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TAX CUTS AND EMPLOYMENT: EVIDENCE FROM FINNISH LINKED EMPLOYER-EMPLOYEE DATA**

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ABSTRACT: We analyse taxes and employment in a system of firm-level labour demand and industry-level regional labour supply, using linked employer-employee data from Finland in 1990-2003. We show that virtually all of the wage tax burden is borne by employers since wages fully adjust. Labour demand also responds with short lags within a year or two to cuts in taxes and labour costs. A unit decrease in wage tax rate (2.2% lower taxes) leads to an average long-run employment improvement of 0.8%, while an equivalent cut in social security payments has effects that are nearly twice as low. Tax cuts thus explain a substantial part of the recent improvement in employment since the deep recession of the early 1990s (besides the release of firms' liquidity constraints). Nearly half of the tax revenue loss due to wage tax cuts is paid back in the form of higher employment and lower unemployment costs. Tax cuts with emphasis on low-wage, low-productivity firms may appear undesirable, as tax cuts cure employment of low-skilled workers especially in skill-intensive firms.

JEL: J31, J59, C24

Keywords: Taxation on Labour, Labour Demand, Regional labour supply, Wage Bargaining, Wage Elasticity.

1 Introduction

Tax cuts to cure employment have been undertaken since the 1990s in a Europe faced with persistent high unemployment. Employment policies have traditionally focused on demand-side measures, also due to the heavy process of industrial restructuring. In recent years, however, several EU countries have also tried to tackle the inactivity trap from a labour-supply perspective of low-income earners. Germany undertook the Agenda 2010 with extended cuts in unemployment benefits and income assistance, accompanied by social security subsidies on low earnings. By 2005 the tax rate in the first tax bracket fell to 15% (from 22.9% in 2000), while the top rate was cut to 42% (from 51% in 2000). In the Netherlands, by 2005 the new maximum marginal tax rate was 52% (from 60% in 2001). In the 2000s, tax cuts have been prevalent in nearly all the other European countries with an emphasis on low-income earners (e.g. the UK, Spain, Austria, France, Norway). In Finland, by 2005 the top marginal tax rate had fallen to 33.5% (from 39% in 1991-96). The cuts in tax rates have been fairly equal at all income levels, but with increasing tax credits for low-income earners in municipal taxation.

It is, however, unclear to what degree the tax burden is borne by employees, affecting labour supply, or by employers, affecting labour demand. Fluctuations in aggregate demand induce shifts in the labour demand schedule, which makes it difficult to isolate pure tax-policy-driven employment effects. We also observe very small fluctuations in the real wage or labour costs relative to the fluctuations in employment. The second stylised fact is the inelastic short-run labour supply, yielding ambiguity in the supply-driven tax policy, too. It is also unclear whether the labour market clears and in what way, as evidenced by Andrews (1987). Empirical estimates vary and can be disputed. Nickell (2004) finds the taxes on labour to have significant but not very strong effects. A consensus estimate is that a 1% increase in taxes on labour lowers employment by 0.2%.[1] The employment effects of this magnitude implies that general tax cuts are a costly way to improve employment. Some of this may be due to separate analysis of labour demand from supply, while labour force participation effects can be notable, see e.g. Fiorito and Padrini (2001). Consensus opinion seems to be among labour economists –not among policy decision-makers who decide on the actual tax policy – that the social security systems, institutions, early retirement routes and disability benefits rather than taxes explain much of the variation in unemployment rates across OECD countries.

[1] See also Davis and Henrekson (2004) and Koskela (2002).

The Finnish labour market is characterized by collective bargaining on wages but not on employment (see Holmlund (1989) for alternative bargaining models; see Pekkarinen and Alho 2005 and Uusitalo 2005 for the Finnish labour market). Wage bargaining is typically co-ordinated at the national level, and the wages of most employees are regulated by collective agreements. In addition to this, there is no formal hindrance for firms to pay more than is agreed in wage contracts. Production (P) and non-production (NP) worker segments belong to different unions. The wage negotiations of upper NP workers are carried out more on an individual basis, but the participation rate in the unions is a high 80% and comparable to that of P workers. Wage drift has been, on average, one-third of the total increase in earnings. A central part of the tripartite co-ordination between unions, employers' confederations and the government has been the promises by the government to cut taxes when wage agreements are moderate. Labour costs are thus potentially elastic with respect to general tax cuts in collective wage bargaining. Collective wage bargaining is most binding for setting wages for production workers. Böckerman et al. (2006) find a peak in the distribution of wage changes for manual manufacturing workers near the level of the agreed wage increase in the contemporaneous collective agreement.

Our unit of analysis for labour demand is the firm, which makes the choice of labour, energy, materials, and capital for use in output creation.[2] It should be emphasized that the price elasticity of demand for a (single) product is higher at the firm level than that of a composite product at the industry level. This implies that also wage elasticity of labour demand is higher when evaluated at firm level than at more aggregate level. Firms are also in different phases in satisfying their demand for labour, which is difficult to account for at the industry level.[3]

Part of the labour costs also emerges from the upgrade of skill level. If technology is complementary to skills acceleration in the rate of technological change, then tax cuts that further support innovation activity may raise, in particular, the demand for skilled labour. New technology raises the marginal productivity of skilled labour relative to unskilled labour, making it cheaper to employ skilled workers in place of unskilled ones. SBTC appears to be a long-term historical trend (Goldin and Katz 1998, Von Tunzelman and Anderson, 1998). Skill-biased technical change (SBTC) would be difficult to isolate at the industry level. Large firms also operate in several industries and face demand shocks

[2] See Hamermesh (1993), for arguments for the right-to-manage model, where wages are bargained while the firm decides employment; see Holm, Honkapohja and Koskela (1994), Koskela (2002) and also Oswald (1993).
[3] The conditions when industry-level analysis is appropriate and aggregate variables do not introduce a negligible bias are quite restrictive; see Solow (1957) and Fisher (1993).

differently. Many of the IT sector firms were formerly classified as belonging to traditional manufacturing.

Supply shocks also vary, depending on the location of the firm and other factors, while it is not possible to locate industries regionally. Firms are also likely to set wage offers, taking into account regional mobility and job opportunities in the region. "Standard rate" wage policies in collective agreements fix both the number of job categories in which workers are placed and the rate of pay for each job, all of which should set a constraint on the supply side. Wage contracts thus define the available labour that can be used in each qualified job. Analogously to Manning (2003), firms face (regional) labour supply that is not perfectly (we also evaluate supply separately in four industries).

It is also useful to analyse worker groups that can be argued to have reasonably segmented labour markets: non-production workers and production workers, young and older workers. These labour market segments are found to be complements in many studies (see Iranzo et al., 2006, for production and non-production workers, and Anderson, 1978 for young and old). Grant and Hamermesh (1982), Berger (1983) and Topel (1994a and b) also find a strong substitutability in production between women, low-skilled men and young workers. 29% of young workers of the ages of 15-39 do indeed belong to the lowest decile of hourly earnings in our data. One ingredient of recent tax reforms has been that the most efficient way to support employment is to target labour tax cuts to low-wage earners such as young workers.

We use here unique panel data of firms and regions mainly from the manufacturing, technology and construction sectors in Finland in 1990-2003. We use fixed effect estimates and include labour supply in the system analysis. Firm-level labour demand – and separately for production and non-production workers – is linked to labour supply in four industries in 78 Finnish regions at the Nuts 4 level. These sub-regions are formed by a central municipality and its neighbouring suburbs. The average size of a region is between 20,000 and 60,000, as measured by employment. In Finland these are regions where people live and go to work and hence are largely self-sufficient economic areas with regard to employment and output. It is thus possible to capture two independent sources of (exogenous) fluctuation to characterize regional labour supply in the main industries and the labour demand schedule for individual firms. A dynamic model with flexible adjustment follows labour demand analysis in Kumbhakar and Hjalmarsson (1995) and in Estonian Manufacturing in Masso and Heshmati (2003).[4]

[4] See also Kumbhakar, Heshmati, Hjalmarsson (2002).

