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The employment effects of low-wage subsidies ☆

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ABSTRACT

Low-wage subsidies are often proposed as a solution to the unemployment problem among the low skilled but the empirical evidence on their effects is still scarce. This paper examines the employment effects of a Finnish payroll tax subsidy scheme, which is targeted at the employers of older, full-time, low-wage workers. The system's clear eligibility criteria open up an opportunity for a reliable estimation of the causal impacts of the subsidy scheme. Our results indicate that the subsidy system had no effect on the employment rate or wages of the eligible groups, but it increased slightly working hours among those already at work.

1. Introduction

One way to reduce unemployment among the low skilled is to cut labour taxation for low-wage workers. A targeted tax cut decreases the cost of employing low-skill workers, and it can thus increase wages and employment of this group. In a competitive labour market it would not matter whether tax cuts are provided as a wage subsidy to the employers or as an equivalent tax reduction to the workers. However, if wages cannot adjust downwards, for example due to minimum wages or union contracts, a wage subsidy may reduce the labour costs and therefore increase labour demand and employment more than a reduction in the labour income tax paid by the employees.[1]

Despite the large agreement in the theoretical literature that these subsidies could be effective, there is relatively little empirical research that has examined the effects of the (employer-side) wage subsidies. This is in a marked contrast to a large literature that has examined the effects of the targeted tax cuts for employees.

The purpose of this paper is to offer new evidence on the causal effects of low-wage subsidies by examining the impacts of a targeted low-wage subsidy experiment that started in Finland in 2006. In order to be eligible for the subsidy, the workers must be over 54 years of age, earn a salary between €900 and €2,000 per month, and work full-time. This implies that we can find several comparison groups for the targeted workers and evaluate the effects of the subsidy based on a difference-in-difference-in-differences approach. We will eventually compare the changes in employment after the introduction of the subsidy in groups eligible for the subsidy to groups that are not eligible, simultaneously controlling for any permanent differences across the groups, and the changes in the labour demand for different skill groups. The latter, particularly, may be quite important if skill-biased technical change or globalisation change the relative productivity of different workers.

The empirical analysis in the paper is based on administrative register data. We begin by looking at the overall impacts of the subsidy system on the employment rates, as well as exit from and entry into employment using a large and representative sample drawn from the Finnish Longitudinal Employee Employer Data. A more detailed

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[1] See Phelps (1994, 1997) and Drèze and Malinvaud (1994).

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analysis, where we need information on exact monthly earnings and working hours, is based on data from the Confederation of Finnish Industries.

This paper contributes to the literature in several ways. First, as mentioned already, the clear eligibility criteria of the Finnish low-wage subsidy experiment makes it possible to examine the effects of a low-wage subsidy on the target group employment, while controlling for the simultaneous changes that affect the demand for all low-wage worker or all older workers. Second, this paper adds to the relatively scarce literature that has examined the effects of low-wage subsidies on employment and it is the first that uses data from a Nordic country. Third, we present a detailed analysis of the heterogeneous effects of the subsidy system, incorporating the possible harmful impact in the phase-out range of the subsidy. Finally, since the subsidy scheme was targeted to older workers, our results also provide new evidence on the effectiveness of policies that aim to increase employment of older workers.

The paper proceeds as follows. Section 2 reviews earlier relevant empirical work. Section 3 explains the Finnish subsidy system in detail and provides a brief description of other relevant labour market institutions. In Section 4 we present the theoretical predictions on the effects of the subsidy system. Section 5 describes the data and Section 6 the empirical approach. The main results are in Section 7, and Section 8 concludes.

2. Earlier empirical work[2]

The best-known scheme aiming at promoting low-wage employment with subsidies to employers was implemented in France, where payroll taxes were reduced for the low-wage workers several times in mid 1990s. The employment effects of the French payroll tax subsidy scheme have been evaluated by Kramarz and Philippon (2001) who examine the effects of changes in the minimum labour costs, hence capturing the effects of both the changes in minimum wage and the changes in payroll tax subsidies at the minimum wage level. By comparing workers affected by the minimum wage increases with workers just above the new minimum wage, they show that increases in labour costs increase transitions to non-employment. The estimates are large; the implied elasticity of labour demand is 1.5.

Targeted payroll tax subsidies that aim to promote low-wage employment have also existed in the Netherlands and in Belgium. Goos and Konings (2007) evaluate the effects of the 'Maribel subsidies' system in Belgium in the late 1990s. These subsidies reduced the payroll taxes for the manual workers. Even though the subsidy was not specifically targeted to the employers of low-wage workers, its lump-sum structure reduced the payroll taxes for the low-wage workers more than for the other groups. Goos and Konings find that the subsidy increased employment of manual workers especially in exporting industries.[3]

The main difference between the French or Belgian low-wage subsidy schemes and the Finnish scheme is that the former affect all low-wage workers, while the Finnish subsidy is targeted to only older low-wage workers. This targeting makes it easier to distinguish between effects that are due to the subsidy from the simultaneous changes that affect all low-wage workers.

In addition to policies that have a direct effect on labour costs of older workers, relative labour costs are also affected by age-specific rules regarding job protection, layoff-taxes and experience-rated early retirement benefits. For example, Behaghel, Crépon and Sédillot (2008) evaluate the effects of the changes in the "Delalande-tax" that required the firms to pay a tax to the UI system if they lay off a worker above a certain age threshold. Behaghel et al. find little effect on lay-offs but show that expected firing costs discouraged the firms from hiring older workers.

An alternative to the employer-side subsidies is to give the subsidy to the employees. This is how the Earned Income Tax Credit in the US and the Working Families Tax Credit in the UK are designed. Despite different nominal recipients, there are also similarities that make the results from the evaluation of these subsidy schemes relevant for the Finnish case. All these schemes share the property that the subsidy is permanent and, importantly for the evaluation, have also other eligibility criteria in addition to low earnings. This allows comparing wage and employment changes after the introduction or expansion of the subsidy in the eligible group and in some comparison group that is in a reasonably similar position in the labour market. There is a large literature that has evaluated these subsidies and found substantial effects on the labour supply.[4]

Overall, earlier studies on employee-side low-wage subsidies indicate that labour supply is elastic at the extensive margin and the subsidies are therefore effective in increasing employment of these groups (Meghir and Phillips, 2010). There is much less evidence on the effectiveness of employer-side wage subsidies. It is also unclear how they work in different institutional settings. Moreover, if labour demand elasticities differ between age groups, the employer-side subsidies that are targeted to older workers can have a different impact than a subsidy that is targeted to all age groups.

3. The Finnish employer low-wage subsidy scheme

In January 1st 2006 Finnish employers became eligible for a wage subsidy if they employed a low-wage worker who was over 54 years old. The subsidy scheme was temporary and was in force until December 2010. The maximum subsidy was 16% of the gross monthly earnings or 13% of the total pre-reform labour costs that include payroll taxes.

The subsidy was introduced as an attempt to increase the employment rates among low-skilled workers. The initial proposal was to offer a subsidy to all employers of low-wage workers, but in the budget negotiations in the fall of 2005, the subsidy was limited to older low-wage workers. At the time, many regarded it as a promising policy proposal, based largely on earlier experience from e.g. the corresponding French subsidy system. The most vocal opponents to the system were unions representing low-wage workers, who feared that the system would limit wage increases, as it made pay rises more costly to the employers.

The subsidy covered full-time workers who were employed at least 140 h per month and whose earnings were between €900 and €2,000 per month. The size of the subsidy was determined as 44% of the part of the monthly earnings that exceeded €900. The subsidy was capped at €220 per month, a level reached when the earnings were €1,400. The amount of the subsidy was reduced by 55% of the monthly earnings exceeding €1,600 so that it was zero for wages over €2,000. According to the Ministry of Employment and the Economy, the annual cost of the system was approximately €90 million (86.2 million in 2007, for example).

[2] In this section we cover only the empirical literature on permanent employer-side subsidies. The theoretical literature on payroll tax subsidies is reviewed for example by Brown et al. (2011). There is also literature on the effects of payroll tax reductions that affected all employees (Gruber, 1997), or all employees in some regions (Korkeamäki and Uusitalo, 2009 and Bennmarker et al., 2009), and temporary hiring subsidies (Blundell et al., 2004 and Katz, 1996).

