactual scenario for the treatment group. The final dataset includes about 275 000 worker-year observations with 70 000 residing in treatment regions and the remaining 205 000 in control regions. Workers are allocated to 13 000 different firms and 54 sectors.

Table 1. Descriptive statistics

	Treatment regions	Control regions
Individual level data		
Worker-year observations	69 075	205 769
Average annual wage growth 1995-1999	5.4%	5.5%
Average annual wage growth in 2000	4.6%	4.1%
Average annual wage growth 2001-2003	4.9%	4.6%
Average firm size (across firms)	5.0	6.2
Median firm size (across workers)	8	14
Age composition		
25-29 years old	0.1	0.103
30-34 years old	0.147	0.157
35-39 years old	0.156	0.164
40-44 years old	0.161	0.162
45-49 years old	0.153	0.149
50-54 years old	0.135	0.128
55-59 years old	0.096	0.091
60-65 years old	0.051	0.048
Ethnic composition		
Native Norwegians	0.97	0.956
Western immigrants	0.028	0.035
Non-western immigrants	0.002	0.009
Level of education		
Primary education	0.244	0.219
Secondary education	0.655	0.659
Tertiary education	0.101	0.123
Share of male workers	0.789	0.786
Sector composition		
Mining and manufacturing	0.32	0.405
Electricity, gas and water supply	0.043	0.047
Construction	0.175	0.153
Wholesale and retail trade	0.188	0.141
Business services	0.094	0.088
Other services	0.18	0.166
Regional level data		
Number of labor market regions	6	12
Average regional population size in 2000	13 576	16 290
Average annual population growth 1995-1999	-0.6%	-0.4%
Average unemployment rate 1995-1999	3.2%	3.0%

Notes: The descriptive statistics are based on yearly data during 1995-2003 for all full time workers in the private sector in 6 treatment regions and 12 control regions. Workers in primary sectors (agriculture, forestry, fishery) and public sectors (education, health care, public administration) are excluded from the dataset. The average annual wage growth refers to the annual growth rate of nominal daily wages. Western immigrants are defined as immigrants from Europe, Japan, North America, Australia or New Zealand. Secondary education corresponds to workers that have completed at least one year of secondary education, while tertiary education includes workers with at least one year at university/college. Other services mainly consist of the sectors hotels/restaurants and transport/storage/communication. Average levels of population size, population growth and unemployment rates are based on regional level data.

The main focus of this paper is to identify the impact of payroll tax cuts on individual wages. If lower payroll taxes in treatment regions stimulate in-migration of workers, the estimated wage effect can be biased due to sorting. I therefore control for observable worker characteristics in the regressions. Furthermore, I account for unobserved individual level variation in wages by focusing on workers who appear in the data in two consecutive years and using the change in log daily wages $(\Delta \ln w_{ijsrt})$ as dependent variable. Since the estimation is at the individual level, wage changes in big firms have a large weight in the estimates. An important advantage of the matched employer-employee dataset is the opportunity to control for firm-specific shocks by including firm fixed effects in the regression. The identification of wage effects of payroll taxes is based on variants of the following regression:

$$\Delta \ln w_{ijsrt} = \alpha_0 + \alpha_1 T_r + \alpha_2 P_t + \alpha_3 T_r \cdot P_t + X_{it}\delta + \gamma_j + \mu_s + \eta_r + \rho_t + \varepsilon_{ijsrt} \quad (1)$$

w_{ijsrt} is the daily wage income for worker *i* in firm *j* in sector *s* located in region *r* in year *t*, T_r is a dummy that equals 1 if the labor market region is part of the treatment group facing lower payroll tax rate, and P_t is a dummy that equals 1 in the post reform years (from 2000 onwards). The main interest is the interaction term between the treatment dummy and the dummy for post reform years. The parameter α_3 captures the difference in wage growth between treatment and control regions in the years after the payroll tax cut compared to the pre-reform period. I also consider specifications with year-specific effects, where interaction terms between the treatment dummy and each year after the reform are included. The vector of worker characteristics in year *t* (X_{it}) includes dummies for age (5-year intervals), education level (primary, secondary, tertiary), immigrant status (native, western immigrant, non-western immigrant) and gender. Firm, sector, regional and year fixed effects are represented by γ_j, μ_s, η_r and ρ_t, respectively. The error term is given by ε_{ijsrt}, α_0 is a constant and δ is a vector of parameters.