It is shown here that tax cuts do improve employment although improving liquidity and thus less hampering financial constraints probably played the main part in the recovery of employment since the deep recession of the early 1990s. Labour costs are most sensitive to the taxes among the production and young workers. The rest of the paper is structured as follows: Section 2 describes the data. Section 3 presents the labour demand and supply model. Section 4 shows labour demand and supply elasticities. Section 5 describes the employment effect of tax policies. Section 6 makes some robustness checks and Section 7 concludes.

2 Data

We use employer data from the Confederation of Finnish Industry, which covers information on employees in a relatively long time dimension: 1990-2003. Data include information on forms of payments, working hours, profession and education level. The NP employees receive monthly salaries and the P workers are remunerated on an hourly basis. Due to the fact that each individual is connected to a firm via a firm and plant identification code we can aggregate the individuals at the firm level. The firm level data is further aggregated to the industry and regional Nuts-4 (2004) levels to represent the supply side with 78 regions (excluding 5 regions with only a few manufacturing firms). The four industries and respective employment shares from total employment of 374,980 in firms members in the Confederation of Finnish Industry are i) manufacturing (57%), ii) technology industries (26%), iii) construction (12%), iv) trade, transportation, energy, services (5 %).

The person-year observations drop from 5.51 million to 5.22 million, of which 68% are P and 32% are NP employees after deleting unreliable values in payments, working hours, education and seniority. Variables using employee-employer data are as follows:

Wage tax rate are based on own calculations using actual tax brackets with standard deductions (work-related expenses including those from travel, income-dependent 'tax credit' in municipal taxation, excluding interest payments on loans deducted from capital income since 1993). Varying municipal tax rates yield a variation in taxes independent of the economic cycle. (The overall standard deviation is 3.3% and that of between years is 1.6% and between regions is 1%.) This requires the evaluation of annual earnings using hourly wages and hours worked among P workers or from monthly wages among NP workers in the data from the fourth quarter.

Social security payments based on own calculations include pensions-related social payments (varying on firm size and depreciation[5]), payments to cover disability and unemployment expenses (varying on firm size) and insurance payments. Here, these include social security payments paid by employees, which are collected by employers but deductible from the taxable income in wage taxation (which is taken into account). The social security payments vary across firms of different size and, thereby, also across regions. These show a significant deviation, depending on the size and capital intensity of the firm according to the tax rules. (The standard deviation is 7.0% and that of between years 3.6% and regions 1.6%.)

Producer wage is the hourly gross wage (depending on a regular weekly working time for NP workers) plus social security payments adjusted for producer prices. *Producer price* is evaluated at the two-digit industry level. NP workers earn, on average, 42% more than P workers based on the producer wage.

Consumer wage is the net-of-tax hourly wages adjusted for consumer prices (aggregated at the regional and industry levels).

Production Worker Share is the share of P workers from all the workforce in the payroll list of the firm in the fourth quarter.

Education is the average of the workers' education years measuring years in schooling in 6 degrees with at the same degree 1-2 less years of education in technical than in non-technical fields.

Seniority is the duration of the worker's employment in the firm. Firm births and deaths are considered as a mere transfer of the firm, in instances where people employed either at the old firm at date t-1 or at the new firm at date t constitute more than 40 per cent of all employees working in these firms at dates t-1 and t. These artificial deaths and births account for approximately 3 per cent of all firm entrance and exits from the market. Many of the old or new firms are large and, hence, recoding will affect 9% of the employees.

Working Age Agglomeration is a decay-weighted sum of the workers of 16-64 years of age over the regions at the Nuts 4 level. Spatial weights are based on a negative exponential function with the

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[5] The predicted value of depreciation is used from the estimation for the subsample of firms where data on depreciation of capital is available, using size and total wage expenses as explanatory factors.

distance decay parameter depending on the distances between neighbouring regions, following Funke and Niebuhr (2005). The half-decay distance that reduces the spatial interaction by one-half is set, on average, at 289 kilometres (an average twice as high in Northern Finland with long distances).

Variables from Statistics Finland are available at the more aggregate Nuts 3 level:

Labour force population share is the labour force of 15-64 years of age per the population of 15-64 years of age.

Unemployment rate is unemployment at 15-64 years of age per the labour force of 15-64 years of age.

The following table, Table 1, shows descriptive statistics.

Table 1. Descriptive Statistics

Year	Total Employ-ment	Age 18-28 (%)	Age 29-40 (%)	Age 41-52 (%)	Age 53-64 (%)	Hourly Wage €	Wage Tax (%)	Social Security (%)	Edu-cation (years)	Senio-rity (.years)
90	405 879	21 %	35 %	33 %	11 %	9.7	26.8 %	22.9 %	10.3	7.5
91	345 124	17 %	35 %	36 %	12 %	9.9	26.7 %	32.3 %	10.6	8.4
92	300 275	15 %	35 %	38 %	12 %	10.2	27.3 %	20.6 %	10.8	9.2
93	256 736	14 %	35 %	40 %	11 %	10.5	26.6 %	29.6 %	10.4	9.5
94	297 785	17 %	34 %	38 %	11 %	10.6	30.1 %	29.9 %	10.2	9.5
95	338 671	17 %	34 %	38 %	11 %	10.5	30.4 %	32.4 %	10.4	9.3
96	380 720	21 %	32 %	36 %	11 %	10.8	30.5 %	30.1 %	12.1	9.3
97	401 492	21 %	32 %	36 %	11 %	10.7	28.3 %	30.8 %	12.0	11.1
98	395 861	22 %	32 %	35 %	12 %	10.6	27.6 %	31.4 %	12.0	8.5
99	401 797	21 %	31 %	34 %	13 %	10.8	26.9 %	31.5 %	12.2	9.2
00	424 081	22 %	31 %	32 %	14 %	11.3	27.6 %	31.8 %	12.3	8.5
01	450 870	22 %	30 %	32 %	16 %	11.3	26.7 %	31.1 %	12.3	8.8
02	431 123	22 %	30 %	31 %	17 %	11.3	25.9 %	29.0 %	12.3	9.3
03	419 306	21 %	30 %	31 %	18 %	11.7	25.7 %	29.3 %	12.3	9.7
Avg	374 980	20 %	33 %	34 %	13 %	10.7	27.7 %	29.5 %	11.3	9.1

It is seen from Table 1 that the average tax rate has increased from 26.8% to a top 30.5% in 1996 and decreased to 25.7% by 2003. The figures are closely the same as obtained by tax payers association of Finland in Kurjenoja (2006). The cut down in wage tax since 1995 has been distributed fairly equally on all tax payers, but with somewhat high cuts for low-wage earners. Social security taxes have stayed at the relatively same level, the average being 29.5% (which includes taxes paid by employees; the exceptions are 1990 and the deep recession year 1992). The social security payments are here on average 1-2%-point lower than the average figures reported by Ministry of Finance due to fixing unemployment insurance payments (although vary depending on wage sum). Social security payments have also decreased since 1995 level because the relative burden on large firms have gone down (firms in the data are larger than in private sector in general). The increasing share of older employees of 55-64 years of age, average work experience and average seniority indicate the steady ageing of the working population, which is a key characteristic of the Finnish labour market. The baby-boomer generation born in 1945-59, which has dominated the market, is beginning to move to retirement during the following ten years. The educated workforce has steadily increased its share.

3 A Dynamic Model of Labour Demand and Supply

Our model includes a dynamic adjustment of labour demand and labour supply the firm faces in the industry in the region. Labour supply is a reduced version of Lucas and Rapping's (1969) supply curve, which is derived by maximising a utility function whose four arguments are current and future goods and leisure, subject to the budget constraint implied by a perfect capital market. We ignore the effect of a real interest rate. We also keep the supply side simple and do not separate transitory and permanent effects that include wealth effects from the future sequence of real wages. For the system to be identified, regional characteristics include variables that do not appear in labour demand, and firm heterogeneity includes characteristics that do not appear in labour supply.