[3] We are not aware of the econometric evaluations of the Dutch system, but Bovenberg et al. (2000) evaluate its effects using a simulation model calibrated to Dutch data. Their conclusion is that the most effective way of reducing unemployment is the introduction of in-work benefits, though the simulation results between the benefits paid to the low-wage workers or to the employers of these workers are roughly similar.

[4] See e.g. Eissa and Liebman (1996) and Blundell (2006). There is also some recent experimental evidence on the effect of randomly allocated employee-based wage subsidies (Card and Hyslop, 2005).

The wage subsidy was paid to the employer and can be seen as simply a reduction in the payroll tax for the firms that employ old low-wage workers. In 2006, the average payroll tax rate was 20.9% of the gross wage. This tax is levied on all wages. The revenues are mainly used for funding the employee's pension system and the sickness insurance. The tax rate is slightly higher for the larger and the more capital-intensive firms. For the large firms, pension payments also vary according to the age structure of the employees and according to the disability and unemployment pensions granted to their former employees. Still, even for large firms the payroll tax is a proportional tax on all wages paid.

The 2006 tax subsidy created a system where the payroll tax rate was a decreasing function of monthly earnings in a range between €900 and €1,400. In the earnings range between €1,400 and €1,600, the subsidy remained constant at €220 but decreased as a fraction of earnings, therefore making the payroll tax progressive also in this range. In the phase-out range between €1600 and €2000, the payroll taxes became strongly progressive with the payroll tax rate increasing from 7.2% for a person earning €1,600 per month to roughly 21% for a person earning €2,000 per month.

The effects of wage subsidies may depend on the rules regarding adjustment of wages and employment prevailing at the time when the subsidy scheme was introduced. To understand the effects of the subsidy scheme, it is useful to briefly sketch the institutional context. Overall, Finnish labour market institutions are reasonably similar to other Nordic countries and not that different from many countries in continental Europe.

According to the OECD statistics, the employment rate of older (between ages 55 and 64) workers in Finland was 53% in 2005 which is clearly lower than in countries, such as Sweden (where the corresponding figure was 70%), or the UK (57%), but higher than in many continental European countries, such as Belgium (32%) or France (39%). In the latter comparison, the difference arises to a large extent from higher female employment rates in Finland. Nevertheless, there is scope for increasing employment among older workers in Finland.

As in many other countries, one of the main reasons for low employment among older workers is extensive use of various early retirement schemes. In Finland, the most important of these are disability and unemployment pension schemes. Disability pensions are relatively generous providing benefits equal to old-age pension for workers that are unable to work. In 2005, unemployment pension could be granted to the long-term unemployed who were over 60. In addition, the unemployment over 57 were entitled to extended unemployment benefits that could be paid until retirement and often led to effective withdrawal from the labour market much before early retirement age (see Kyyrä, 2010 for details).[5]

Part-time employment is slightly less common in Finland than on average in the OECD countries. Just before the reform, in 2005, 13.2% of all workers between 15 and 64 worked part time, while the OECD weighted average figure was 15%. The fraction of part-time workers is much higher, 19.3%, among workers between 55 and 64. The main reason for higher part-time employment among older workers in Finland is a part-time retirement scheme that employees were eligible after age 58. As part-time workers have more opportunities to adjust their working hours, we also expect them to be more responsive to the subsidy scheme.

Also employment protection legislation may affect employment adjustment of older workers through dismissal costs. However, the Finnish labour law is not particularly strict. Age-based discrimination is prohibited but the Finnish law contains no "first in - last out" clauses that exist in some countries. According to the OECD index of the stringency of employment protection legislation from 2008, Finland is close to the OECD average (2.3 versus 2.2 at a scale from 0 to 6 with 6 indicating the most stringent legislation).

As in the other Nordic countries, the union density is very high in Finland (71% in 2005) and the union wage contracts are extended also to non-unionized workers. Therefore, union contracts cover some 90% of workers, which is high but comparable to other Nordic countries and countries such as France, Italy and Spain (Venn, 2009). High coverage of union contracts also implies that a meaningful distinction between unionized and non-unionized sectors cannot be made in Finland.[6]

Wage determination is relatively centralized in Finland. The unions negotiate wage contracts with employer organizations separately in each industry. These negotiations are typically co-ordinated by central organizations leading to rather similar pay rises in different industries. Finland has no minimum wage laws, but since union contracts are extended to non-union workers, the union contracts effectively determine also the minimum wages. In the typical low-wage sector contracts, the lowest full-time wages were around 1,300 in 2006 when the subsidy system was introduced. The average wage for full-time workers was around €2,500. The Finnish low-wage subsidy was therefore targeted at workers that were well below the average wage, with the maximum subsidy paid to those whose wage is close to the minimum wage. Fig. 1 illustrates this by plotting the size of the subsidy on the top of the earnings distribution in 2006. It also shows that the majority of the subsidized workers were on the phase-out range of the subsidy.

4. Theoretical predictions

The low-wage subsidy is likely to affect employment both at the extensive margin (i.e. the number of different types of workers the firm hires) and at the intensive margin (the number of hours demanded from workers already employed). In the appendix we provide a simple formal model of the effects on both margins.

The predictions on the extensive margin are rather straightforward. When the cost of employing old low-skill workers decreases, a cost-minimizing firm that employs several types of workers hires more old low-skill workers and fewer workers from the groups that are substitutes to the old low-skill workers. These effects can be intermediated by an increase in the relative hiring rate of low-skill workers or a decrease in the relative exit rate of these workers. The effects on the extensive margin only depend on the average tax rate. As the size of the tax cut depends on monthly earnings, the magnitude of the effect is likely to be heterogeneous with respect to the wage. The effect also varies by age, and the tax cut targeted to workers over 54 also affects younger groups because firms hiring these workers should expect some of them to stay until age 54 when they eventually become eligible for the subsidy. We do not develop a full dynamic model that would account for expectations here, but simply use changes in the expected discounted sum of future labour costs in the empirical analysis.

At the intensive margin the predictions are more complicated, since the low-wage subsidy creates a payroll tax regime with several kink points. Fig. 2 illustrates how the subsidy affects the relative demand for hours from a low-skilled worker earning €9 per hour. It depicts the firm's cost minimisation problem with the original linear isocost line and a new kinked isocost line that the reform generates. The latter features first a phase-in region for earnings below €1400, which for €9 per hour refers to less than 155 h per month. In this segment the subsidy system lowers the marginal payroll tax. In the

[5] Lower age limit of the extended UI benefit scheme was raised by 2 years for the unemployed born in 1950 or later. However this affected all unemployed. As our estimates are identified from differential impacts on workers at different earnings levels they should still be consistent. For robustness, we nonetheless also run regressions where the affected cohorts are dropped from the sample. Results were qualitatively similar to those reported in this paper.

[6] The implications of the unionised labour markets on how tax changes affect employment are discussed at the end of Section 4.

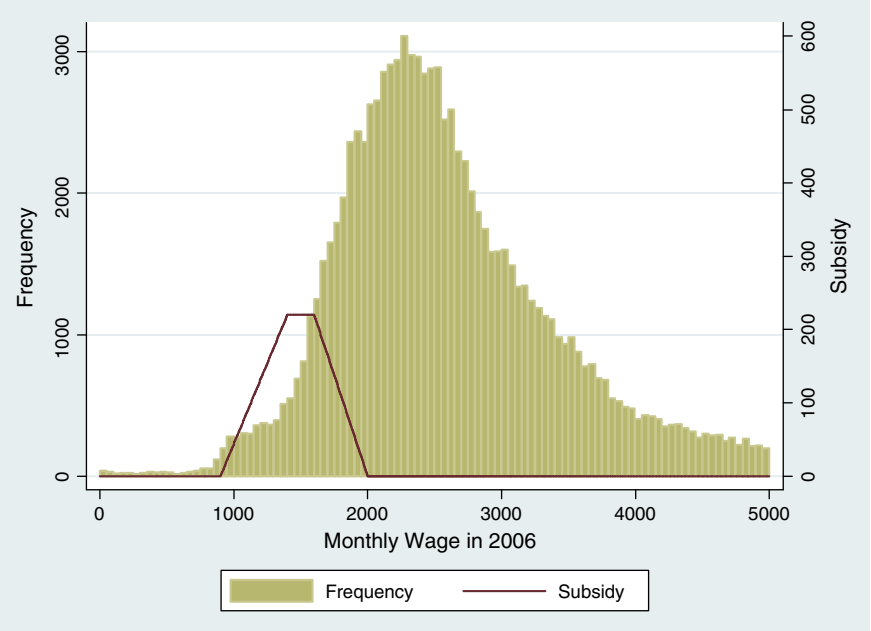

Fig. 1. Wage distribution for employees between 55 and 64 in 2006 (left axis) and the size of the subsidy (right axis).

segment between 155 and 178 h, the marginal payroll tax is the same as originally. In the phase-out region for hours above 178 the marginal payroll tax is higher than before the reform. The full-time requirement of the subsidy system creates another large kink point at 140 h per month. As usual, the optimal factor choices are in points where the isocost line and the isoquants are parallel, or at the kink points of the isocost line.