The second part of the analysis takes advantage of the matched employer-employee dataset to study the impact of lower payroll taxes on employment. The dependent variable is the growth in the number of full time workers within a firm from one year to the next $(\Delta \ln size_{jrt})$ and the estimation is based on the following difference-in-difference approach:

$$\Delta \ln size_{jrt} = \beta_0 + \beta_1 T_r + \beta_2 P_t + \beta_3 T_r \cdot P_t + \eta_r + \rho_t + \tau_{jrt} \quad (2)$$

The error term is given by τ_{jrt} and β_0 is a constant. Explanatory variables are defined above. The regression includes dummies for treatment regions and reform years, as well as regional and year fixed effects. The parameter β_3 captures the difference in firm size growth between treatment and control regions in the years after the payroll tax cut compared to the pre-reform period. To investigate if the payroll tax cut affects employment through entry and exit of firms (rather than increased firm size), I also consider potential effects on the total number of firms located in the region and on the aggregate regional employment level.

According to standard neoclassical labor market theory, lower payroll taxes imply lower labor costs and give a positive shift in the labor demand curve. In perfect market equilibrium the implication is higher employment and higher wages. The magnitude of effects depends on the elasticity of labor demand and the elasticity of labor supply. The labor demand response following the reduction in labor costs determines the size of the demand curve shift and thus the magnitude of the impact on wages and employment. For a given elasticity of labor demand, perfectly inelastic labor supply (vertical supply curve) implies that employment is unaffected while wages increase. If labor supply is perfectly elastic (horizontal supply curve), wages are unaffected while employment increases.

3. Payroll tax cuts and individual wages

Table 2 documents the impact of the payroll tax reform in 2000 on individual wages based on the difference-in-difference approach described in equation (1) in section 2. Column (1) gives the average wage growth effect of the payroll tax cut in the post-reform years. Our main interest is the interaction term between the treatment dummy and the dummy for post-reform years, which is significant at the 1% level with a coefficient of 0.005. The change in annual wage growth from the pre-reform period to the post-reform period is 0.5 percentage point higher in treatment regions compared to control regions. The interpretation is that 4.2 percentage point reduction in the payroll tax rate (equivalent to 3.8% reduction in labor costs) generates 0.5 percentage point higher wage growth per year (average effect during the post-reform years 2000-2003).[6]

[6] The 4.2 percentage point reduction in the payroll tax rate from an initial level of 10.6% corresponds to 3.8% reduction in labor costs: (1.106w – 1.064w)/1.106w = 0.038.

Table 2. Impact of payroll tax cut on individual wages

	(1)	(2)	(3)
Dependent variable	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$
Effect	Average	Year-specific	Placebo
Treatment	0.005	0.005	0.005
	(0.0073)	(0.0073)	(0.0075)
Post 2000	-0.006***		
	(0.0012)		
Treatment x Post 2000	0.005***		
	(0.0013)		
Treatment x 1996			0.000
			(0.0027)
Treatment x 1997			0.003
			(0.0027)
Treatment x 1998			-0.003
			(0.0027)
Treatment x 1999			-0.001
			(0.0027)
Treatment x 2000		0.007***	0.006**
		(0.002)	(0.0027)
Treatment x 2001		0.007***	0.007**
		(0.002)	(0.0027)
Treatment x 2002		0.005**	0.005*
		(0.002)	(0.0027)
Treatment x 2003		0.000	-0.000
		(0.002)	(0.0027)
Firm fixed effects	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Period	1995-2003	1995-2003	1995-2003
Observations	274 844	274 844	274 844
Obs. treatment	69 075	69 075	69 075
Obs. control	205 769	205 769	205 769
Adj. R^2	0.06	0.06	0.06

Notes: The regressions are based on yearly data for all full time workers in the private sector during 1995-2003 in 6 treatment regions and 12 control regions. Workers in primary and public sectors are excluded. The dependent variable is the change in log daily wages from one year to the next. All regressions include year fixed effects, regional fixed effects (18 labor market regions), sector fixed effects (2-digit level, 54 sectors), firm fixed effects (the dataset consists of 13 426 distinct firms), age controls (5-year intervals), dummies for education level, immigration status and gender, as well as a constant term. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively.

Column (2) reports year-specific effects for the post-reform period, and as expected, the effect is strongest in the first years after the reform. The wage growth effect is positive and significant during 2000-2002, while it dies out in 2003 (consistent with the pattern in Figure 2). The persistence in the wage growth effect during the first three years could reflect lags in wage adjustments. Under the assumption of equal wage levels in treatment and control regions prior to the reform, the accumulated effect in 2002 is 1.9% higher wages in treatment regions, which means that half the labor cost reduction of 3.8% is shifted to employees. The placebo test in column (3) confirms this finding. This regression is an extension of the year-specific effects model in column (2), where interaction terms between the treatment dummy and pre-reform years are included. The estimation reveals that none of the pre-reform interaction terms are significant. This confirms my assumption of equal wage growth in treatment and control regions prior to the reform, and indicates that the findings in columns (1) and (2) are not driven by long-term trends. The coefficients for the interaction terms in the post-reform years are still significant and of the same magnitude as in column (2).