Labour demand is different in the short and the long run, due to adjustment costs in hiring and firing labour, see Sargent (1978). The partial adjustment process specifies labour demand as linear combinations of previous labour use (L_{ijt-1}) and minimal optimal labour input for a given level of output (L^*_{ijt}), where index *i* is firm, *j* is the labour market segment (all, production (P) workers, non-production (NP) workers, young, older) and *t* is the time period. The partial adjustment process that is used to characterize labour demand can be presented as follows:

$$\left(L_{ijt} \big/ L_{ijt-1} \right) = \left(L^*_{ijt} \big/ L_{ijt-1} \right)^{\delta_{ijt}} \quad . \qquad (1)$$

Taking a natural logarithm (small capital denotes logarithmic form), rearranging and appending an error term we get

$$l_{ijt} = (1-\delta_{ijt})l_{ijt-1} + \delta_{ijt}l^{*}_{ijt} + \mu_{ij} + \lambda_{ijt} + \nu_{ijt}\,, \qquad (2)$$

where $l_{ijt} =$ the natural log of the number of employees $\ln(L_{ijt})$, $0 \le \delta_{ijt} \le 1$ = the adjustment parameter. In the error term μ_{ij} are firm-specific effects in the labour market segment *j*, λ_{ijt} are time-specific effects and ν_{ijt} are random error components, which are assumed to be independently and identically distributed with mean zero and constant variance. The adjustment parameter measures the percentage with which the gap between actual and optimal demand is eliminated per time period. For example, if $\delta_{ijt} = 1$, then the adjustment of demand is full and occurs within a single period. In contrast to Masso and Heshmati (2003) and Heshmati and Bhandari (2005), we control firm-specific effects. This helps in eliminating the influence of omitted variables, the most important being here the lack of information on capital intensity. The optimal level of labour input is modelled as

$$l^{*}_{ijt} - \mu_{lji} = \eta X_{ijt} - \mu_{xji} + \nu_{ijt}\,, \qquad (3)$$

where

$$\eta X_{ijt} - \mu_{xji} \equiv \eta_j (w_{ijt} - \mu_{wji}) + \eta^{e}_{wj}(w_{it}\ln E_{it} - \mu_{wei})$$
$$+ \eta^{h}(\ln H_{it} - \mu_{hi}) + \eta_T T_{it},$$

with w_{ijt} = log of labour costs, $w_{ijt}E_{ijt}$ = log of labour costs interacted to log of education level of workforce E_{it}, H_{it} = firm heterogeneity: log of education, log of seniority and the share of P workers. All variables that relate to labour demand are expressed as deviations from firm-specific means. The education E_{ijt} shows up in its own right and is a better equation, on statistical grounds, than the version that has only the trend as a proxy for skill-biased technical change. The interaction $w_{ijt}E_{ijt}$ captures the variation in flexibility depending on educational skills. The share of P workers is found to be necessary in the estimation of demand for NP workers, since the demand is heterogeneous and varies a lot depending on the type of firm. P workers are, instead, more homogeneous and remunerated on a more equal basis, irrespective of the type of firm. Including the share of P workers would only capture part of the wage cost effect. The wages are deflated by producer prices that have consistently undershot CPI inflation. Time-specific effects T_{it} take into account the time trend and the years 1990-1994, including the deep recession in 1991-1994, although there is, in principle, enough information available to explain the secular increases in employment and the real wage over the sample.

The adjustment parameter is modelled as a function of endogenous and exogenous factors

$$\delta_{ijt} = \delta_0 + \delta_1 DIST_{ijt} + \delta_2 t_{90-94} + \delta_3 trend\,, \tag{4}$$

with $trend$ = a time trend, t_{90-94} = a dummy for the period 1990-94 and DIST is the distance from the optimum defined as

$$DIST_{ijt} = \left| l^*_{ijt} - l_{ijt-1} \right| \geq 0\,, \tag{5}$$

being thus the absolute value of the difference between the predicted employment and actual employment in the preceding period. Equations (4) and (5) bring considerable flexibility to the model, as adjustment is firm specific. The conventional approach would have been to define $\delta_{it} = \delta_0$ so that the distance to equilibrium would have had no effect for the adjustment speed. By substituting equations (3) and (4) to equation (2) we get the dynamic labour demand.

$$l_{ijt} - \mu_{lij} = (1-\delta_{ijt})(\eta X_{ijt} - \mu_{xij}) + \delta_{ijt}(\eta X_{ijt} - \mu_{xij}) + v_{it}\,. \tag{6}$$

Labour supply in region k=1,…,78 in the main industry n=1,…,4 for the labour market segment j is given correspondingly by

$$l_{knjt} - \mu_{knj} = (1-\delta_{knjt})(\varepsilon X_{knjt} - \mu_{xknj}) + \delta_{knjt}(\varepsilon X_{knjt} - \mu_{knj}) + \varpi_{knjt}\,, \tag{7}$$

where $\varepsilon X_{knjt} - \mu_{knj} = \varepsilon_j (w_{knjt}(1-t_k) - \mu_{w(1-t_k)knj}) + \varepsilon^r (\mathrm{R}_{kjt} - \mu_{rkj})$,

with $l_{knjt} = \ln \sum_{i \in k,n} L_{ijt}$ = the log of sub-region k's regional supply in four industries n in year t, $w_{knt}(1-t_{knt}) = \sum_{i \in k,n} \omega_{it} W_{it}(1-t_{kt})$ = the log of sub-region k's average wages net of taxes t_{knt}, where the weight ω_{it} is the relative employment of each firm from the total employment in industry in the region and sums to unity $\sum_{i \in k,n} \omega_{it} = 1$ and R_{kjt} = regional characteristic: the labour force share of worker group *j*, the unemployment rate of worker (age) group *j* and the working age population share. The labour force share and the unemployment rate (in lags) and the agglomeration of the working-age population of 15-64 years of age set the regional labour supply together with the response of labour supply to wage offers in the industry. The labour force share is typically higher in urban areas. The unemployment rate indicates labour market tightness. The agglomeration of the working-age population of 15-64 years of age also captures shifts in cohort sizes; see Connelly (1986).

The regional supply is the sum over the firms located in the sub-region in the industry, and the error terms ν_{it} and ω_{kt} in Equations (6) and (7) are correlated, $(corr(\nu_{it}, \omega_{kt}) \neq 0, \forall i \in k)$. The system of Equations (6) and (7) is estimated by using Seemingly Unrelated Regression (SUR; see Zellner, 1962) jointly. The system includes equation for the labour demand (or two for P and NP workers) and equation for the regional labour supply. This method is based on the assumption that the right-hand part of the equation is independent of the error term, that the errors are crossed, and that the method therefore guarantees greater efficiency compared with an OLS estimation of the single equations. (For a discussion of this methodology in the context of skill-biased change, see Sanders and Ter Weel, 2000, p. 22 ff.)

4 Labour Demand and Supply

The following table, Table 2, shows the estimation results of the model for labour demand and regional supply from (6) and (7). Column 2 includes the interaction term of wages to education. Columns 3 and 4 report the results of the three-equation SUR system with a separate estimation for P and NP workers. Hence, the same equation (demand for labour) is applied to two different components (production and non-production workers) of the same workforce within the same firm, where it is natural to assume that the errors are correlated. Table A.1 in Appendix A shows a separate estimation for the P and NP workers and, additionally, for the age groups 18-28 and 53-64 years of age. For P workers we use an hourly gross wage for all workers. Table 3 presents the overall long- and short-run wage elasticities of labour demand and regional supply, aggregated from the firm level, using as weights the total employment. The short-run effects are obtained by multiplying the long-run effects by the speeds of adjustment, which are not separately reported (simply short-run divided by long-run effects). Table 3 also reports the elasticities, having only the labour demand side in the system.