The intensive margin response depends on the marginal payroll tax rate. The hours increase for those workers whose marginal payroll tax rate is reduced. The extent of this reaction hinges on the degree to which tax changes are shifted into gross wages, i.e. on tax incidence. The gross wage rate remains fixed for perfectly elastic labour supply, whereas the wage reaction completely absorbs the change in the tax rate if labour supply is fixed. In the realistic intermediate case, part of the payroll tax decrease is captured by workers via a higher wage rate. Similarly, hours and the wage rate will decrease for workers whose marginal payroll tax increases and remain unchanged for workers whose marginal payroll taxes are unaffected by the reform.

The kinks at the isocost line can lead to bunching of hours at the kink points, an excess mass at points where the marginal payroll tax increases and a loss of mass in places where the marginal tax rate decreases.[7] In particular, we could expect to observe bunching at the point where workers become eligible for the subsidy, i.e. at 140 h per month. For a wide range of wages it would be optimal to increase hours from slightly below 140 h to exactly 140 h.

One of the crucial assumptions of the reasoning above was the reliance on perfectly competitive labour markets. The predictions regarding the reduction in the average tax rate remain valid also for imperfectly competitive labour markets: when the average tax rate is reduced, the equilibrium employment rate increases. Therefore, at the most important margin of reaction, the subsidy system leads to similar effects irrespective of labour market arrangements.

However, the impacts of progressivity of taxation change in models with imperfectly competitive labour markets. For example, in the union models, a revenue-neutral increase in tax progressivity can increase employment, since it renders nominal wage increases less profitable for the unions, tilting the balance between employment and high wages in favour of increased employment.[8] A mirror image of this result is that gross wages for low-paid workers may rise less than they would have risen in the absence of the progressive payroll tax system. However, many of the Finnish labour unions are relatively large, and the targeted workers represent a minority in each union. Therefore the wage negotiations have not necessarily internalised the effects discussed above, which mitigates the effects of the wage subsidy on the wage contracts.

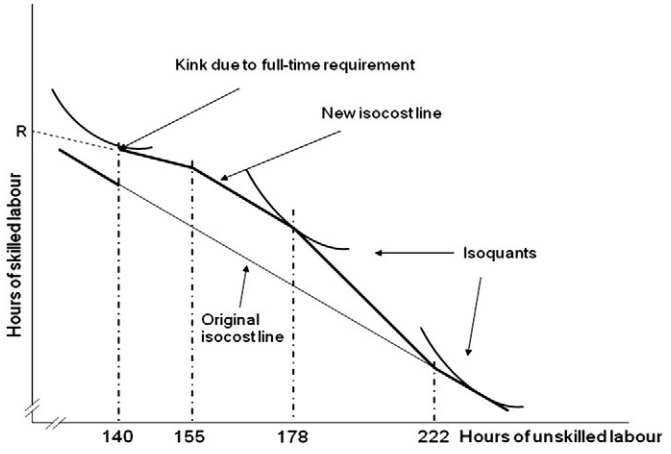

Fig. 2. An illustration of the effects of the non-linear subsidy system for the firm's cost minimisation problem in a two-input case. Because the size of the subsidy depends on the monthly earnings, the location of the kink points depends on the hourly wage. The isocost line displayed in Fig. 2 is drawn based on 9€/h wage for the unskilled worker and 18€/h wage for the skilled worker.

[7] For an analysis of bunching in the context of estimating elasticity of taxable income, see (Saez, 2010).

[8] See e.g. Lockwood and Manning (1993), Holmlund and Kolm (1995), and Koskela and Vilmunen (1996), and the discussion of Sørensen (1997). Even if a rise in tax progressivity may increase employment at the extensive margin, it can still reduce the hours of work or, more generally, effort by individual workers at the intensive margin (Jackman and Layard (1990).

5. Data

5.1. Data set 1: FLEED

As the primary motivation for introducing the low-wage subsidy scheme was to improve the labour market prospects of elderly low-skill workers it is natural to start analysing its effects by examining the changes in the employment rates of the these groups. For this purpose we use individual-level data from the Finnish Longitudinal Employer-Employee Data (FLEED).[9] These data contain a 33% random sample of population that resided in Finland at some point between 1990 and 2007 and hence also a random sample of any subgroup at any given point in time. Data are in the panel format and individuals can be followed over time from 1990 to 2007. Here we mainly use these data as if they came from repeated cross-sections only utilizing the panel features to identify exits from and entry into employment.

The employment rates in the data are defined according to the end of year status. Similarly unemployment is defined based on being registered as an unemployed job-seeker at an employment office in the end of the year. The earnings are measured based on tax records on an annual basis. Monthly earnings for the full-time, full-year workers can be calculated but even though data contain information on months employed, the monthly earnings calculations are not necessarily as reliable for the part-time or part-year workers.

Data on age and gender are based on population register and should be accurate. Information on education is based on the Register of Completed Education and Degrees maintained by Statistics Finland. These data are also based on direct report on degrees granted from all Finnish educational institutions and are of high quality. We limit the analyses to persons between 45 and 64 and to the years between 2004 and 2007, i.e. to the 2 years before and the 2 years after the introduction of the low-wage subsidy system.

5.2. Data set 2: Payroll data

In the analysis regarding the effect of the subsidies on wages and working hours at intensive margin, we use data from the payroll records of the Confederation of Finnish Industries. These data cover all private sector workers in all firms that are members of the confederation. The main benefit of the payroll data is that wages and hours are accurately reported. For most firms this information comes directly from the firms' pay systems. Data also contain information on workers' individual characteristics such as age, gender and education. Each person can be followed over time as long as she remains employed by one of the firms that are included in the data.

We make similar restriction to these data as in the FLEED data and therefore focus on groups between 45 and 64 years in age and years between 2004 and 2007. In the intensive margin analyses we focus on the workers who stay in the firm where they were employed in the end of 2005.

Comparing the two available data sets one should note that the payroll data contain more detailed information on wages and hours and is more useful for analyzing effects on the intensive margin. On the other hand payroll data only include those who are employed in large private sector firms omits the public sector entirely. Hence effects on aggregate employment are easier to analyze using the FLEED data.

5.2.1. Descriptives

Table 1 provides the means and the standard deviations of both data sets that are used in the empirical section. When comparing these to each other one should keep in mind that the FLEED data covers the entire population in the relevant age groups; the payroll data only those who are employed and working in the private sector. These restrictions explain some of the differences between the two data sets. For example, the persons in the payroll data are on average younger since the employment rates in older age groups are lower. The monthly wages appear comparable even though the wage rate in the FLEED data is calculated based on annual earnings while the payroll data contains information on actual monthly earnings. Exit rates differ, but this is due to different definition. In the FLEED data exits refer to a transition from employment to non-employment; in the payroll data exits refer to leaving the firm.

Table 1
Descriptive statistics.