The rich administrative register data on individual wages and worker characteristics allows me to investigate possible heterogeneous effects of payroll tax cuts across workers' level of education. Table 3 documents the wage effects of reduced payroll taxes for three education groups; primary, secondary and tertiary. The average effect on annual wage growth during the post-reform years is given in columns (1), (3) and (5), while year-specific effects are reported in columns (2), (4) and (6). Primary and secondary educated workers benefit from the payroll tax cut in terms of higher wages, and the magnitude of the effect is consistent with the aggregate results with about 50% tax shifting. Interestingly, there is no significant effect on wages of tertiary educated workers (neither on average nor in specific years). Placebo tests with interaction terms between the treatment dummy and pre-reform years confirm the findings of Table 3.

A possible understanding of the heterogeneity across education groups is related to differences in demand and supply elasticities in the respective labor markets. Positive and significant wage effects for low educated workers combined with limited employment response (documented in section 4) indicate elastic labor demand and inelastic labor supply for these education groups. The lack of any wage or employment effect among workers with tertiary education implies inelastic labor demand. This is consistent with empirical studies finding that the absolute value of the labor demand elasticity decreases with the level of education (Hamermesh, 1993). Low elasticity of demand (steep labor demand curve) among highly educated can be understood from capital-skill complementarity and lack of opportunities to substitute away from highly educated workers.

Table 3. Impact of payroll tax cut on individual wages by level of education

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$
Education group	Primary	Primary	Secondary	Secondary	Tertiary	Tertiary
Effect	Average	Year-specific	Average	Year-specific	Average	Year-specific
Treatment	-0.01	-0.01	0.006	0.006	0.019	0.019
	(0.0209)	(0.0209)	(0.0099)	(0.0099)	(0.0238)	(0.0238)
Post 2000	-0.023***		-0.015***		-0.001	
	(0.0027)		(0.0015)		(0.004)	
Treatment x Post 2000	0.005*		0.006***		-0.001	
	(0.0029)		(0.0016)		(0.0045)	
Treatment x 2000		0.01**		0.006**		0.007
		(0.0043)		(0.0023)		(0.0065)
Treatment x 2001		0.01**		0.007***		-0.004
		(0.0044)		(0.0024)		(0.0066)
Treatment x 2002		0.004		0.007***		-0.007
		(0.0046)		(0.0024)		(0.0066)
Treatment x 2003		-0.005		0.001		0.000
		(0.0047)		(0.0024)		(0.0067)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period	1995-2003	1995-2003	1995-2003	1995-2003	1995-2003	1995-2003
Observations	61 860	61 860	180 742	180 742	32 242	32 242
Obs. treatment	16 865	16 865	45 234	45 234	6 976	6 976
Obs. control	44 995	44 995	135 508	135 508	25 266	25 266
Adj. R^2	0.06	0.06	0.06	0.06	0.10	0.10

Notes: I separate between three subsamples according to the level of education (primary, secondary, tertiary). The dependent variable is the change in log daily wages from one year to the next. All regressions include year fixed effects, regional fixed effects (18 labor market regions), sector fixed effects (2-digit level, 54 sectors), firm fixed effects (5 418 firms in the subsample with primary educated, 10 145 and 4 235 firms in the subsamples with secondary and tertiary educated, respectively), age controls (5-year intervals), dummies for immigration status and gender, as well as a constant term. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively.

Furthermore, institutional factors like degree of union membership could contribute to the difference between low and high educated workers. Nergaard (1999) presents union densities across education groups based on the labor force survey of Statistics Norway in the 2nd quarter of 1998. The survey covers about 10 000 workers and on aggregate 57% are members of a trade union. The union density is much higher in the public sector (83%), while 43% of workers in the private sector are organized. Among private sector workers, the degree of union membership is remarkably similar across education groups (40% for primary, 44% for secondary and 43% for tertiary). This implies that differences in union density cannot explain the identified heterogeneity in wage effect of payroll tax cut across education groups.

In Table 4, I take advantage of the matched employer-employee dataset to test for heterogeneous wage effects of lower payroll taxes across firms of different sizes. The median firm size (calculated across workers, not across firms) equals 12 full time workers. I separate between small firms with firm size below the median and large firms with firm size equal to or above the median. With this classification, the number of worker-year observations is roughly similar across the two subsamples. Consistent with Gavrilova et al. (2015), the degree of tax shifting increases with firm size. As seen from the year-specific effects for large firms in column (5), the payroll tax cut leads to an accumulated effect on wages equal to 2.7%, indicating that about 70% of the labor cost reduction of 3.8% is shifted to employees. The placebo test in column (6) confirms this finding. In small firms, on the other hand, the degree of tax shifting is less than 30% and the estimated effects are not robust to the placebo test, as documented in columns (2) and (3), respectively.