Table 2. Fixed Effects SUR Estimates of Labour Demand and Supply

Firm Labour Demand	All	std	All	std	Production Workers SYSTEM	std	Non-Production Workers SYSTEM	std
Producer Wage	-0.710	(0.033)	0.783	(0.139)	-0.472	(0.036)	-0.001	(0.031)
Interaction with Education			-0.598	(0.054)				
Interaction with Production Worker Share							-0.214	(0.015)
Education	-0.693	(0.036)	0.797	(0.139)	-0.174	(0.041)	0.051	(0.043)
Production Worker Share							0.230	(0.041)
Seniority	-0.194	(0.009)	-0.197	(0.009)	-0.207	(0.011)	-0.036	(0.009)
Years 90-94	-0.061	(0.005)	-0.056	(0.005)	-0.117	(0.005)	0.024	(0.005)
Time Trend	0.006	(0)	0.006	(0)	0.003	(0.001)	-0.001	(0)
Adjustment speed: Constant	0.785	(0.007)	0.784	(0.007)	0.740	(0.008)	0.764	(0.007)
Distance from optimum	0.036	(0.003)	0.036	(0.003)	0.043	(0.004)	0.040	(0.003)
Years 90-94	-0.050	(0.015)	-0.053	(0.015)	-0.022	(0.018)	-0.072	(0.017)
Time Trend	-0.022	(0.002)	-0.023	(0.002)	-0.027	(0.002)	-0.025	(0.002)
Regional Labour Supply								
Consumer Wage	1.490	(0.042)	1.495	(0.042)	1.286	(0.051)	1.286	(0.051)
Labour Force Population Share$_{t-1}$	-1.726	(0.118)	-1.661	(0.118)	-0.871	(0.143)	-0.871	(0.143)
Working Age Population Agglomeration	1.299	(0.129)	1.308	(0.129)	1.555	(0.157)	1.555	(0.157)
Unemployment Rate $_{t-1}$	-0.813	(0.086)	-0.815	(0.086)	-0.419	(0.104)	-0.419	(0.104)
Years 90-94	0.260	(0.008)	0.247	(0.008)	0.188	(0.01)	0.188	(0.01)
Time Trend	-0.009	(0.001)	-0.010	(0.001)	-0.010	(0.001)	-0.010	(0.001)
Adjustment speed: Constant	0.752	(0.005)	0.752	(0.005)	0.715	(0.006)	0.715	(0.006)
Distance from optimum	0.051	(0.001)	0.050	(0.001)	0.064	(0.002)	0.064	(0.002)
Adjusted R2, Durbin-Watson (labour demand)		0.127, 1.645		0.131, 1.642		0.163, 1.61		0.092, 0.153
Adjusted R2, Durbin-Watson (labour supply)		0.194 1.113		0.195, 1.123		0.203, 0.157		
Correlation of Residuals		0.119		0.119		0.126, 0.382		0.089, 0.382
Observations		23 777		23 777		15 131		

Last columns show system estimation for P and NP workers. Here, correlation of residuals reports first the one with the other labour market segment and the second one is with labour supply. All the estimates are significant at 99.9% level or at 99% level (net wage for P workers and production worker share for NP workers) except education, net wage and time trend for NP workers.

Table 3. Long-Run and Short-Run Average Wage Elasticities in SUR and OLS estimations

		All	Education Interaction	P worker	NP worker	18-28 yrs	53-64 yrs
SUR	Demand	-0.71	-0.70	-0.472	-0.14	-0.62	-0.11
	Short run	-0.62	-0.53	-0.360	-0.09	-0.23	-0.06
SUR	Supply	1.49	1.50	1.29	1.29	1.79	1.85
SUR	Demand Only	-0.71	-3.77	-0.4748	-0.15	-0.64	-0.18
	Short run	-0.62	-3.45	-0.3583	-0.10	-0.48	-0.13

Note. Table shows overall average of long and short run elasticity. OLS is single equation labour demand estimation.

It is seen from the Durbin-Watson test that autocorrelation is absent at the 5% level on the demand side. We observe some positive autocorrelation in the labour supply residuals. Labour supply is not, however, our main focus. We can see from Tables 2 and 3 that the overall long-run wage elasticity is -0.71. This means that when the producer wage increases by 1% labour demand falls ceteris paribus by -0.71%. We find the flexible adjustment model convenient, as the adjustment speed is faster when employment is far from the optimum. (The early 1990s' period dummy is negative but small.) Surprisingly, the speed of adjustment has decreased over time. On average, the short-run effects are 60-80 per cent of the long-run effects, so that it takes from 15 to 18 months to achieve the long-run equilibrium.

It is seen from Column 1 in Table 2 that average upgrading of the education level by 5% (0.6 yrs) leads to a decrease in labour input by 3.5%, the effect of which is entirely borne by P workers. Column 2 reveals a negative coefficient of the interaction of wages to the education level. Table 3 in turn shows that the average wage elasticity over the firms is close to the same around -0.70 – -0.71 without or with this interaction term. It is also noteworthy that the wage elasticity would be higher, around –1, if the education level of workers were dropped from the model. We can say that part of the negative effect of labour costs relate to more intense use of educated labour force and SBTC. The negative interaction to the education level can be interpreted as the SBTC effect. Therefore, tax cuts with emphasis on low-wage, low-skill firms may appear undesirable, as tax cuts cure employment of low-skilled workers especially in skill-intensive firms.

Taking into account that other approaches have only indirectly controlled SBTC – which explains part of the negative wage elasticity – it can be said that the wage elasticity is close the same as in earlier firm-level studies across several British industries in Blanchflower, Millward and Oswald (1991) (-0.93), in the British coalmine industry in Carruth and Oswald (1985) (-1 – -1.4) or for Finland in Honkapohja et al. (1999, p. 38) (-0.87). These studies include either a time trend or an economic cycle phase and do not control for skill level. The labour cost would capture part of the higher costs incurred when the skill level in the firm is upgraded and (possibly) the overall demand for labour decreases. SBTC has made the labour demand of P workers more sensitive to the labour cost. The estimates without this SBTC control are, hence, not likely to reflect the true ceteris paribus effects of an increase in labour costs. Carruth and Oswald (1985) also noted that SBTC might have shifted the labour supply curve of unskilled labour to the right, tending to lead to the overestimation of wage elasticity. We come to this issue later in robustness checks.

According to the Hicks-Marshall hypothesis, elasticity increases when the cost of employing the category of labour is a large share of the total cost of production. We have thus in general not included in the estimation the share of P workers as this would capture part of this effect. The exception is NP workers to whom the labour demand varies a lot depending on the type of firm as captured by the share of P workers. We can see that the demand for NP workers associates positively with the share of P workers. In less skill-intensive firms, the demand appears labour-cost-sensitive both to P and to NP workers. This is against the Hicks-Marshall hypothesis on the part of NP workers.

It is seen from Column 3 that the wage elasticities for P workers are somewhat lower than for all workers. This is even despite the use of the firm's average wages to explain the demand for P workers and not only its own wage level. It is noteworthy that we have used very reliable information on hourly wages so that the lower elasticities in the disaggregate level are not likely to be explained by errors in variables. It is seen from Table A.1 in the Appendix that the wage elasticity would be much the same in a separate estimation for the labour demand of only P workers. Column 3 in Tables A.1 also show that the wage elasticity is negligible for NP workers except for those in firms with a high share of P workers. The basic conclusion of the more elastic labour demand of P workers is clear.