	FLEED				Payroll data			
	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Age	54.15	5.53	45	64	52.45	4.76	45	64
Primary education	0.30	0.46	0	1	0.28	0.45	0	1
Secondary educ.	0.39	0.49	0	1	0.40	0.49	0	1
Lowest tertiary educ.	0.16	0.37	0	1	0.18	0.39	0	1
Bachelor's level educ.	0.06	0.24	0	1	0.06	0.24	0	1
Master's or Doctorate	0.08	0.27	0	1	0.03	0.18	0	1
Gender/male	0.50	0.50	0	1	0.43	0.49	0	1
Employment rate	0.66	0.47	0	1	1.00	0.00	1	1
Exits between $t-1$ and t	0.07	0.26	0	1	0.18	0.39	0	1
Monthly earnings	2592	1357	0	10000	2623	883	0	172293
Weekly hours	n.a.				38.50	3.68	0	142
Fraction full-time	n.a.				0.96	0.18	0	1
Subsidy size (if positive)	n.a.				115.19	69.69	0	220
Receive subsidy (if eligible)	n.a.				0.61	0.49	0	1
Expected decrease in labor costs (relative subsidy)					0.002	0.01	0	0.13
n persons	568,577				241,677			
n observations	1,983,360				767,991			

Notes: FLEED sample is representative of the total population in these age groups in 2004–2007. Payroll data contains those who are employed in 2004–2007 in the private sector and who stay in the 2005 firm at least two consecutive years. (Exit rates and take up rates in payroll data are calculated before imposing this restriction from a larger sample.) Wages in the FLEED data are calculated based on annual earnings for the full-year workers. Zeroes are included in calculating the means but earnings are top-coded at €10,000 in both data sets.

For data secrecy reasons, we could only link information on actually receiving a subsidy to the payroll data. The average subsidy for those who receive positive subsidies is €115 per month. As a fraction of expected discounted future labour costs the subsidy is on average 5%. Average take-up rate of the subsidy is 61% of the eligible group but it increases from 60% in 2006 to 63% in 2007, so there is a small learning element present. Representatives of the Confederation of Finnish Industries have suggested that cumbersome administrative details related to the subsidy system may explain why some firms have not applied for the subsidies. The take-up rate is the greater, the higher the expected subsidy for employees. When the average expected subsidy is less than €50 a month, the take-up rate is 52%. When the subsidy is close to its maximum level (€220 a month), the take-up rate is around 70%. We have also run regressions where the take-up rate is explained by firm-level characteristics. This analysis reveals that take up is higher in the larger firms, in the firms where the mean wage is relatively low and in the firms where the mean age of the workforce is high. All these observations are consistent with rational behaviour. The firms apparently compare the administrative costs and monetary benefits when deciding whether to apply for the subsidy.

The primary motivation of targeting the low-wage subsidies for workers over 54 was to increase the employment of these age groups.

[9] We are using a standard version of the FLEED sample that is released in an anonymized format for researchers via a remote access system. Other interested users should contact Statistics Finland or search for more information on options for data access from their website: http://stat.fi/meta/tietosuoja/kayttolupa_en.html.

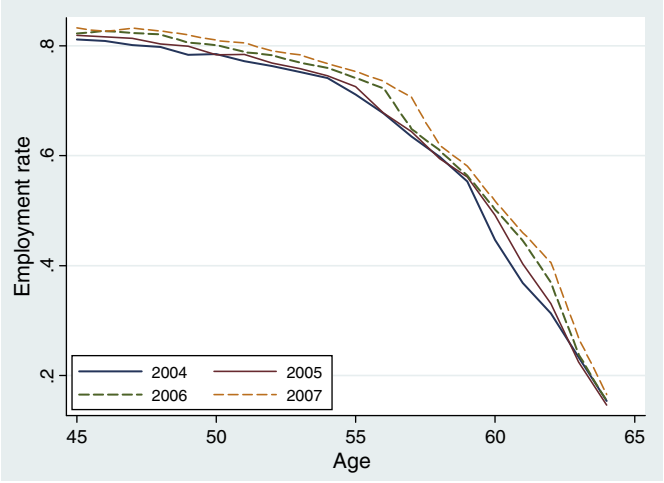

Fig. 3. Employment rates in 1-year age groups from 2004 to 2007. Notes: Author's calculations based on the FLEED data. Employment status is measured according to activity in the last week of each year.

As shown in Fig. 3, the employment rates decrease rapidly with age, particularly after age 55. Age-specific employment rates are higher after the introduction of the subsidies in 2006 and 2007 (dashed lines) than in 2004 or 2005 (solid lines). Notably the increase in employment rates after 2006 is reasonably large around age 55 and again at ages above 60. Naturally, there may be other reasons for the increase than the low-wage subsidy for the old workers. In fact, the employment rates in these age groups have been rising in Finland since mid 1990's.

Low-wage subsidies may have effects on the wage distribution both because the changes in marginal tax rates may affect wages and because the subsidy may affect employment rates of workers in different wage (or skill) categories. As a first look at these effects we plot in Fig. 4 the cross-section distributions of monthly earnings in our payroll data separately for the workers over 54 who became eligible for the subsidy in 2006, and slightly younger workers between 45 and 53 who were not eligible. We do this separately for years before and after the introduction of the subsidy system. In the middle part of the figure we calculate the change in the fraction of the workers in each monthly earnings interval and in the bottom of the figure differences in these changes between older and younger workers.

If the low-wage subsidy had an effect on employment or wages, we should expect the fraction of workers in the 900–2,000 earnings range to grow, this growth only occurring in the older age groups. As described in the theory section, we might also expect bunching of observations in the kink points of the new isocost line (€1,400 and €1,600) where marginal payroll taxes increase, and possibly fading mass around the kink point where marginal payroll taxes decrease (€2,000). However, nothing of this sort can be observed in the data. As Fig. 4 illustrates, the nominal earnings grew over time for both the old and the young workers shifting the earnings distribution to the right. As the eligibility limits remained constant in nominal terms, this shift reduced the fraction of workers in earnings ranges where they were eligible for the subsidy. This decrease in the fraction of workers in the subsidized earnings levels is almost equally large for old and young workers. The difference-in-differences estimates plotted in the bottom of the figure are not statistically significant. The point estimates even indicate that older workers are increasingly concentrated in earnings ranges that are above the higher earnings limit of the subsidy system. A simple triple difference estimate indicates no

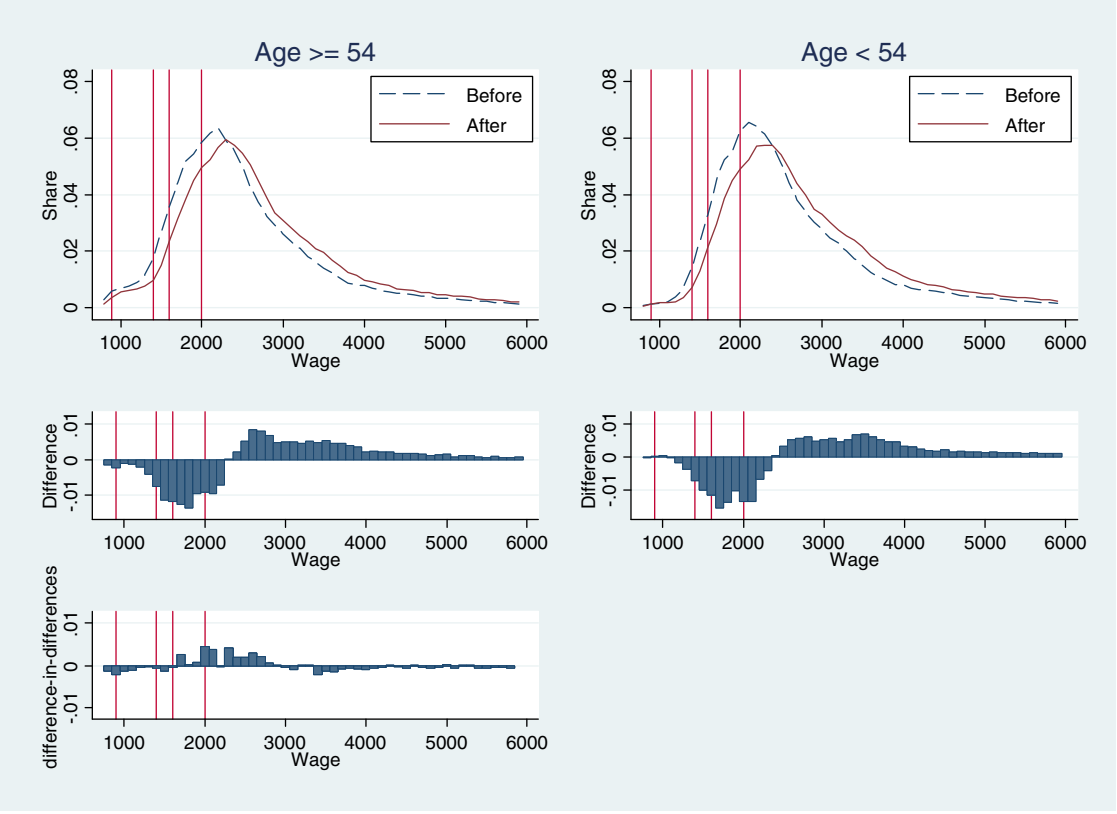

Fig. 4. Change in earnings distribution before and after introduction of the low-wage subsidy. Notes: Author's calculations based on payroll data. "Before" years are 2004 and 2005 and "after" years 2006 and 2007. Sample is restricted to workers between ages 45 and 64 earning a wage between €800 and €6000.

significant impact in the fraction of workers earning less than €2,000 among the older age groups.