Table 5 investigates if the heterogeneous wage effects across education groups identified in Table 3 are driven by differences in firm size. Could the lack of any wage response among highly educated workers be due to an overrepresentation of this education group in small firms? As seen from the year-specific effects estimated in columns (5) and (6) of Table 5, this is not the case. The payroll tax cut does not generate any significant wage effect among highly educated workers, neither in small nor in large firms. The positive wage effect among primary and secondary educated workers is mainly driven by workers in large firms, and the magnitude of effects is similar to the aggregate estimates in Table 4 with about 70% tax shifting. Overall, the limited wage response in small firms is consistent across all education groups, while the difference in wage effect between low and high educated workers is found in firms of above-median firm size.

Table 4. Impact of payroll tax cut on individual wages by firm size

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$
Firm size	< 12	< 12	< 12	≥ 12	≥ 12	≥ 12
Effect	Average	Year-specific	Placebo	Average	Year-specific	Placebo
Treatment	-0.004	-0.004	0.01	0.007	0.007	0.005
	(0.0126)	(0.0126)	(0.0144)	(0.0083)	(0.0083)	(0.0087)
Post 2000	-0.007***			-0.006***		
	(0.002)			(0.0015)		
Treatment x Post 2000	0.005**			0.006***		
	(0.002)			(0.0017)		
Treatment x 1996			-0.001			0.003
			(0.0042)			(0.0036)
Treatment x 1997			0.003			0.003
			(0.0042)			(0.0036)
Treatment x 1998			-0.006			0.002
			(0.0042)			(0.0036)
Treatment x 1999			-0.003			0.003
			(0.0042)			(0.0035)
Treatment x 2000		0.005	0.003		0.009***	0.011***
		(0.003)	(0.0042)		(0.0026)	(0.0035)
Treatment x 2001		0.005*	0.003		0.01***	0.012***
		(0.0031)	(0.0042)		(0.0026)	(0.0036)
Treatment x 2002		0.004	0.002		0.008***	0.01***
		(0.0031)	(0.0042)		(0.0027)	(0.0036)
Treatment x 2003		0.005*	0.003		-0.003	-0.000
		(0.0031)	(0.0042)		(0.0027)	(0.0037)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period	1995-2003	1995-2003	1995-2003	1995-2003	1995-2003	1995-2003
Observations	135 573	135 573	135 573	139 271	139 271	139 271
Obs. Treatment	40 002	40 002	40 002	29 073	29 073	29 073
Obs. Control	95 571	95 571	95 571	110 198	110 198	110 198
Adj. R^2	0.07	0.07	0.07	0.03	0.03	0.03

Notes: I separate between two subsamples according to firm size; firms where the number of full time workers is below the median (12 workers) and firms with above-median size. The dependent variable is the change in log daily wages from one year to the next. All regressions include year fixed effects, regional fixed effects (18 labor market regions), sector fixed effects (2-digit level, 54 sectors), firm fixed effects (13 048 firms in the subsample with small firms and 908 firms in the sample with large firms), age controls (5-year intervals), dummies for education level, immigration status and gender, as well as a constant term. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively.

Table 5. Impact of payroll tax cut on individual wages by level of education and firm size

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$
Education group	Primary	Primary	Secondary	Secondary	Tertiary	Tertiary
Firm size	< 12	≥ 12	< 12	≥ 12	< 12	≥ 12
Treatment	-0.044	-0.037	0.009	0.022*	0.018	0.014
	(0.0469)	(0.024)	(0.0153)	(0.0117)	(0.0369)	(0.0277)
Treatment x 2000	0.008	0.014**	0.004	0.007**	0.008	0.004
	(0.0071)	(0.0054)	(0.0036)	(0.0031)	(0.0097)	(0.009)
Treatment x 2001	0.008	0.014**	0.006*	0.008***	-0.009	0.012
	(0.0073)	(0.0056)	(0.0037)	(0.0031)	(0.0098)	(0.009)
Treatment x 2002	0.003	0.005	0.005	0.011***	-0.003	-0.003
	(0.0075)	(0.0059)	(0.0037)	(0.0032)	(0.0098)	(0.0089)
Treatment x 2003	0.002	-0.01	0.005	-0.001	0.008	-0.002
	(0.0077)	(0.0061)	(0.0037)	(0.0033)	(0.01)	(0.0091)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period	1995-2003	1995-2003	1995-2003	1995-2003	1995-2003	1995-2003
Observations	28 781	33 079	88 796	91 946	17 996	14 246
Obs. Treatment	8 899	7 966	26 396	18 838	4 707	2 269
Obs. Control	19 882	25 113	62 400	73 108	13 289	11 977
Adj. R^2	0.07	0.02	0.07	0.03	0.10	0.06

Notes: I separate between six subsamples according to firm size and level of education. The dependent variable is the change in log daily wages from one year to the next. All regressions include year fixed effects, regional fixed effects (18 labor market regions), sector fixed effects (2-digit level, 54 sectors), firm fixed effects, age controls (5-year intervals), dummies for immigration status and gender, as well as a constant term. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively.