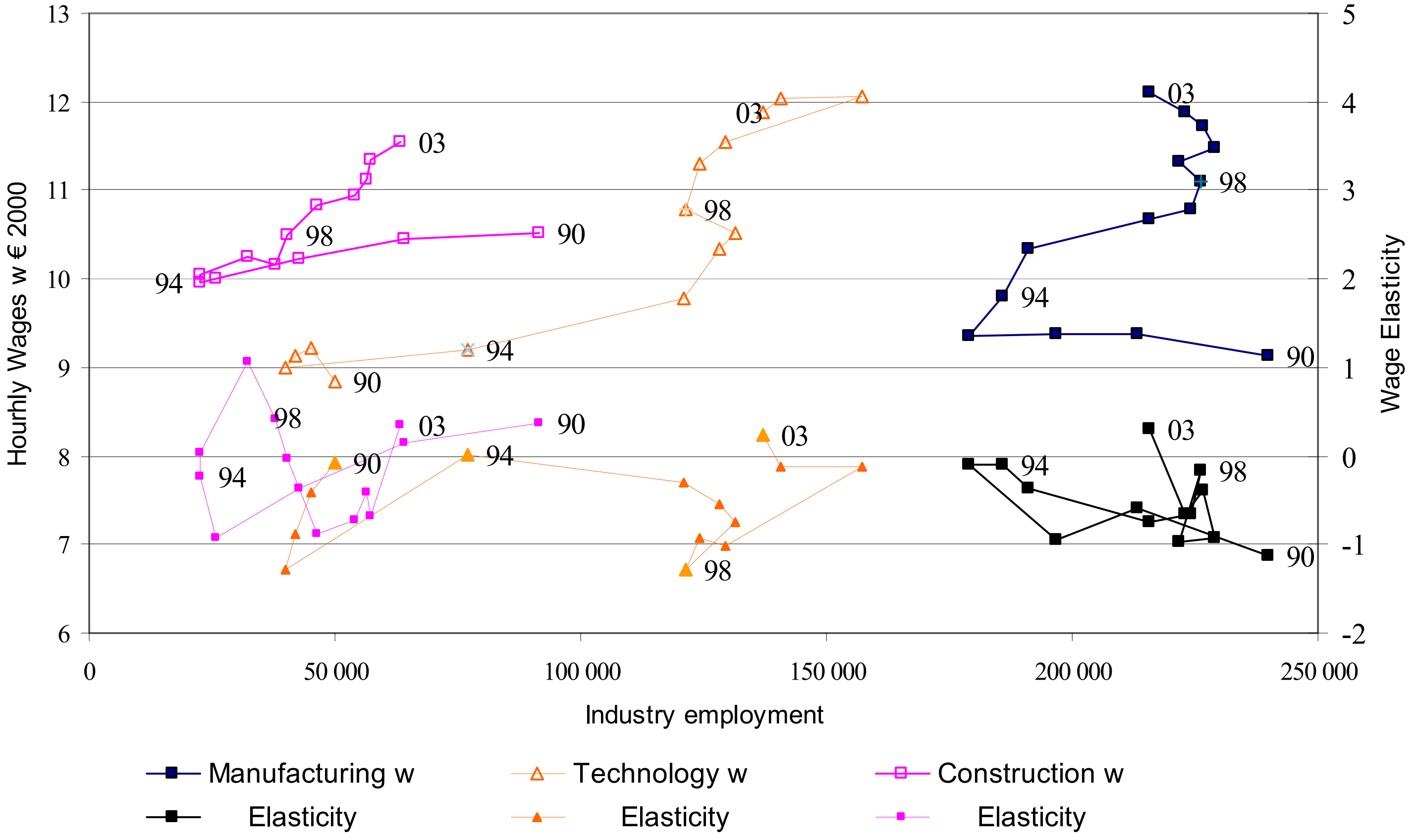
In Table A.1 the wage elasticities are also higher for young workers than for older workers. It has been shown in several studies that the labour demand of young workers is sensitive to demand shocks. This probably creates a downward bias so that the true labour demand elasticity is even higher than that recorded here.

Turning to the labour supply side, a less positive supply curve is a sign of the regional shortage of labour. Wage elasticities in labour supply are close to 1.5 so that the labour supply curve is relatively steep. It can be said that other factors than labour costs move the supply curve. It is seen that in regions with high labour force participation, which is typical of urban areas, the availability of labour may cause a greater problem. The local unemployment rate, in turn, indicates labour market tightness. It is seen that a rise in the unemployment rate is negatively related to the labour supply. A rise by one percentage point in the unemployment rate decreases the labour supply by 0.7%. This can be explained by increases the reservation wages and search costs when unemployment rate goes up, which is in line with job search models like Haurin and Sridhar (2003). Haurin and Sridhar, however, do find empirical support for this in contrast to Blanchflower and Oswald (2005). Migration is here not analysed but it can claimed that the positive agglomeration effects capture most of these effects. In any case, wage effects are robust to the omission of the working age population agglomeration variable.

Finally, an interesting observation from Table A.2 in the Appendix is that the labour supply of young and older workers is sensitive to the local industry-level wages. Labour supply factors can play an important role for the recent increase in the labour force participation of older workers. In maximising workers' rent, trade unions may negotiate the largest wage premium for groups with a very elastic labour supply such as older men; see later Figure 1 (reflecting their high opportunity cost of retirement opportunities). The employment rate of older workers of 55-64 years of age has seen a recovery in 1999-2003 of up to 10% points. Equally, young people's wages cannot be cut without also recognizing the potentially large effects to the labour supply.

Next, we examine changes in wage flexibility over time. Koskela, Stenbacka and Kauppi (2004) expect that increased competition on goods markets has increased the wage flexibility in labour markets over time. (This also relates to the deregulation of financial markets, EU membership and globalisation in general). The estimation is done with having time dummies and interactions of wages to these, separately in each industry. We also drop the 5% of observations representing other industries. The yearly variation is entirely explained by the interaction of the wage variable with 13 year dummies. Over half of the interaction terms appear to be significant and here the average labour demand elasticity is -0.5. We also show the evolution of hourly wages and employment. The time patterns are presented in Figure 1.

Figure 1. Hourly Wages and Wage Elasticity of Labour Demand Over Time



The upper three curves show real hourly wages (left axes) and employment by industry. The recession years include a rise in the unemployment rate from just 3% at the end of the 1980s to 18% in 1994. Here it is seen that in the first half-decade of 1990s the employment in traditional manufacturing decreased by 20% (240,000 in 1990 and 190,000 in 1995). The employment in technology sector increased by 70,000 employees to 120,000 by 1995. (This sector also includes the metal industry besides electronics.) In construction more than half of jobs were lost during the recession. In the recession years real hourly wages stagnated or decreased in construction although the adjustment does not appear to be very large relative to the staggering decrease in employment. Since then, wages have increased steadily and most stunningly in the technology sector, which is now clearly the biggest single industry. We can also observe relatively high wage increases in traditional manufacturing in the 2000s, which also reflects labour shortages as the labour force ages. The lower three curves show the respective wage elasticities (right axes). It is seen that the wage elasticity of labour demand includes no clear time trend in any of the industries or has moderately decreased over time in the 2000s. We can see the highest negative elasticities in the recession years of 1992-93 and again in 1999-2000 for traditional manufacturing. Since the demand elasticity has not markedly increased over time and the speed of adjustment to the equilibrium level of employment has even decreased (from Table 2) we find no support for the expectation in Koskela, Stenbacka and Kauppi (2004) that increased competition on goods markets has increased the wage flexibility in labour markets.

5 Taxes and Employment

We specify here a wage setting to capture the indirect effect of taxes via wages on labour demand. The wage equation tells us the structure and impact of a tax change on wages. We use random effects models due to the relatively low longitudinal variation in taxes and formulate the following wage equation in log form.

$$\begin{aligned}\log(w_{ijt}) &= \beta_\tau \log(1+\tau_{it}) + \beta_{\tau F} \log(1+\tau_{it})\log(F_{it}) \\ &+ \beta_t \log(1-t_{ijt}) + \beta_{tF} \log(F_{it})\log(1-t_{ijt}) \\ &+ \beta_F \log(F_{it}) + \beta_q \log(q_{it}) + \varepsilon_{it}\,,\end{aligned} \tag{8}$$

where w_{ijt} is the average hourly gross wage in firm i for worker group j at time t, $1+\tau_{kt}$ = 1 + the employer's social security tax, $1-t_{jt}$ = 1 - worker group j's income tax, q_{it} = the producer price index across one-digit industries and ε_{it} is a random error term. Firm heterogeneity F_{it} includes the average seniority of workers and firm size. Here $\theta = \beta_\tau + \beta_{\tau F} \log(F_{it})$ is the elasticity of wages with respect to social security contributions $1+\tau_t$ and $\phi = \beta_t + \beta_{tF} \log(F_{it})$ is the elasticity with respect to income tax $1-t_{it}$. Based on equation (8) we have the following effects of tax wedges on wages for employers' social security contributions (dropping sub-indices)

$$\Delta \log w = \theta \Delta \log(1+\tau) \ , \tag{9}$$

and for the employees' income tax

$$\Delta \log w = \phi \Delta \log(1-t) \ . \tag{10}$$

The long-run effect of tax wedges on labour demand is from $\log L = \eta\left[\log A - \log(1+1/\varepsilon) - \log(1+\tau) - \log(w)\right]$, derived in Appendix B in a monopsonist labour market, and using (9) and (10) given by

$$\Delta \log L = \eta/(1+\tau)\left[\Delta \log(1+1/\varepsilon) - (1+\theta)\Delta \log(1+\tau) - \phi \Delta \log(1-t)\right]. \tag{11}$$

We expect ϕ to be negative so that higher taxes on wages (1-t goes down) shift wages upwards so that the decrease in net incomes is lower. Table 4 reports the estimation results of the wage equation and Table 5 the elasticities (firm-level estimates aggregated up using employment as weights). Note again that we interact wage taxes with average seniority and social security payments with firm size. Table 4 shows the tax elasticities for all, in sur system estimation for P and NP workers and for young and old and Table 5 shows the respective overall elasticities.