The similarity in the changes in the earnings distributions already suggests that the subsidy scheme probably had no large effects on employment or wages. However, our payroll data excludes small firms that do not belong to employer organization and the public sector that employs a large fraction of low-wage workers. In the next section we use a representative sample of population to examine aggregate employment effects, as well as effects on weekly hours and hourly wages separately.

6. Empirical approach

We first examine the effect of the change in the labour costs on the employment rate, and entry to and exit from employment. In the next part we focus on impacts at the intensive margin, i.e. on log weekly working hours and hourly wages for employed workers. Our basic approach follows a simple difference-in-difference-in-differences setup. We estimate variants of equation

$$\begin{aligned} y_{it} = {} & \alpha + \beta_1 D(\text{age}\geq 54)_{\text{it}} + \beta_2 D(\text{wage}<2000)_{\text{it}} \\ & + \beta_3 D(\text{year}\geq 2006)_{\text{it}} + \gamma_1 [D(\text{age}\geq 54) \times D(\text{wage}<2000)]_{it} \\ & + \gamma_2 [D(\text{age}\geq 54) \times D(\text{year}\geq 2006)]_{it} \\ & + \gamma_3 [D(\text{wage}<2000) \times D(\text{year}\geq 2006)]_{it} \\ & + \delta [D(\text{age}\geq 54) \times D(\text{wage}<2000) \times D(\text{year}\geq 2006)]_{it} + \varepsilon_{it} \end{aligned} \quad (1)$$

Here the outcome variables are explained by age, wage and time and their interactions. The parameter of interest is the coefficient of the triple interaction term δ that measures the differences in the changes over time between the eligible and ineligible groups after accounting for cross-sectional differences and general changes over time, as well as for the potentially different shocks to the demand of older workers and low-wage workers. Controlling for the interaction between age and time is particularly important because employment rates of older workers have been increasing over time also for reasons unrelated to the low-wage subsidy scheme.

A simplest possible way of estimating Eq. (1) would be to define the eligible group as workers over 54 earning at most €2,000 per month. However, this is problematic in a number of ways. First, the monthly earnings are potentially affected by the subsidy scheme and therefore endogenous. In addition, measuring effects on employment rates by the earnings level would be difficult as earnings can be observed only for the employed. Second, also the workers below 54 may be affected by the subsidy if the firms are forward looking and expect to employ these workers also after they turn 54 and become eligible for the subsidy. Third, the size of the subsidy depends on the monthly earnings. Those earning between €1,400 and €1,600 receive much higher subsidies than those earning almost €2,000. Also the change in the marginal payroll tax rate varies across earnings levels indicating that the effect on the intensive margin may be different at different points of the earnings distribution. Below we will discuss each of these issues in more detail.

6.1. Endogeneity issue and missing wages for the non-employed

Analysing the effects on aggregate employment rates or re-employment rates of the unemployed is difficult since the potential earnings of the unemployed cannot be observed. We approach this problem by using the predicted earnings instead of actual earnings. Specifically, we use the pre-reform data from 2005 and split the data into cells defined by gender and education (12 groups). We then calculate, in each cell, the fraction of workers that earn less than €2,000 per month and replace the low-wage indicator in Eq. (1) with this fraction. Table 2 shows that the fraction of low-wage workers is much higher among groups with low education and particularly among women with low education. We will therefore end up comparing the changes in the employment rates in the groups that are more affected by the subsidy scheme because they contain many low-wage workers to the change in employment rate in the groups where the fraction of low-wage workers is smaller. To ensure that the results are not driven by cross-sectional differences or different changes over time across these groups, we also include full interactions between sex, age, and education as well as the interaction of each of these covariates and the post-reform dummy to the estimated model.

Table 2
Fraction of full-time full-year workers earning less than €2000/month in 2005.

	FLEED		Payroll Data	
	Women	Men	Women	Men
Primary education	0.605	0.362	0.491	0.211
	[34,150]	[38,500]	[30,638]	[35,914]
Secondary education	0.537	0.279	0.461	0.135
	[59,185]	[58,686]	[37,832]	[59,083]
Lowest tertiary education	0.250	0.171	0.178	0.073
	[34,935]	[22,348]	[23,470]	[21,839]
Bachelor's level education	0.130	0.093	0.093	0.021
	[9,885]	[13,196]	[5,106]	[12,496]
Master's level education	0.073	0.064	0.038	0.017
	[13,040]	[13,923]	[4,806]	[9,262]
Doctorate level education	0.048	0.030		
	[1,433]	[2,589]		

Notes: 45- to 64-year-old-workers. Number of observations in each group in square brackets. Postgraduate degrees are merged with Master's level education in the payroll data.

6.2. Anticipatory effects

The firms that hire new workers usually expect them to remain in the firm for several years. Hence a wage subsidy targeted to workers over 54 may also affect the employment rates of younger low-wage workers that will eventually become eligible for the subsidy. Some workers are also likely to remain in the firm after 2010 when the program ends.

We account for these effects by calculating the expected change in the discounted sum of future labour costs due to the subsidy scheme. This depends on the likelihood of remaining in the firm while the subsidy program is in place, the eligibility of the subsidy that is a function of age and wage, and the expected remaining tenure in the firm.

In practice we first calculate age-specific exit rates using data from the pre-program years. We use these exit rates to construct expected survival rates for each year up to the year when the workers turn 65 and reach the retirement age. These estimates are then used to calculate expected remaining tenure in the firm as described in Lancaster (1990). Based on age and time limits of the program we also calculate the eligibility for the subsidy in each future year when the worker remains in the firm.

As eligibility also depends on monthly earnings, we will have to make some assumptions on the expected wage growth. Since we focus on older workers that are on a flat segment of the age-earnings profile, we simply assume that the firms predict the nominal earnings to grow according to average annual increase of the wage and salary index, i.e. by 3% per year. Because the earnings limits of the subsidy were not indexed, even nominal earnings growth affects the relative size of the subsidy. Finally, we discount all future earnings and all future subsidies using a 2% annual discount rate. Apparently the discounting makes no difference for the results.