In Table 6, I consider differences across sectors and separate between industry and services.[7] The estimations reveal a strong positive wage effect of reduced payroll taxes in the industrial sector. The average post-reform effect in column (1) indicates 0.7 percentage point higher annual wage growth in treatment regions compared to regions with constant payroll taxes. The year-specific estimates in column (2) show that the effect is positive and significant during the first three years after the reform. The accumulated medium-term effect is an increase in wages of 2.9%, implying that about ¾ of the labor cost reduction is shifted to employees through higher wages. The placebo test in column (3) confirms these findings. As seen from Appendix Table 1, the degree of tax shifting is significant and of the same magnitude in subsectors within the industrial sector, including manufacturing. This is consistent with Gavrilova et al. (2015), who use firm-level data for the manufacturing sector in Norway, and find that 1% increase in payroll taxes reduces the average wage bill by 0.4 – 0.8%. When

[7] The industrial sector consists of mining, manufacturing, electricity/gas/water supply and construction, while services include wholesale and retail trade, business services and other services (hotels/restaurants and transport/storage/communications). Primary (agriculture, forestry, fishery) and public (education, health care, public administration) sector workers are excluded from the dataset.

it comes to services, however, there is no significant effect on wages following the payroll tax reform. Looking at the service sector in more detail, I find indications of positive wage effects in business services (with about 35% tax shifting), but no significant effects in the other (larger) service sectors (documented in Appendix Table 1).

Table 6. Impact of payroll tax cut on individual wages by sector affiliation

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$
Sector	Industry	Industry	Industry	Services	Services	Services
Effect	Average	Year-specific	Placebo	Average	Year-specific	Placebo
Treatment	0.002	0.003	0.004	0.02	0.02	0.02
	(0.0095)	(0.0095)	(0.0098)	(0.014)	(0.014)	(0.0143)
Post 2000	-0.014***			-0.013***		
	(0.0015)			(0.0021)		
Treatment x Post 2000	0.007***			0.003		
	(0.0017)			(0.0021)		
Treatment x 1996			-0.001			0.002
			(0.0035)			(0.0043)
Treatment x 1997			0.004			0.001
			(0.0035)			(0.0044)
Treatment x 1998			-0.002			-0.005
			(0.0035)			(0.0043)
Treatment x 1999			-0.005			0.002
			(0.0035)			(0.0043)
Treatment x 2000		0.01***	0.008**		0.003	0.003
		(0.0025)	(0.0035)		(0.0031)	(0.0043)
Treatment x 2001		0.012***	0.01***		0.002	0.002
		(0.0026)	(0.0035)		(0.0031)	(0.0043)
Treatment x 2002		0.007***	0.006*		0.003	0.003
		(0.0026)	(0.0035)		(0.0032)	(0.0043)
Treatment x 2003		-0.003	-0.004		0.005	0.005
		(0.0027)	(0.0035)		(0.0032)	(0.0044)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period	1995-2003	1995-2003	1995-2003	1995-2003	1995-2003	1995-2003
Observations	161 749	161 749	161 749	113 095	113 095	113 095
Obs. treatment	37 143	37 143	37 143	31 932	31 932	31 932
Obs. control	124 606	124 606	124 606	81 163	81 163	81 163
Adj. R^2	0.05	0.05	0.05	0.08	0.08	0.08

Notes: I separate between two subsamples according to the workers' sector affiliation (industry and services). The dependent variable is the change in log daily wages from one year to the next. All regressions include year fixed effects, regional fixed effects (18 labor market regions), sector fixed effects (2-digit level, within the larger sector groups), firm fixed effects (4 601 firms in the subsample with industrial sector workers and 9 001 firms in the service sector subsample), age controls (5-year intervals), dummies for education level, immigration status and gender, as well as a constant term. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively.

The estimation results in Table 6 contradict the findings by Korkeamäki and Uusitalo (2009) for Finland, who use individual wage data for a sample of large firms. In services, they find that about 50% of the labor cost reduction following a payroll tax cut is shifted to wages, while there are no significant wage effects in manufacturing. To check whether my findings are driven by workers in small firms, I estimate wage effects for industry and services across firms of different sizes (documented in Appendix Table 2). About 2/3 of industrial sector workers are employed in large firms (at least 12 full time workers, the aggregate median firm size), but the strong wage response in industry following the reduction in payroll taxes is independent of firm size. The degree of tax shifting equals 66% and 76% in small and large firms, respectively, and the estimated effects are robust to placebo tests. In services, the majority of workers are employed in small firms (less than 12 full time workers). Consistent with Korkemäki and Uusitalo (2009), there are some indications of positive wage effects among workers in large service sector firms (less than 30% tax shifting).[8]

A possible understanding of the differences in wage effect between industry and services is related to union density. According to Nergaard (1999), 35% of private sector workers in services are part of a trade union, compared to 56% of workers in industry. In addition, different relationship to world export markets could possibly affect the opportunity and incentive of firms to shift labor cost reductions to employees.