It can be seen from Table 4 that the wage tax elasticities are very high, while social security taxes exert a positive effect on labour costs. We can see from Table 5 that the overall wage tax elasticity ϕ is -1.15 and higher for P workers and of the wrong sign for NP workers. The estimates exceed firm-level fixed effect estimates in Honkapohja et al. (1999) or consensus estimates reported in Hamermesh (1993), while close to industry-level estimates by Tyrväinen (1995). We can conclude that, on average, all the tax burden is borne by employers, which justifies our focus on the demand side when we examine the employment effects of tax cuts. Collective wage negotiation comparable to the German

Table 4. Fixed Effect Estimates of Gross Hourly Wages

	All Random Effects	t-value	Production Worker (P) SUR	t-value	Non-Production Workers (NP) SUR	t-value	18-28 yrs Random Effects	t-value	53-64 yrs Random Effects	t-value
1-Wage Tax$_t$	-1.095**	(44)	-1.229**	(56.95)	-0.290**	(25.79)	-1.122**	(35.24)	-1.248**	(31.01)
1-Wage Tax$_{t-1}$, Seniority$_{t-1}$	-0.029**	(5.56)	0.063**	(9.6)			-0.005	(0.7)	0.001	(0.17)
1+ Social Security Tax$_{t-1}$	0.055**	(2.58)	0.374**	(8.86)	0.443**	(8.93)	0.020	(0.52)	0.218**	(4.42)
1+ Social Security Tax $_{t-1}$, Firm Size $_{t-1}$	0.058**	(15.91)	-0.060**	(4.92)	0.027*	(2.19)	0.020	(1.49)	0.012	(0.75)
Production Worker Share$_{t-1}$	-0.103**	(24.98)	-0.128**	(24.44)	-0.128**	(24.44)	-0.043**	(8.14)	-0.128**	(20.03)
Seniority$_{t-1}$	-0.007**	(4.18)	-0.009**	(4.88)	-0.009**	(4.88)	-0.016**	(7.59)	-0.002	(0.67)
Size$_{t-1}$			0.020**	(5.63)	0.020**	(5.63)	0.012**	(2.95)	0.020**	(4.09)
Producer Price$_t$	0.221**	(16.1)	0.281**	(14.34)	0.281**	(14.34)	0.132**	(7.54)	0.283**	(13.74)
Producer Price$_{t-1}$	0.242**	(17.03)	0.094**	(4.73)	0.094**	(4.73)	0.234**	(12.9)	0.306**	(14.39)
Constant	-0.108**	(2.94)	0.207**	(4.67)	0.699**	(15.69)	0.166**	(3.56)	-0.722**	(13.01)
R-squared		0.53		0.33		0.31		0.34		0.43
Observations		23 715		14 939		14 939		20 989		22 825

Statistical significance: * Significant at 95% level, ** Significant at 99% level, *** Significant at 99.9% level. All variables are in log form except production worker share and firm size.

Table 5. Average Tax Elasticities

	All	All (P + NP Workers)	Production Worker	Non-Production Worker	18-28 yrs	53-64 yrs
Mean Elasticity 1-Wage Tax	-1.15	-1.06	-1.61	0.23	-1.14	-1.25
Standard Deviation	0.09	0.29	0.39	0.06	0.22	0.06
Mean Elasticity 1+ Social Security Tax	0.17	-0.14	0.23	-1.01	0.06	0.24
Standard Deviation	0.08	0.26	0.06	0.71	0.03	0.02

bargained wage setting is likely to give a high emphasis to general wage rises for P workers. The government has participated in wage negotiation with promises of tax cuts when wage agreements are moderate. This can explain the results. It is noteworthy that the wage negotiations of NP workers, especially upper NP workers, is done more on an individual basis, and taxes exert here little influence on wage setting. It is also seen that tax elasticities are equally high for young and older workers.

We can see that the tax elasticity for P workers goes down as the average stay of workers in the firm is longer. The flexibility of wage setting thus appears to decrease for P workers when workers have, on average, stayed longer in the firm. We can also observe similar asymmetry for the firm size. Social security tax elasticity is lower for P workers in large firms, while the opposite holds for NP workers. By combining these two results, we can claim that the tax-cutting – wage-moderating -- policy has been most efficient for P workers in small firms and with a short average stay of workers in the firm. The standard union bargaining model like Lockwood and Manning (1993) thus applies for P workers, where the mark-up on wages plays an important role (at least when the average seniority is low) and wage flexibility is high compared to adjustments in employment. (The unemployment threat plays little role in wage setting.) There is, instead, relatively little wage moderation among the NP workers due to tax cuts and even less so in small firms with a high turnover of employees.

It is seen from Table 5 that the overall social security tax elasticity is a positive 0.17 for NP workers. The fact that the average burden of the social security tax burden is not borne by employees is not necessarily against a traditional wage-bargaining model such as Lockwood and Manning's (1993), although earlier empirical estimates find a negative relation in Finland (see Tyrväinen, 1995, and Honkapohja et al., 1999). In particular, Honkapohja, Koskela and Uusitalo (1999) obtained -0.21. P and NP worker segments belong to different unions.

Wage taxes and social security payments are not fully symmetric, since wage taxes moderate wages more than social security taxes increase labour costs as 0.7*(1+0.17) is less than 1.15. (0.7 adjusts here for the difference in tax bases.)[6] However, it is seen that the wage tax elasticity exceeding -1 is consistent with social security tax having a positive effect on labour costs. We can now analyse the employment effects based on our wage and labour demand elasticities using (8). Note that the employment effects are assessed for each firm separately and aggregated up using firm size as weight. Micro-level estimates do not, however, diverge largely from aggregate estimates at the industry level, since the interaction terms of taxes to firm characteristics (average seniority and size) in Table 4 are

[6] Lockwood and Manning (1993), on the other hand, found social security taxes to generate stronger effects.

small in effects. Table 6 shows a unit decrease in wage taxes or tax revenues equivalent to a 0.74 unit decrease in social security taxes in static tax revenue effects.

Table 6. The Employment Effect of Cutting Social Security Payments by 0.74 Units (2.5%) and Wage Taxes by 1 Unit (3.8%)

	1+τ Elasticity θ	1-t Elasticity ϕ	Demand Elasticity η	τ: Employment %	t: Employment %
All	0.17	-1.15	-0.71	0.44 %	0.79 %

Note: Equivalent to a decrease in Soc.Sec. payment by 2.9% and t rate by 2.2%. Tax elasticities for P and NP workers are set the same as for all workers. Labour demand and supply elasticities are from table 3 and wage elasticity is from table 5.

It is seen that, in our benchmark case, employment is, on average, increased though wage tax cuts by 0.79% and through social security cuts by 0.44%. Recall also that employment is improved mainly among the P workers and very little among the NP workers. Our estimates are double those obtained by Nickell (2004) as overall estimate in country panel. This is a notable difference also because our estimates ignore the creation of employment through new firms in the industry.

Piekkola and Haaparanta (2006) approximate employment reduction during the deep recession in the early 1990s via liquidity constraints. The unemployment rate rose from less than 3 per cent up to 16 per cent during the recession years of 1991-1994 and interest rates peaked above 15 before the devaluation of the Finnish markka in 1992. The borrowing ratio, interest payments divided by cash flow, increased to around 0.4 during the slump, while the average non-recession borrowing ratio has been about 0.13 in the post-recession period since 1997. According to Piekkola and Haaparanta (2006) the rise in the borrowing ratio caused a 13.5% decrease in employment in the long run. This would be equivalent to 270,000 jobs lost out of the 2 million employees. (To this should be added some 35,000 jobs lost through closures.) Taxes on wages increased from 1990 to 1995 by 3.7 %-points according to our estimates, which would have explained an additional loss of jobs by 3.2% or around 60,000 jobs. The total loss in private sector employment was 290,000, which is not far from the sum of all these figures added together.