Fig. 5 illustrates the expected changes in the labour costs for selected earnings levels. For monthly earnings above €2,000 the expected labour costs remain unchanged. For earnings below €2,000 the expected reduction of labour costs is naturally the larger the lower is the current wage. Workers under 50 years of age in 2006 are unaffected because they do not reach eligibility age by the end

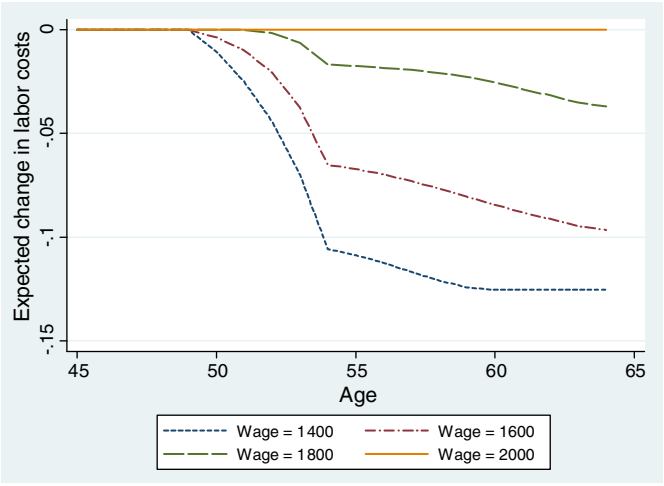

Fig. 5. The effect of the subsidy scheme on expected labour costs by age and wage rate. Note: Decrease in the discounted present value of the expected labour costs during the remaining tenure in the firm due to the subsidy system. Graphs in the figure are calculated for a worker employed in 2006; in 2007, the decrease is slightly smaller due to the remaining duration of subsidy system being a year shorter.

of the program in 2010. Expected costs for workers between 50 and 53 decrease since the workers who remain in the firm will eventually become eligible for the subsidy while the program is still running; the decrease is the larger the sooner the worker reaches the eligibility age. The firms hiring workers over 60 can expect to receive the subsidy until the worker retires. However, even in this age group the size of the subsidy decreases over time due to expected wage growth for the workers who initially are on the progressive part of the subsidy scheme. The decrease in the larger, the longer the worker will remain in the firm and hence depends on expected remaining tenure and therefore on age.[10]

6.3. Heterogeneous effects

For reasons stated above the effects of low-wage subsidy are likely to vary both across the wage level and by age of the worker. We therefore also estimate models where we replace the wage and age indicators in Eq. (1) by finer wage and age categories. This produces separate estimates of the effect of the subsidy for each wage and age category. We present tables displaying these heterogeneous effects after first presenting the main results related to the average outcomes.

7. Results

In order to distinguish the effects of the subsidy system from other factors affecting the employment rates, we first compare the changes in the age-specific employment rates between the groups that are more affected by the low-wage subsidy system to the groups where low-wage subsidies are less important. Table 3 below illustrates the approach.

In the upper section of the table we report employment rates in groups where more than 50% of the employees earned less than €2000 per month in 2005. We report separately the employment rates of persons under 54 and over 54, before and after the introduction of the low-wage subsidy scheme. The next column reports the change in employment rate in each group comparing the 2 years after the reform to the 2 years before the reform. As can be seen from the table the employment rates increase in both groups but the increase is clearly higher among the persons over 54. This difference in changes over time across the age groups is a difference-in-differences estimate for the effect of the subsidy. The estimate is statistically significant and the point estimate indicates a one percentage point increase in the employment rates.

Table 3
Change in the employment rates in groups affected by low-wage subsidies.

	P(Low wage≥0.5)			
	Before	After	Before − After	Diff-in-Diff
Age<54	0.749	0.764	0.015	
	(0.001)	(0.001)	(0.002)	
	[144,891]	[136,738]		
Age≥54	0.482	0.507	0.025	0.010
	(0.001)	(0.001)	(0.002)	(0.002)
	[193,805]	[198,377]		
	P(Low wage<0.5)			
	Before	After	Before-After	Diff-in-Diff
Age<54	0.808	0.828	0.02	
	(0.001)	(0.001)	(0.001)	
	[318,644]	[321,037]		
Age≥54	0.562	0.587	0.025	0.005
	(0.001)	(0.001)	(0.001)	(0.002)
	[324,311]	[345,557]		
			DDD	
				0.005
				(0.003)

Note: Calculations based on FLEED data. "Before" period refers to 2004–2005, and "after" to 2006–2007. Employment rates are calculated based on end of year status. The standard errors are in parenthesis and the number of observations in each group in square brackets.

In the lower section of Table 3 we repeat a similar analysis for groups with less low-wage workers. Also here we first report employment rates separately by age and time and then calculate the changes in each group, eventually producing another difference-in-differences estimate. The estimate is positive also in this case, though smaller in magnitude. We therefore conclude that employment rates increased in all older age groups, not only in those with a large fraction of low-wage workers. A difference-in-difference-in-differences estimate comparing the difference in the estimates in groups with a large fraction of low-wage workers to the estimates in groups with less low-wage workers is still positive (0.005) but no longer statistically significantly different from zero (t-value 1.74).

In Table 4 we present results from regression models explaining the effects on employment. The first column of Table 4 reproduces the estimates that were used to create Table 3. The next two columns report separately the effects on the re-employment rates of the unemployed and to the exits into non-employment from a similar specification. The point here is that if the employment rate of older workers is to grow the adjustment has to occur in one of these margins.

Most coefficients of the regression model are not surprising. Older workers have lower employment rates, lower re-employment rates and higher exit rates. Employment rates are also lower and exit rates higher for low-wage groups, but interestingly so are their re-employment rates. Employment increases slightly over time which is reflected in the coefficients of the post-reform dummy on all three outcomes. The key parameters, the triple difference-estimates, are marked in bold. The small positive effect on employment rates was already discussed above. Table 4 merely shows that effect is certainly not due to increase in the entry of elderly unemployed into low-skill jobs. The point estimate on the re-employment rates of the unemployed is even negative, though statistically insignificant. The effect on exits is slightly negative though close to zero.

[10] One might also worry about anticipatory effects due to a known policy change in the future. However in the case of Finnish payroll-tax subsidies this is unlikely to cause problems. The policy change in January 2006 took most Finnish economists and probably also most firms by surprise. As discussed in Section 3, the government program from 2003 had promised that payroll taxes will be lowered for all low-income workers. Even in spring 2005 the government proposal still involved a general low-wage subsidy scheme without any age limits. However, the program budget was cut in the budget negotiations in September 2005 and the program then limited to the oldest age groups.

Table 4
Effect of subsidy on employment.

	Employment rate	Entry from unemployment	Exit to non-employment
Age≥54	−0.246	−0.142	0.062
	(0.027)	(0.014)	(0.007)
P(Low-wage≥0.5)	−0.059	0.029	0.021
	(0.018)	(0.013)	(0.003)
P(Low≥0.5)×(Age≥54)	−0.021	−0.034	0.001
	(0.052)	(0.026)	(0.013)
Year≥2006	0.020	0.025	−0.007
	(0.002)	(0.004)	(0.001)
(Age≥54)×(Year≥2006)	0.005	−0.012	−0.006
	(0.004)	(0.006)	(0.003)
P(Low≥0.5)×(Year≥2006)	−0.005	0.010	−0.003
	(0.002)	(0.005)	(0.001)
P(Low≥0.5)×(Age≥54)×(Year≥2006)	0.0047	−0.007	−0.002
	(0.007)	(0.009)	(0.005)
n	1 983,360	187,373	1 353,440
R^2	0.078	0.042	0.015
Alternative specifications			
P(Low)×(Age≥54)	0.003	−0.018	−0.001
×(Year≥2006)	(0.018)	(0.029)	(0.011)
P(Low)×Subsidy(Age)	0.044	−0.209	−0.002
×(Year≥2006)	(0.159)	(0.250)	(0.102)
P(Low)×Subsidy(Age)	0.086	−0.179	−0.010
×(Year≥2006)[a]	(0.071)	(0.207)	(0.057)

Notes: FLEED sample. Data in column 1 include all persons between 45 and 64. In column 2, the sample is restricted to those who were unemployed in the end of year $t-1$ and in column 3 to those who were employed in the end of year $t-1$. Robust standard errors clustered by sex/age/education groups in parentheses.

[a] Estimates on the last row are based on an equation that includes full interactions between gender, 1-year age groups and education levels, as well as the interactions between these covariates and the post-reform dummy.

In the regression results reported in the upper part of Table 4 we had divided the gender/education groups in two categories according to the fraction of low-wage workers in each group. In alternative specifications reported in the lower section of Table 4 we try to make the estimates more precise by using all the variation in low-wage intensity in the data. We therefore first replace the low-wage indicator with a continuous variable measuring the fraction of low-wage workers in the same gender/education category. The estimates are still close to zero, the point estimate on the effect of employment even smaller than before. We then also replace the age indicator with an age-specific measure of the size of the subsidy as a fraction of expected labour costs calculated as described in Section 6. Apparently, however, even this has little effect. The point estimates are different, but this is merely due to a different scale in the subsidy measure (replacing a 0/1 indicator with a relative subsidy measure ranging from 0 to 0.13). Despite very large sample sizes, none of the effects are statistically different from zero. Finally, we add full interactions between gender, 1-year age groups and six education categories, as well as interactions of all these covariates with a post-reform dummy. The estimated effects on employment and exit rates increase in absolute value but remain insignificantly different from zero. We have also run regressions separately in 1-year age groups and within gender/education groups (not reported in the table) but the impact of the subsidy on employment rate was statistically not different from zero in any of these groups.

Since the size of the subsidy is measured as a fraction of labour costs in the two last specifications, these estimates can be used for calculating the elasticity of labour demand with respect to labor costs. At sample mean a 10% decrease in labor costs due to the subsidy increases the employment rate by 0.44 percentage points or by 0.67% using estimate on the second last line and 0.86 percentage points or 1.3% using the estimate on the last line. The absolute values of implied demand elasticities 0.067 and 0.13 are small and indicate that the demand for labour is inelastic in these age groups. Note also that even though the estimates are not significantly different from zero, they are quite precise due to a large sample size. Even the upper limit of the 95% confidence interval is around 0.3.

7.1. Effects on the intensive margin

To examine the effects of the subsidy system on hours, we first plot the hours distribution of the low-wage workers in various age groups before and after the reform in Fig. 6. As we focus on the intensive margin response, we limit the data to those who remain in the same firm where they worked just before the reform, in the end of 2005. We also focus on persons who earned less than €2,000 per month, and define this earnings limit according to 2005 earnings.[11]

Some observations can be made directly from Fig. 6. First, there is no evidence of low-wage workers bunching just above the full-time threshold (32 h) that would make them eligible for the subsidy. Instead, a typical part-time worker is employed for about 20 or exactly 30 h per week. Second, the fraction working part-time is very low in the younger age groups but much higher among workers over 58. As noted before, this is related to the part-time pension scheme, the lower age limit of which is 58. However, the fraction of the oldest age group working part-time was substantially reduced after introducing the subsidy system. A natural explanation would be that part-time pension arrangements became relatively more costly for the employers as part-time pensioners are not eligible for low-wage subsidies.

In Table 5 we report estimates from a regression model examining the effects on hours and hourly wages. The regression model in the first column follows the specification in Eq. (1). In the second column we add person fixed effects to this specification.[12] In the third and the fourth column we replace the eligibility indicator with the size of the wage subsidy. In all cases we limit the data to workers that stay in the firm where they worked in the end of 2005 and define the low-wage

[11] Similar graphs were drawn for the high-wage workers. These do not display any major changes and are therefore not presented for brevity. They are available from the authors upon request.

[12] As low-wage indicator is defined according to the 2005 earnings, the fixed effects absorb its effects so that all the parameters are no longer identified. However, the key parameter, triple interaction between low-wage status, age and the reform is still identified.

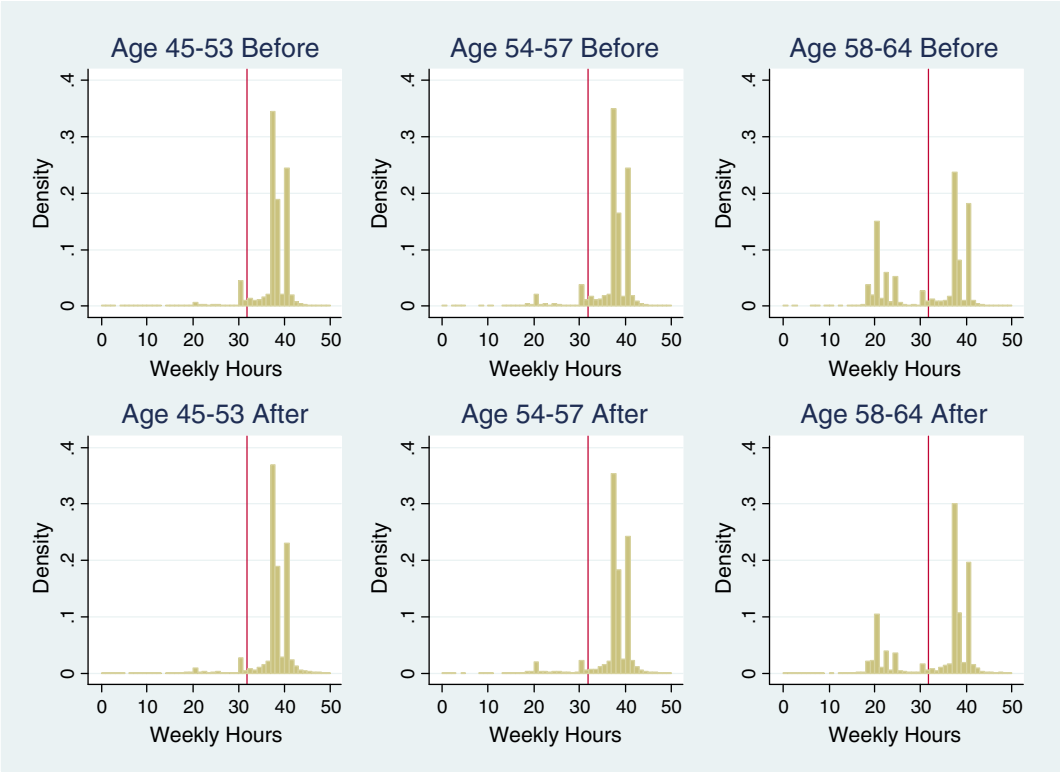

Fig. 6. The distribution of working hours among low-wage workers. Notes: The distribution of working hours among low-wage workers (those who earned less than €2,000 a month in 2005) in the data of the Confederation of Finnish industries, used in the intensive margin analysis of the paper. The vertical line at 32 weekly hours of work indicates the threshold level above which workers were regarded as being full-time workers, thereby being eligible for the low-wage subsidy.

indicator according to the 2005 monthly earnings. To focus on the effects in the lower end of the wage distribution we limit the analysis to workers earning less than €5,000 per month. No restrictions on hours are imposed in order to also capture the effect of part-time workers becoming full-time workers or vice versa.

According to the OLS results on the first row the subsidy increased hours of the low-wage workers. The fixed-effects estimates are smaller and not statistically significant. On the next two rows of the table we examine the heterogeneity of the effect by age by replacing the old age indicator with two age group specific dummy variables and interacting both of these with all the other variables. The coefficients reported in the table are triple interaction terms of the age group, low-wage indicator and post-reform dummy. The results indicate that the positive effect of low-wage subsidies on hours is entirely due to the response in the oldest age group. The fixed-effects estimates are again smaller, but remain statistically significant.

In the bottom part of the table we split the low-wage indicator to three categories representing the different segments of the firms' isocost line shown in Fig. 2. We expected the hours response to be largest in the lowest monthly earnings range where the marginal

Table 5
The effect of low-wage subsidy on working hours and wages for stayers.

Effect for	Log. weekly working hours				Log. hourly wage			
	DDD-dummy		Relative subsidy size		DDD-dummy		Relative subsidy size	
	OLS	FE	OLS	FE	OLS	FE	OLS	FE
All	0.011	0.002	0.136	0.088	−0.015	0.001	−0.489	0.027
	(0.003)**	(0.002)	(0.078)	(0.059)	(0.003)**	(0.001)	(0.066)**	(0.032)
Age 58–64	0.032	0.014	0.322	0.194	−0.031	0.002	−0.489	0.058
	(0.005)**	(0.005)**	(0.098)**	(0.087)*	(0.004)**	(0.002)	(0.086)**	(0.041)
Age 54–57	−0.005	−0.005	−0.168	−0.122	−0.003	0.000	−0.348	0.004
	(0.002)*	(0.003)	(0.062)**	(0.085)	(0.002)	(0.001)	(0.079)**	(0.028)
Wage 900–1400	−0.029	0.012	−0.038	0.165	−0.014	−0.001	−0.216	−0.057
	(0.012)*	(0.019)	(0.161)	(0.215)	(0.010)	(0.008)	(0.115)	(0.081)
Wage 1400–1600	0.035	0.004	0.228	0.003	−0.038	0.003	−0.373	0.075
	(0.013)**	(0.007)	(0.131)	(0.084)	(0.011)**	(0.003)	(0.111)**	(0.038)*
Wage 1600–2000	0.011	0.001	0.129	0.128	−0.011	0.000	−0.795	0.019
	(0.003)**	(0.002)	(0.094)	(0.074)	(0.003)**	(0.001)	(0.095)**	(0.053)

Notes: Observations 766467. The sample includes workers who are 45- to 64-year-old in 2004–2005 and whose earnings were in 2005 between 900 and 5000 euros and who remained with their 2005 employer. The first row in the table reports the coefficient on the third level interaction term (low-wage*older*after) or the expected size of the subsidy as a fraction of total labour costs. The next rows report the coefficient on the specifications where the effect is allowed to vary by age groups (rows 2 and 3) or by year 2005 monthly wage groups. In all columns controls include dummies age dummies, wage group dummies (900–1000, 1000–1200, 1200–1400, etc.), wageg*year, age*year, and age*wageg interactions. The model without fixed effects also include education, sector and gender dummies. Robust standard errors clustered by age and wage groups in parentheses.

payroll tax decreased and smallest or potentially negative in the earnings range between €1600 and €2000 where the marginal payroll tax increased. However, no clear patterns emerge. In particular, none of the fixed-effects estimates are statistically significant.

On the right-hand panel of Table 5 we present similar estimates for the log hourly wages. Again we report both OLS and fixed-effects estimates both for the entire old low-wage workers group and separate estimates for finer divisions by age and pre-reform monthly earnings.

The OLS estimates indicate a negative effect on hourly wages. Given that the OLS estimate for hours was positive, we suspected that the firms could intentionally misreport hours and wages keeping monthly earnings constant to become eligible for subsidies. However, the fixed-effects estimates on wages were generally positive indicating that wage growth among the workers eligible for the subsidies was slightly larger than wage growth among the ineligible. As most of the fixed-effects estimates are insignificant, we would be hesitant of making strong statements on the wage response.

Our general conclusion from the intensive margin analysis is that low-wage subsidy had little effect on hours or wages in all other groups except the oldest. The effect in the oldest age group is explained by the increase in the fraction working full-time and the corresponding decrease in the fraction entering into part-time pension arrangements. As low-wage subsidies were provided for full-time workers only part-time pension became relatively more expensive for the employers, reducing its popularity.

8. Conclusions

This paper estimated the employment effects of a Finnish low-wage subsidy scheme that was targeted to older low-wage workers. We used fixed-effects estimators that controlled for differences between eligible and ineligible workers and general changes over time.

According to our results the subsidies to employers of old low-wage workers had little effect on the employment rate of the target group. Depending on the specification our estimates implied elasticities around −0.1. The effect was small even though the subsidy was sizable, up to 16% of gross wages, subsidy program lasted for as long as 5 years, and the target group was reasonably large. It should be added that even though our estimates on employment rates were typically not statistically different from zero, they were quite precise due to very large sample sizes. Our conclusion based on these estimates is that the demand for older workers is relatively inelastic at the extensive margin and hence the prospects of improving labour market position of older low-skill workers with financial incentives for the employers appear limited. A subsidy system that has an annual fiscal cost of around €90 million and no significant effect on employment clearly performs poorly in any cost-benefit analysis. In fact, the government reached similar conclusions and the low-wage subsidy scheme ended in 2010.

When examining the effect on working hours along the intensive margin (i.e. among those that stayed in the same firm over the period of analysis), we found effects only among those who were 58 years or older. These workers are eligible for part-time pension arrangements and have more flexibility in their hours choices. The elasticity of working hours among this group eligible for part-time pension is approximately 0.2, which is of smallish but reasonable magnitude given prior knowledge of elasticities at the intensive margin. One of the findings of the analysis is, therefore, that pension arrangements and subsidies targeted to cut labour costs among older workers can have interesting interaction effects.

Appendix. Theoretical framework

To understand the expected effects of the payroll tax reform, we consider a simple framework with two types of labour, highly skilled (h) and unskilled (u). We suppose further that the tax changes affect a relatively small proportion of the labour force and the overall output remains unchanged, that is, we can concentrate on a cost minimisation problem at the firm side. We examine the responses to the tax reform both at the extensive margin (i.e. the number of different types of workers the firm hires) and at the intensive margin (the number of hours demanded from workers of different types who already work).

First we illustrate the impact of subsidy on employment at extensive margin. Suppose, therefore, that the firm chooses the number of workers of each type, who all work a given amount of hours. This choice then depends on the average payroll tax rate payable for each worker. In this framework, the cost function of the firm's cost minimisation problem is $C=(1+t)y_h+(1+S)y_u$, where y_h and y_l denote the number of highly skilled and unskilled workers, and t and S denote the per-worker payroll tax on highly skilled and unskilled worker. The firm minimises costs C subject to the requirement that output $z=f(y_u,y_h)$ must be at a given level, $\bar{z}$. Because of the properties of the cost function in the two-input case, the following comparative statics properties hold:

$$\frac{\partial y_u}{\partial(1+S)w_u}<0 \tag{A.1}$$

$$\frac{\partial y_h}{\partial(1+S)w_u}>0 \tag{A.2}$$

These results imply that since the payroll tax experiment reduced the average tax rate of all older low-wage workers, their labour demand at the intensive margin should go up, although to a varying degree depending on the exact magnitude implied by the tax cut.

Consider next the intensive margin. Denote the hourly wage rate by w_i and the working hours by l_i so that the earnings per month are $y_i=w_i l_i$, for $i=h,u$. The unskilled worker earns wages below €2,000 a month whereas the skilled worker always earns more than €2,000. The firm's cost function is now $C=(1+t)y_h+[1+S(y_u)]y_u$, where t denotes the constant payroll tax rate the firm pays for skilled labour (and for simplicity, the number of workers of both types is unity). The firm pays a non-linear payroll tax, $S(y_u)$ for the use of unskilled labour.

Following the technique in examining labour supply in a framework with non-linear taxes, we linearise the cost function so that $C=(1+t)y_h+(1+s)y_u+R$, where s denotes the marginal payroll tax rate for low-skilled labour and R is a kind of 'virtual cost', i.e. the intercept of the isocost line if the marginal payroll tax rate s was paid for the entire workforce of u. The virtual cost is also illustrated in Fig. 2 for the first changed segment from the left, corresponding to the segment with a negative marginal payroll tax rate.

Cost minimisation leads to conditional factor demand functions $l_h[(1+t)w_h,(1+s)w_u,R,\bar{z}]$ and $l_u[(1+t)w_h,(1+s)w_u,R,\bar{z}]$. These imply that, for a fixed hourly wage rate, an increase in the marginal payroll tax rate s will reduce the demand for unskilled labour and increase the demand for the highly skilled labour force, as also depicted in Fig. 2.

To illustrate the degree of which taxes are shifted into wages, we consider a simple closed-form solution with Cobb–Douglas production function $z=Al_u^a l_h^b$. With constant returns to scale ($a+b=1$) and the parameter A normalised to unity, the conditional demand for unskilled labour in the two-input Cobb–Douglas case is of the form (Varian 1992, p. 54)

$$l_u^D=\left[\frac{a(1+t)w_h}{b(1+s)w_u}\right]^b z \tag{A.3}$$

Suppose further, as in Rothstein (2010), that labour supply is of the constant elasticity form

$$l_u^S=\alpha[(1-\tau)w]^\sigma, \tag{A.4}$$

where τ represent the marginal labour income tax rate, which is ignored below since it is assumed to remain constant. Setting labour demand equal to labour supply gives the equilibrium wage

$$w_u = \Psi(1+s)^{\frac{-b}{\sigma+b}}, \tag{A.5}$$

where $\psi = (z/\alpha)^{\frac{1}{\sigma+b}}[a(1+t)w_h/b]^{\frac{b}{\sigma+b}}$. Taking logarithms from each side and differentiating,[13] again as in Rothstein (2010), one can infer how the percentage change in wages for the unskilled labour reacts to percentage changes in the marginal payroll tax rate

$$d\ln w_u = -\frac{b}{\sigma+b} d\ln(1+s) \approx -\frac{b}{\sigma+b} d\ln s \tag{A.6}$$

The wage rate remains fixed for perfectly elastic labour supply ($\sigma \to \infty$); the wage reaction completely absorbs the change in the tax rate if labour supply is fixed ($\sigma = 0$), and in the intermediate case gross wages grow somewhat.

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