Finally, in Table 7, I consider the wage effect of the payroll tax cut across sectors separately for each education group. Columns (1) – (3) document the year-specific effects for industrial sector workers with primary, secondary and tertiary education, respectively. Lower payroll taxes generate significant wage increases for all education groups, but the magnitude of the effect is highest among low educated workers with close to 100% tax shifting. Among workers with secondary education, wage growth during 2000-2002 is significantly higher in treatment regions with an accumulated wage effect equal to 2.5%, indicating that about 2/3 of the reduced labor costs are shifted to employees. Even highly educated workers in the industrial sector seem to benefit from the payroll tax cut. The wage effect in the reform year indicates that workers in treatment regions have 1.7 percentage points higher wage growth compared to regions with constant payroll taxes (about 45% tax shifting), although the effect is only significant at the 10% level. The average effect during the post-reform years is however not significant for this education group. The lack of any wage effect in services is consistent across education groups, as documented in columns (4) – (6).

[8] Among small-firm workers in services, the wage response from lower payroll taxes is insignificant during 2000-2002, while it becomes positive and significant in 2003. The estimated effect indicates about 20% tax shifting, but it is not robust to the placebo test.

Table 7. Impact of payroll tax cut on individual wages by level of education and sector affiliation

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$
Education group	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
Sector	Industry	Industry	Industry	Services	Services	Services
Treatment	-0.022	0.007	0.003	-0.043	-0.011	0.096**
	(0.0237)	(0.0102)	(0.0278)	(0.0482)	(0.019)	(0.0422)
Treatment x 2000	0.018***	0.006**	0.017*	-0.005	0.005	0.003
	(0.0043)	(0.0031)	(0.0091)	(0.0072)	(0.0037)	(0.0094)
Treatment x 2001	0.021**	0.009***	0.005	-0.009	0.005	-0.008
	(0.0055)	(0.0031)	(0.0092)	(0.0074)	(0.0037)	(0.0095)
Treatment x 2002	0.007	0.01***	-0.012	-0.002	0.005	0.001
	(0.0057)	(0.0031)	(0.0092)	(0.0077)	(0.0038)	(0.0094)
Treatment x 2003	-0.012**	-0.000	0.001	0.005	0.004	0.003
	(0.0059)	(0.0032)	(0.0094)	(0.0078)	(0.0038)	(0.0095)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period	1995-2003	1995-2003	1995-2003	1995-2003	1995-2003	1995-2003
Observations	39 130	107 942	14 677	22 730	72 800	17 565
Obs. treatment	10 331	24 170	2 642	6 534	21 064	4 334
Obs. control	28 799	83 772	12 035	16 196	51 736	13 231
Adj. R^2	0.06	0.05	0.08	0.07	0.08	0.12

Notes: I separate between six subsamples according to level of education and sector affiliation. The dependent variable is the change in log daily wages from one year to the next. All regressions include year fixed effects, regional fixed effects (18 labor market regions), sector fixed effects (2-digit level, within the larger sector groups), firm fixed effects, age controls (5-year intervals), dummies for immigration status and gender, as well as a constant term. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively.

4. Payroll tax cuts and employment

The impact of reduced payroll tax rate on employment is estimated based on the difference-in-difference approach outlined in equation (2) in section 2, and documented in Table 8. The analysis covers the period 1995-2003 and is based on about 20 000 observations of annual growth in the number of full time workers within firms.[9] As seen from the estimated year-specific effects in column (1), there is no significant effect of the payroll tax reform on firm size during 2000-2002. However, the 2003 effect is positive and significant, and the estimated coefficient implies that the growth in the number of workers within firms from 2002 to 2003 is 2.2 percentage points higher in treatment regions compared to control regions. The estimation is robust to the placebo test in column (2), but the delay in the employment response (three years after the reform) casts some doubts on the credibility of this finding.

[9] Firms with less than three full time workers are excluded from the analysis.