From 1995 to 2003 wage taxes were cut by 4.7% points (15.5%), and social security taxes by 3.1%-points (9.6%) according to our estimates, and generated 70,000 new jobs in the private sector. (See Appendix B and Table B.1.) New jobs from the release of financial constraints can be expected to be a substantial part of job creation. The service costs of debt have been very low since the recession and particularly after the entry of Finland into the Euro area in 1999. Between 1995 and 2003 the actual improvement in private sector employment was less than 260,000 jobs. Firms members of Confederation of Finnish industries (includes all big private firms) have employed in this period new 120 000 workers in Finland (40,000 from service sector not included in the analysis here). We have also argued that SBTC, with the upgrading of the education level by 15%, has led to a decrease in employment. Another important phenomenon is internationalization and the outsourcing of manufacturing employment abroad. The 500 biggest companies have employed over 300,000 more workers in Finland between 1995 and 2003 so over half of this abroad (see Siljander 2006, Table 1). The gap also relates to permanent loss in human capital of employees. According to Nickell's (2004) survey the employment rate of primary age workers has been lower than the European average since the deep recession at the beginning of the 1990s. A 2% lower labour force participation at the ages 30-54 is equivalent to approximately 40,000 fewer employed.

We also analyse in the Appendix in a simplistic way the tax revenues' loss from tax cuts. The positive employment effects and lower costs of unemployment yield doubly lower losses in tax revenues than if ignoring the dynamic effects.

6 Robustness Checks

Labour demand and supply have been estimated by an appropriate single-equation estimator. It can also be valid to examine each separately. Manning (2003), in a static framework, examines biases from the estimation of labour demand alone (or rather inversely how wages relate to employment). An example of no bias is a labour demand curve when the observed characteristics are the same for all firms and there is no unobserved demand shocks. Labour supply shocks will then nicely trace the labour demand curve. Uncorrelated or negatively correlated shocks bias the elasticity upwards in a single labour demand estimation. Correlation is, however, positive here for the estimation for all and we cannot say anything about the direction of the bias. Mean squared errors are much higher in the estimation for all workers (0.17 in labour demand and 0.17 in labour supply) than in the estimation for P and NP workers (0.13 in P worker labour demand, 0.09 in NP worker labour demand and 0.15 in labour supply). Thus, the variance of residuals is lower in worker group estimations which direct the bias downwards. A similar, downward bias exists for young workers. This may explain some of the lower demand elasticities when analysing labour market segments separately. Levinsohn and

Petrin (2003) find that productivity shocks are greater for marginal groups such as the young. (The elasticity would be -0.67 with a labour demand estimate only, not reported.)

Single labour demand estimations are shown as Table A.2 in Appendix A. We can see that labour demand elasticities are of the same magnitude for all. Thus it can indeed be the case that the opposite implications of the variance of residual and positive correlation between demand and supply residuals offset each other. On the other hand, the model with education interaction gives much higher wage elasticity, -3.77. The biggest difference in the estimates of single demand and system are thus found when including the interaction term of wages to the education level. Thus it is the shifts in the share of skilled workers on the supply side that should be included in order to obtain consistent estimates that control for SBTC. It can also be seen that the system with separate estimations for P and NP workers (Column 3) gives an equal elasticity for P workers as for all, and, again, a negligible effect for NP workers.

We also report GMM estimation results for comparative reasons, where the procedure follows Green (2003, Chapter 15). The system of equations (6) and (7) is thus estimated by using a non-linear iterative GMM estimation procedure which takes into account the cross-correlation of the equations. We use a heteroscedastic two-stage least squares regression, which is a modification of the traditional two-stage least squares used to estimate simultaneous equation models when the disturbances are heteroscedastic. It can be interpreted as a GMM estimator where the variance of the moment function is taken to be block-diagonal. Each block, corresponding to each single equation, is estimated, using the residuals from the two-stage least squares estimates. Most of the variables are treated as endogenous, and lagged values of the level of variables from period t-1 and t-2 are used as instruments. Here we use 5 regions as additional instruments: the Helsinki area, city, regional centre, manufacturing, rural, periphery and the wage-tax variation across regions fairly independent of the economic cycle.

The GMM estimates pass the instrumental validity test. The adjustment speed is close to immediate adjustment (1.0 with a standard deviation of 0.66) because of the large positive coefficient assigned for the distance from the optimum. The coefficient for labour costs in GMM estimates are fourfold compared with SUR estimates. It is left open whether the true employment effects of tax cuts are greater than the ones obtained in the SUR estimation.

Table 7. Fixed Effects GMM Estimates of Labour Demand and Supply

	All	std
Labour Demand		
Producer Wage	-4.390	(0.896)***
Education	-1.964	(0.718)**
Production Worker Share		
Seniority	-0.995	(0.395)*
Years 90-94	-0.204	(0.092)*
Time Trend	-0.017	(0.022)
Adjustment speed: Constant	-0.004	(0.169)
Distance from optimum	0.212	(0.072)**
Years 90-94	0.660	(0.456)
Time Trend	-0.007	(0.057)
Regional Labour Supply		
Consumer Wage	0.267	(0.313)
Labour Force Share$_{t-1}$	-17.111	(2.762)***
Working Age Agglomeration$_t$	-6.008	(2.387)*
Unemployment Rate $_{t-1}$	-8.212	(1.813)***
Years 90-94	0.555	(0.1)***
Time Trend	0.112	(0.017)***
Adjusted R2 (labour demand)	-0.97	
Adjusted R2 (labour supply)	-0.36	
Test of Overidentifying Restrictions (J)	75.1	
Probability of J-test	0.99	
Observations	9 543	

Statistical significance: * Significant at 95% level, ** Significant at 99% level, *** Significant at 99.9% level. Level instruments are firm employment t-2,t-3. firm wages lags t-2,t-3 and worker group wages lags t-2,t-3, log of average education years t-2,t-3, log of average seniority lags t-1,t-2,t-3, municipal taxes and 5 regional dummies: city (not greater Helsinki area), regional centre, manufacturing, rural, periphery.

7 Conclusions

This paper has examined labour demand and supply in a system where short-run labour supply is regionally determined in four industries. All the tax burden is borne by employers, which makes the analysis of the demand side most relevant. Here, SBTC and fluctuations in the labour supply of skilled workers have been important to control for. We show that the employment effect of social security taxes or wage taxes is such that an equal cut in them (wage taxes by one unit and social security taxes by 0.74) improves employment by around 0.4%-0.8%. Wage taxes generate the highest and social security taxes the lowest effect. The wage tax effect is twice more than the consensus estimates in the country-level analysis in Nickell (2004). We believe that our estimates are still on the lower bound as the dynamic GMM model would yield much higher effects. Our labour demand elasticities, however, match well with some earlier plant-level studies. The adjustment speed also appears faster than in the industry-level analysis. This is tied up with the price elasticity of the product, which is significantly higher for an individual firm than for the industry in general.

We show that elasticities differ among the labour market segments and find taxes to be an effective tool for the employment of production workers, in particular. The employment effects are due to the fact that unions are willing to agree on lower wage demands when compensated by lower taxes on earnings. This is exactly the policy that has been carried out in the Finnish tripartite wage negotiations, where the government promises wage tax cuts on condition that a moderate wage agreement is negotiated between employers and employee unions. This has resulted in the improvement of the employment of production workers. One should, however, note that the actual improvement in employment has been less than that implied by the tax cuts and improved financial liquidity of the firms. This can be explained by SBTC, the internationalisation of firms, outsourcing and loss in human capital of workers in the recession of the early 1990s. A rule of thumb with half of the lost tax revenues accruing back in the form of improved employment and lower unemployment expenses appears to hold.

Young workers are, in many respects, comparable to low-wage earners, and employment is most sensitive to tax setting in this labour market segment. However, firms with a higher skill level have a more flexible labour demand of production workers (and young workers) so that tax cuts targeted to low-wage firms is not optimal. Tax cuts with emphasis on low-wage, low-productivity firms may appear undesirable, as tax cuts cure employment of low-skilled workers especially in skill-intensive firms. With all these results in view one finds a general cut in the level of taxes at all income levels – as done in Finland since 1995 – an attractive policy to boost employment.

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Appendix A. Tables

Table A.1 Fixed Effects SUR Estimates of Labour Demand and Supply in Labour Market Segments

Labour Demand	Production Worker	std	Non-Production Worker	std	18-28 yrs	std	53-64 yrs	std
Producer Wage	-0.517	(0.037)***	-0.076	(0.032)*	-0.625	(0.044)***	-0.108	(0.036)**
Interaction with Production Worker Share			-0.072	(0.015)***				
Education	-0.350	(0.043)***	0.182	(0.044)***	-0.745	(0.059)***	0.079	(0.057)
Production Worker Share			0.208	(0.04)***				
Seniority	-0.221	(0.011)***	-0.022	(0.009)*	-0.474	(0.015)***	0.048	(0.015)**
Years 90-94	-0.082	(0.005)***	0.030	(0.005)***	-0.137	(0.008)***	-0.146	(0.009)***
Time Trend	0.005	(0.001)***	-0.002	(0)***	0.002	(0.001)*	0.019	(0.003)***
Adjustment speed: Constant	0.748	(0.008)***	0.753	(0.007)***	0.986	(0.018)***	0.751	(0.008)***
Distance from optimum	0.038	(0.004)***	0.027	(0.003)***	-0.036	(0.002)***	-0.012	(0.003)***
Years 90-94	-0.008	(0.019)	-0.140	(0.016)***	-0.039	(0.019)*	-0.033	(0.02)
Time Trend	-0.025	(0.003)***	-0.046	(0.002)***	-0.032	(0.002)***	-0.049	(0.003)***
Regional Labour Supply								
Consumer Wage	0.288	(0.02)***	0.105	(0.047)*	1.791	(0.041)***	1.851	(0.031)***
Labour Force Share $_{t-1}$	-1.086	(0.144)***	-2.996	(0.173)***	-1.580	(0.13)***	-3.281	(0.128)***
Working Age Agglomeration$_t$	1.406	(0.159)***	0.582	(0.12)***	0.578	(0.155)***	1.750	(0.153)***
Unemployment Rate in the Age Group $_{t-1}$	-0.470	(0.102)***	-2.282	(0.127)***	-0.702	(0.087)***	-2.161	(0.103)***
Years 90-94	0.106	(0.01)***	0.276	(0.011)***	0.174	(0.011)***	0.170	(0.01)***
Time Trend	-0.003	(0.001)*	0.002	(0.001)*	-0.009	(0.001)***	0.004	(0.004)
Adjustment speed: Constant	0.730	(0.006)***	0.676	(0.006)***	0.692	(0.006)***	0.681	(0.006)***
Distance from optimum	0.056	(0.002)***	0.062	(0.002)***	0.063	(0.002)***	0.064	(0.002)***
Adjusted R2, Durbin-Watson (labour demand)		0.155, 1.544		0.134, 1.483		0.208, 1.674		0.169, 1.626
Adjusted R2, Durbin-Watson (labour supply)		0.142, 1.209		0.188, 1.183		0.151, 0.979		0.326, 1.318
Correlation of Residuals		0.136		0.089		0.194		0.029
Observations		15 077		17 660		21 051		18 176

Statistical significance: * Significant at 95% level, ** Significant at 99% level, *** Significant at 99.9% level. Labour force participation for age groups is for the particular age.

Table A.2 Fixed Effects SUR Estimates of Labour Demand

Labour Demand	All	std	All	std	Production Workers SYSTEM	std	Non-Production Workers SYSTEM	
Producer Wage	-0.715	(0.033)	-0.618	(0.037)	-0.475	(0.036)	-0.004	(0.031)
Interaction with Education			-1.272	(0.292)				
Interaction with Production Worker Share							-0.212	(0.015)
Education	-0.681	(0.037)	0.628	(0.303)	-0.170	(0.041)	0.055	(0.043)
Production Worker Share							0.229	(0.041)
Seniority	-0.194	(0.009)	-0.194	(0.009)	-0.207	(0.011)	-0.037	(0.009)
Years 90-94	-0.060	(0.005)	-0.062	(0.005)	-0.117	(0.005)	0.024	(0.005)
Time Trend	0.006	(0)	0.006	(0)	0.003	(0.001)	-0.001	(0)
Adjustment speed: Constant	0.782	(0.007)	0.775	(0.006)	0.738	(0.008)	0.763	(0.007)
Distance from optimum	0.037	(0.003)	0.039	(0.003)	0.044	(0.004)	0.041	(0.003)
Years 90-94	-0.059	(0.015)	-0.061	(0.015)	-0.033	(0.018)	-0.075	(0.017)
Time Trend	-0.023	(0.002)	-0.023	(0.002)	-0.028	(0.002)	-0.025	(0.002)
Adjusted R2, Durbin-Watson (labour demand)		0.163, 1.627		0.165, 1.627		0.143, 1.581		0.021, 1.33
Observations		25 332		25 332		22 369		

All the estimates are significant at 99.9% level or at 95% level (education in second column) except net wage, education and time trend for NP workers.

Appendix B. Taxes, Revenues and Employment

We formulate wage effects in a monopsony union following Manning (2003). The firm is assumed to face elastic labour supply $w = BL^{1/\varepsilon}$, where w=wage, $B =$ shock to supply curve, L=employment and $\varepsilon = (w(1-t)/L)\partial L/\partial w(1-t)$ is the elasticity of labour supply where is t is the tax on wages. The marginal cost of labour is thus

$$(w + L\partial w/\partial L)(1+\tau) = (1+1/\varepsilon)w(1+\tau), \tag{b.1}$$

where τ is the social security tax paid by employers. In the case of perfect competition the elasticity of labour supply with respect to wages is infinite $1/\varepsilon = 0$. The simple production function is given by

$$Y = \frac{1}{1-1/\eta} AL^{1-1/\eta}, \tag{b.2}$$

where A = technology shock to labour demand and $\eta = (w/L)\partial L/\partial w$ is the elasticity of labour demand. The firm will choose employment, where the marginal product of labour equals marginal supply

$$AL^{-1/\eta} = (1+1/\varepsilon)w(1+\tau), \tag{b.3}$$

The firm's isoprofit curve is flat on the labour demand curve and the solution is characterised by the intersection of the maximal isoprofit curve and the horizontal isoutility curve for employees (since wage negotiations fixed the level of wages). In log-linear form this can be written as

$$\log L = \eta\left[\log A - \log(1+1/\varepsilon) - \log(1+\tau) - \log(w)\right], \tag{b.4}$$

where A is a technology shock to labour demand, $(1+\tau)$ is the employer's tax wedge and w is the wage earned by the employee.

Tax Revenues

Tax revenues can be written as

$$T = t(1-a)wL + \tau wL \quad , \tag{b.5}$$

where a is the share of income that is tax deductible. This gives the following tax revenue effects.

$$\frac{dT}{d\tau} = wL + \frac{wL}{1+\tau}\left[(t+\tau)\theta - (t(1-a)+\tau)\eta(1+\theta)\right] \; ; \tag{b.6}$$

$$\frac{dT}{d\tau} = (1-a)wL + \frac{wL}{1-t}\left[t+\tau-(t(1-a)+\tau)\eta\right]\theta \; . \tag{b.7}$$

Table B.1 The Tax Revenue Effect of the 9.5% Decrease in Social Security Payments and the 14.9% Decrease in Wage Taxes in 1995-2003

	τ , t Change %	τ: Employ-ment %	Employ-ment	Tax Revenue	Savings Unemploy ment Expenses	Total Tax Revenue
Social Security Tax	-9.6 %	1.5 %	18 984	-6 513	404	-6109
Wage Tax	-14.9 %	3.9 %	47 460	-3 856	1 011	-2 846

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