Table 8. Impact of payroll tax cut on firm size

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	$\Delta \ln size$	$\Delta \ln size$	$\Delta \ln size$	$\Delta \ln size$	$\Delta \ln size$	$\Delta \ln size$
Sector	All	All	Industry	Industry	Services	Services
Treatment	0.013	0.008	0.003	-0.000	0.006	-0.001
	(0.0123)	(0.0158)	(0.0186)	(0.0241)	(0.018)	(0.0223)
Treatment x 1996		0.004		-0.004		0.012
		(0.0155)		(0.0239)		(0.0203)
Treatment x 1997		0.006		0.003		0.009
		(0.0153)		(0.0237)		(0.0201)
Treatment x 1998		0.008		0.002		0.014
		(0.0151)		(0.0233)		(0.0198)
Treatment x 1999		0.004		0.015		-0.004
		(0.015)		(0.0231)		(0.0195)
Treatment x 2000	-0.009	-0.005	-0.012	-0.008	-0.007	-0.001
	(0.011)	(0.0149)	(0.0171)	(0.023)	(0.0143)	(0.0195)
Treatment x 2001	-0.000	0.004	-0.005	-0.001	0.003	0.009
	(0.0111)	(0.0149)	(0.0171)	(0.023)	(0.0145)	(0.0196)
Treatment x 2002	0.007	0.012	0.005	0.008	0.01	0.016
	(0.0110)	(0.0148)	(0.0168)	(0.0228)	(0.0144)	(0.0195)
Treatment x 2003	0.022**	0.027*	0.022	0.025	0.024*	0.03
	(0.0109)	(0.0148)	(0.0168)	(0.0228)	(0.0142)	(0.0193)
Regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period	1995-2003	1995-2003	1995-2003	1995-2003	1995-2003	1995-2003
Observations	19 492	19 492	8 711	8 711	10 781	10 781
Obs. treatment	5 697	5 697	2 587	2 587	3 110	3 110
Obs. control	13 795	13 795	6 124	6 124	7 671	7 671
Adj. R^2	0.00	0.00	0.00	0.00	0.00	0.00

Notes: The regressions are based on yearly data on firms in the private sector during 1995-2003 in 6 treatment regions and 12 control regions. The dependent variable is the change in log firm size, where firm size is measured as number of full time workers. All regressions include regional and year fixed effects, as well as a constant term. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively.

The lack of wage effects among highly educated workers and in large parts of the service sector (documented in Tables 3 and 6, respectively) motivates an analysis of heterogeneous employment effects following lower payroll taxes. Columns (3)-(6) of Table 8 separate between firms in industry and services, and in both sectors the employment effect is insignificant during 2000-2002. The estimated coefficient for 2003 is roughly similar across sectors, but the positive employment effect is only significant within the service sector. I also consider potential impacts of the payroll tax reform on the composition of workers within firms with respect to the level of education, but do not find any significant effects.

I further investigate if lower payroll taxes generate an employment expansion through entry of new firms (rather than increased firm size) by considering the total number of firms located in the region as well as the aggregate regional employment level. According to the findings in Table 9, lower

payroll taxes stimulate the inflow of new firms. The dependent variable is the annual change in the log number of firms in 6 treatment regions and 12 control regions during 1995-2003. The estimated average effect during 2000-2003 given in column (1) implies that the annual growth in the number of firms from pre-reform to post-reform years is 2.5 percentage points higher in treatment regions compared to control regions. Column (2) reports year-specific effects for the post-reform period, and the effect is significant in 2000 and 2002. However, when focusing on the aggregate regional employment level, rather than number of firms, I do not find any significant effects following the payroll tax reform. This could reflect a situation where the entry of new firms into treatment regions primarily consists of smaller firms. Excluding all firms with only one full time worker, the effect of lower payroll taxes on the number of firms is weaker. The average post-reform effect is not significant and in the year-specific estimation the effect is only significant in 2002. Overall, the employment response to the payroll tax reform is limited. This implies that the potential bias in the wage estimations in section 3 due to sorting of workers moving into the region, is less of a concern.

Table 9. Impact of payroll tax cut on number of firms

Dependent variable	(1) Change in log number of firms	(2) Change in log number of firms
Treatment	-0.009	-0.009
	(0.0063)	(0.0062)
Post 2000	-0.102***	
	(0.0098)	
Treatment x Post 2000	0.025***	
	(0.0094)	
Treatment x 2000		0.044***
		(0.0152)
Treatment x 2001		0.014
		(0.0152)
Treatment x 2002		0.034**
		(0.0152)
Treatment x 2003		0.007
		(0.0152)
Year fixed effects	Yes	Yes
Observations	162	162
Obs. treatment	54	54
Obs. control	108	108
Adj. R^2	0.51	0.61

Notes: The dependent variable is the annual change in the log number of firms in 6 treatment regions and 12 control regions during 1995-2003. All regressions include year fixed effects and a constant term. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively.

5. Conclusions

While the empirical evidence on the incidence of payroll taxation is primarily based on the wage bill of firms, this paper applies matched employer-employee register data on individual wages for all private sector workers in Norway. Exploiting a payroll tax reform and using the difference-in-difference approach, the aggregate results indicate that about half the reduction in labor costs is shifted to employees through higher wages. The wage response differs across education groups. Low educated workers benefit from the payroll tax reform through higher wages, while there is no significant wage effect among highly educated. The impact on wages is somewhat higher in large firms, and the difference across education groups is mainly documented in firms of above-median size. To my knowledge, this is the first analysis of heterogeneous wage effects of payroll tax cuts based on workers' level of education. The estimation results also reveal differences across sectors. While the degree of tax shifting is about 75% in industry, large parts of services have no significant wage effect from lower payroll taxes. This contradicts the analysis of payroll tax cuts in Finland, where Korkeamäki and Uusitalo (2009) use a sample of large firms and find significant tax shifting in services and no effect in manufacturing. The potential employment response to payroll tax cuts is investigated by considering both firm size, number of firms located in the region, and aggregate regional employment level. Overall, the employment effects are limited. The heterogeneous wage response across education groups combined with modest employment response implies that the absolute value of the labor demand elasticity decreases with the level of education.

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Appendix Table 1. Impact of payroll tax cut on individual wages by sector of employment

	(1)	(2)	(3)	(4)	(5)
Dependent variable	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$
Sector	Manufacturing	Construction	Wholesale and retail trade	Business services	Other services
Effect	Year-specific	Year-specific	Year-specific	Year-specific	Year-specific
Treatment	-0.003	0.006	-0.022	-0.058*	0.013
	(0.0098)	(0.0143)	(0.0478)	(0.0298)	(0.0213)
Treatment x 2000	0.01***	0.009**	-0.006	0.014**	0.005
	(0.0032)	(0.0043)	(0.0049)	(0.0073)	(0.0048)
Treatment x 2001	0.01***	0.014***	-0.002	0.006	0.003
	(0.0032)	(0.0043)	(0.0049)	(0.007)	(0.005)
Treatment x 2002	0.007**	0.005	0.005	0.009	-0.002
	(0.0032)	(0.0043)	(0.0049)	(0.007)	(0.0051)
Treatment x 2003	-0.005	0.003	0.008	-0.000	0.004
	(0.0033)	(0.0045)	(0.0049)	(0.0071)	(0.0052)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Period	1995-2003	1995-2003	1995-2003	1995-2003	1995-2003
Observations	105 465	56 284	41 963	24 632	46 500
Obs. treatment	22 111	15 032	12 986	6 509	12 437
Obs. control	83 354	41 252	28 977	18 123	34 063
Adj. R^2	0.05	0.05	0.06	0.11	0.10

Notes: The table shows the estimation results for sectors within industry and services. Column (1) mainly represents the manufacturing sector, but also includes workers from mining (accounts for less than 2% of the labor force). Column (2) consists of workers from the rest of the industrial sector, mainly construction, but also electricity, gas and water supply. Columns (3)-(5) constitute services, and are divided into wholesale and retail trade, business services and other services (hotels/restaurants and transport/storage/communication). The dependent variable is the change in log daily wages from one year to the next. Further descriptions of the regressions are given in the notes to Table 6. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively.

Appendix Table 2. Impact of payroll tax cut on individual wages by sector and firm size

	(1)	(2)	(3)	(4)
Dependent variable	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$	$\Delta \ln w$
Sector	Industry	Industry	Services	Services
Firm size	< 12	≥ 12	< 12	≥ 12
Treatment	0.003	0.005	0.002	-0.008
	(0.0175)	(0.0091)	(0.018)	(0.0246)
Treatment x 2000	0.009*	0.01***	0.001	0.004
	(0.005)	(0.0029)	(0.0038)	(0.0053)
Treatment x 2001	0.016***	0.009***	-0.002	0.011**
	(0.0051)	(0.003)	(0.0039)	(0.0053)
Treatment x 2002	0.004	0.01***	0.004	0.002
	(0.0051)	(0.0031)	(0.0039)	(0.0055)
Treatment x 2003	-0.000	-0.002	0.009**	-0.008
	(0.0052)	(0.0032)	(0.0039)	(0.0056)
Firm fixed effects	Yes	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Period	1995-2003	1995-2003	1995-2003	1995-2003
Observations	51 719	110 030	83 854	29 241
Obs. treatment	15 442	21 701	24 560	7 372
Obs. control	36 277	88 329	59 294	21 869
Adj. R^2	0.06	0.03	0.08	0.04

Notes: I separate between four subsamples according to firm size and sector affiliation. The dependent variable is the change in log daily wages from one year to the next. All regressions include year fixed effects, regional fixed effects (18 labor market regions), sector fixed effects (2-digit level, within the larger sector groups), firm fixed effects, age controls (5-year intervals), dummies for education level, immigration status and gender, as well as a constant term. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively.