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Erling Barth
Alex Bryson
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Quantitative Social Science
UCL Social Research Institute
University College London
55-59 Gordon Square
London WC1H 0NU

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Erling Barth[1]
Alex Bryson[2]
Harald Dale-Olsen[3]

Abstract

Using administrative linked employer-employee data for Norway we estimate the impact of changes in tax subsidies for union membership on individuals' membership probabilities. Increased subsidisation of the union good increases union take-up, while increased union fees reduce the demand for membership. The price elasticity of demand for union membership is -7 percent in 2012 (the last year for which we have data) though effects are heterogeneous across types of worker. In the absence of the hikes in tax subsidies and holding workforce composition constant aggregate private sector union membership density would have fallen by 5 percentage points between 2001 and 2012. Since membership fees are a substantial part of unions' total revenues the findings have important implications for unions' viability. They are also significant because union bargaining strength, which is often proxied by union density, affects a range of social, economic and political outcomes.

.

Keywords: trade unions; union membership; wages, tax subsidies

JEL Codes J01, J08, J50, J51

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[1] Institute for Social Research, Oslo, and ESOP, Department of Economics, University of Oslo
[2] University College London, IZA and NIESR
[3] Institute for Social Research, Oslo, and IZA

1. INTRODUCTION

In most modern economies union membership is on the decline and has been for several years. This is true in major industrial countries such as the UK and Germany, but also in the previously strongly organised Nordic countries (Addison et al., 2011; Schnabel, 2013; Bryson et al., 2019; OECD, 2017). According to the OECD (2017), average unionisation rates among employees have almost halved in three decades from 33 percent in the mid-80s to 17 percent today. Norway stands out with a more moderate decline than other countries. In the period from 2000 to 2012, union membership was practically flat in Norway, whereas the decline continued in most other countries. During the same period, the tax subsidy on union membership fees quadrupled in Norway. In this paper we use this shift in policies to estimate the price elasticity of union membership, and to provide an assessment of how much the change in tax subsidies counteracted the union membership decline over time.

The proportion of all workers who purchase union membership – union density – has important implications for workers' employment (Bryson, 2004), wages (Metcalf and Stewart, 1992), wage inequality (Card et al., 2007), labour productivity, firm profits and investments (Doucouliagos et al., 2017; Hirsch, 2004), and the operation of the labour market more broadly, including quits, absence rates and tenure (Freeman and Medoff, 1984). The precise nature of those effects is uncertain a priori because trade unions perform a number of functions which can have counterveiling effects. Chief among these are what Freeman and Medoff (1984) term the two faces of unions – their monopoly face which captures their role in wage bargaining on behalf of their members, and their voice face which is the role they perform in representing workers' interests to management.[4] Uncertainty also arises about union density effects because they vary across countries, in part due to different institutional arrangements surrounding unions and employment relations systems (Doucougliagos et al., 2017).

Unions' demise has led many economists to question the relevance of unionisation in answering economic questions today. This stance is puzzling for two reasons. First, the disappearance of unions in some parts of the economy, and their weakening in others, has its own impact on social, economic and political outcomes, as documented by Rosenfeld (2014) for the United States. Taking one example in Europe, Dustmann et al. (2009: 845) show the sharp decline in

[4] Freeman and Medoff (1984) adapt Hirschman's (1970) original exit, voice, loyalty model - which he used to depict consumer behaviour - to an employment relations setting in which workers with problems at work were faced with the choice of quitting for alternative employment (exit) or investing in solving the problem at their current employment by "voicing" their concerns to management through representation.

unionisation in Germany in the 1990s and early 2000s accounted for over one-quarter of the large increase in wage inequality at the bottom end of the German labour market. Second, unions continue to have a substantial impact on economic behaviours and outcomes where they remain in place. For example, in a recent paper for Norway – which is the setting for this paper – Barth et al. (2017) showed union density at firm-level had a large causal impact on productivity and wages in the period 2001-2012.

Since union effects on firms and workers are still apparent today there is good reason to try to understand the determinants of unionisation. Policy analysts also emphasise unions' significance for economic wellbeing and prosperity. For example, the OECD (2018:76) argues that unions and collective bargaining could play a central role in creating more and better jobs. In particular, they observe that employee representation is associated with fewer job demands, more training and better career advancement (OECD, 2018:100-101). Thus, trends in unionisation raise important issues related to inequality and economic performance.

It is conceivable that union decline is due to falling demand for the union good, the problems unions face in supplying the union good, or a mixture of the two. Our contribution to this literature, which is reviewed in Section Two, is to establish the price elasticity of demand for the union good, holding the quality of the union good constant, using exogenous variance in its net price arising from changes in its tax subsidisation. We know from studies of other workplace-provided goods and services such as employer-provided health (Gruber and Lettau, 2004), company cars (Gutiérrez-i-Puigarnau and Van Ommeren, 2011) and stock options (Austin et al., 1998) that employee demand responds to tax subsidization.

We analyse how sensitive the demand for unionisation is to the union fee, and how it responds to public support in the form of tax subsidies. Union membership attracts a tax subsidy in many countries including Germany (where work membership is deductible), the UK and, until 2018, the United States.[5] Assuming union membership is a normal good, one would expect demand for that good to reflect its net price. Thus, changes in net membership fees induced by changes in the tax subsidy should affect individuals' decisions to purchase union membership, as tax subsidies affect the demand for other workplace-provided goods and services. Although the literature on the determinants of union membership is rich[6] it does not consider the price of

[5] When completing a tax return in the United States one could deduct dues and initiation fees paid for union membership. These were entered as unreimbursed employee expenses on Line 21 of Schedule A (Form 1040) Itemized Deductions. This arrangement came to an end in 2018 (Thornton, 2019).

[6] For example, see the book edited by Bennet and Kaufman (2007) and the survey-article of Schnabel (2013).

union membership. Abowd and Farber (1982), Farber and Krueger (1993), and Riddell (1993) are examples of papers adopting a supply and demand framework which imply an intersection at a price settled in equilibrium, but this price is in practice not observed. We are the first to examine the effects of tax subsidisation on the demand for the union good.

We also explore the margins on which the tax subsidy has an effect. Does the subsidy affect membership differentially by age, contract type or position in the earnings distribution? The answers to these questions are relevant in order to understand the potential impact of tax subsidies on workers with high versus low individual bargaining power.

Our setting is Norway, a place that has seen substantial changes in the rate of tax subsidy for union membership in recent years, as we will show in Section Four. The exogenous change in tax treatment of the union good should induce a change in the net price of the good which, assuming there are no instantaneous adjustments to the quality of the union good offered, permits us to capture the price elasticity of demand for that good net of quality adjustments. We find increased subsidisation of the union good increases union take-up, while increased union fees reduce the demand for membership. The price elasticity of demand for union membership is -9 percent in 2012 (the last year for which we have data). In the absence of the hikes in tax subsidies and holding workforce composition constant aggregate private sector union membership density would have fallen by 2 percentage points between 2001 and 2012.

The structure of the remainder of the paper is as follows. In the next section, we discuss the current literature on the demand for unionisation. In Section 3, we present a simple model of demand for union membership. In Section 4, we present the Norwegian system for tax deductions for union membership fees and its development over time. Data are presented in Section 5. In Section 6, we describe the development in union density over time for public and private sectors and for major industries. In Section 7, we study the relationship between the tax deductions, union fees and union membership. Section 8 examines heterogeneous responses to the subsidy, and Section 9 concludes.

2. PREVIOUS LITERATURE

In many industrialised countries the number of individuals purchasing membership began to decline in the early 1980s. This has serious consequences for unions for a number of reasons. First, in most countries, including Norway, unions are voluntary membership organisations

largely reliant on membership fees for their revenue. Their financial viability, and thus the supply of the union good, can be jeoparised if workers are less inclined to pay union dues (Willman et al., 2020; Willman and Bryson, 2009). Second, union density is often treated as a proxy for union bargaining power on the grounds that unions' ability to restrict the supply of labour to an employer (for example, through the threat of strike action) rises as the proportion of workers it represents rises. There is ample evidence from the union effects literature to confirm that this is the case (eg. Metcalf and Stewart, 1992; Lee and Mas, 2012). If that bargaining power wanes, so too does unions' ability to procure the union good that members are paying for.

The reasons why union membership is in decline are disputed, but analysts point to a number of proximate causes which, it is often asserted, are consistent with a decline in the demand for the union good. One part of the literature emphasises the role played by structural changes in the economy, such as the decline in employment in heavy industries characterised by manual labour where the demand for unionisation has been traditionally strong (Bain and Elsheik, 1976). Others speculate that cohort effects may be at play, with younger workers – referred to by Bryson et al. (2010) as the Facebook generation - less inclined to think in terms of collective action than the previous generations of workers who entered the labour market as the proportion union members was rising. Acemoglu et al. (2001) suggest skills-biased technological change has resulted in deunionisation by increasing the outside (non-union) options of skilled workers (effectively reducing their desire for union membership), thus undermining coalitions of skilled and unskilled workers in support of unions.

Another tranche of the literature suggests aspects of the union good face increased competition from union substitutes, effectively reducing demand for the union good. For instance, in European countries like Germany unions are increasingly facing competition from statutory-based forms of worker representation, such as works councils, which can be accessed without a membership fee (Addison, 2009). Unions also face competition from employer-led initiatives to generate worker voice. In a series of papers Willman and co-authors track the growth in non-union employer-made mechanisms in Britain which, they argue, indicate employers choosing to 'make' voice as opposed to the 'buy' option implied by contracting worker voice out to trade

unions (Willman et al., 2020). These employer-based systems have the potential to reduce employee demand for union-generated voice.[7]

New statutory entitlements at work may undermine union efforts to bargain for better terms and conditions of employment, thus reducing the net benefits to membership, and thus demand for the union good. For example, Forth and Bryson (2019) show statutory increases in holiday entitlements reduced the paid holiday premium associated with union membership. Similarly, growth in employment protection legislation may limit the value of the insurance component of the union good.

In a recent development in the literature unions are viewed as a cost disease sector (Willman et al., 2020). Cost disease organisations are highly labour intensive and, as such, unable to avail themselves of the productivity-increasing advantages of technological innovation. This, in turn, leads to sliggish productivity growth, resulting in price stickiness relative to the other goods and services workers may wish to purchase. As such the relative price of the union good rises and, unless this is matched with a commensurate rise in the quality of service, so demand for the good may fall.[8]

Whereas these trends might betoken a decline in demand for the union good, direct measures of change in demand for unionisation are lacking in most studies and the union demand story is not the only possible explanation. For instance, while it may be the case that heavy industies dominated by manual labour did engender higher demands for unionisation (eg. because they were risky, hazardous places to work), their large plants may simply have been easier for unions to organise, thus reducing the costs unions faced in supplying the union good at a given level of demand. A related literature tracking direct measures of demand for unionisation challenges the assertion that demand has fallen over time. Indeed, most of the literature for the Anglo-Saxon world suggests there is what Towers (1997) referred to as a 'representation gap' wherein many workers desirous of unionisation do not get it. This gap has been growing in recent years among workers in the United States (Bryson and Freeman, 2013). There are, perhaps, two primary reasons for the persistence of a representation gap and declining union membership.

[7] The situation is a little different in the United States since the Wagner Act places strict limits on employers' ability to invest in alternative non-union forms of voice where unions have won the right to operate as employees' sole bargaining agent following a successful campaign for union recognition (Bryson et al., 2019).
[8] Unions may increase their use of what Willman and co-authors term "off-balance sheet" resources to supply the union good. These off-balance-sheet resources include union lay-representatives, that is, volunteers from the employee workforce prepared to take on the mantle of union representative. There is indeed evidence that unions in Britain have responded by doing so (Willman and Bryson, 2009).

The first is a supply-side problem associated with unions' increasing inability to organize and represent workers wishing to purchase union membership. This supply-side problem may reflect the marginal costs of organizing (especially in growth sectors of the economy where workers are hard to locate, and difficult to mobilise) – what we might think of as part of Olson's (1965) first order collective action problem. It may also reflect unions' recognition that they face substantial marginal costs associated with servicing such workers (Olson's second order collective action problem) which limits the value of organizing non-union workers, even if they desire union membership.

The second possibility is that the representation gap does not really exist, in the sense that, although individuals claim they would 'vote' union or purchase union membership if it was available, in practice they discount the costs of purchasing the good when asked the question in a survey. When faced with the actual costs of organising and purchasing membership, perhaps they forgo the opportunity to generate the union good and purchase it? This is plausible, not least because the costs of unionisation to a worker extend beyond the pecuniary costs of membership. In the absence of a union, workers must organise to trigger the supply of a union good. This can often entail organising in the face of employer opposition, something that can result in vulnerability to dismissal or actions short of dismissal which limit one's career chances. These practices are well-documented in the United States but recent work by Thomas Breda (Breda, 2013) has shown that, even in a country like France, those who volunteer to be union representatives suffer a substantial wage penalty relative to what they might have earned if they had not become union representatives.

Even where unions are organised, that is, where there is a supply of the union good, there is a large public good component to what unions do which can lead to free-riding behaviour whereupon non-members benefit from union coverage without paying dues. The classic solution to this problem discussed by Olson (1965) was the closed shop which required the purchase of membership where unions were present. However, in countries like the UK the closed shop is no longer legally enforceable, resulting in a sizeable rise in free-riding behaviour (Millward et al., 2000; Bryson, 2008).[9] Unions may have responded by putting more effort into the procurement of private excludable goods which were only available to members. In general

[9] In the United States, free-riding remains relatively uncommon because states usually require workers in unionised workplaces to pay a union fee in recognition of their bargaining services, even if the individual chooses not to be a member. This arrangement does not exist in what have been called 'right to work' states, and recently more states have switched to a 'right to work' arrangement, which, it is anticipated, will lead to an increase in free-riding.

there is little evidence that this has happened. An exception is the provision of legal insurance to professionals such as teachers against allegations of misconduct: Murphy (2020) uses press coverage of such allegations as a means of proxying exogenous variance in demand for legal insurance and shows demand for this excludable good rises with such reports, leading to an increase in the take up of union membership.

The union good is co-produced by those who purchase it. In the case of the union wage premium, for example, as noted earlier higher union density is usually linked to a higher union wage premium due to increased union bargaining power. One might therefore have thought that, with falling union density, the quality of the union good may have declined, such that the quality-adjusted price of membership may have risen over time.[10] But there is no clear evidence that this has happened. Indeed, evidence suggests relative stability in the union wage premium over time (Blanchflower and Bryson, 2007).

The above presupposes that unionisation is, broadly speaking, a normal good. However, in a series of papers Gomez and co-authors have portrayed union membership as a good with both search components (such as the union wage premium) and experience components. The experience good model has important implications for the propensity of workers to purchase union membership once membership has begun to decline. Given the experiential component to the union good, the chief way in which workers establish the value of union membership for themselves is reports from colleagues and friends (Bryson and Davies, 2018). These recommendations are less frequent in a world where a growing percentage of employees are never-members (Bryson and Gomez, 2005). One way to increase the likelihood of purchasing an experience good is to offer it at a discount initially, to induce purchase, then raise the price subsequently in the expectation that the purchaser will be prepared to pay the full price having recognised the quality of the good. In practice, this rarely happens, although there are instances in which students or newly qualified professionals do qualify for lower membership rates (eg. in teaching and nursing in the UK).

What remains unresolved in this literature is just how much workers are prepared to pay for the union good holding the quality of the good constant. Changes in the tax subsidy for membership, plus the actual union dues paid by workers, provide an opportunity to estimate the

[10] Booth (1985) presents a social custom model of union membership in which the cost of unionisation is partly offset by foregoing the reputational damage of non-membership in an environment where unionisation is the norm or custom. In recent times, when the norm is often non-membership, this reputational damage is reduced or no longer exists, thus reducing (increasing) the relative cost of (non)-membership.

price elasticity of demand for union membership by looking at the proportion of workers flowing into and out of union membership as the net price of membership changes. We can do this in the Norwegian case, a setting where local bargaining at workplace level remains very important, even though some union bargaining also occurs at firm and sectoral level.

3. UNION MEMBERSHIP AND TAX SUBSIDIES

A simple model of the worker's choice between becoming a union member or not in the presence of tax subsidies is presented in Barth et al. (2020). Since this is the key choice that we study in our empirical analysis, we provide a brief recap of the model here in order to motivate our empirical strategy. The union provides two kinds of services attractive to workers; they may increase the wage, and they may provide various forms of insurance and legal services at discounted prices. Assume that the utility of each worker can be expressed by a Cobb-Douglas utility function, depending on insurance, I, and consumption (or a composite good), C:

(1) $U = I^{\alpha} C^{(1-\alpha)}$,

Each worker faces a budget set, which differs depending on union membership:

(2) Union: $p_I^U I + C + P - S = W_U$,

Non-union: $p_I^N I + C = W_{N,}$

where C is the numeraire good, $p_I^U \leq p_I^N$ are the prices of insurance for union and non-union members, P is the union membership fee, S is a tax subsidy amount on union membership, and the Ws are wages. Let $\tilde{\alpha} = [\alpha^{\alpha}(1-\alpha)^{1-\alpha}]$, so that the indirect utility functions may be written as:

(3) Union: $V^U = \tilde{\alpha}\left[\frac{1}{p_I^U}\right]^{\alpha}[W_U - (P - S)(1+\varepsilon)]$,

Non-union: $V^N = \tilde{\alpha}\left[\frac{1}{p_I^N}\right]^{\alpha} W_N$.

The monetary costs of union membership are P-S, and we allow for heterogeneity across workers by discounting the monetary costs by a factor $(1+\varepsilon)$. The term ε varies across workers and represents their attitudes or mental rewards from being member of a union. The average worker considers only the monetary costs and benefits of joining ($\varepsilon = 0$), whereas some

workers discount the costs of joining ($\varepsilon < 0$), for instance because they believe in collective action, have a political leaning towards the left, feel a responsibility towards fellow workers, or enjoy being part of the group; while other workers may have the opposite attitudes and rather tend to exaggerate the costs of joining ($\varepsilon > 0$). The cost of membership may also be attenuated or magnified by both union and management actions towards membership and non-membership.

The bargaining power of the union is represented by the difference, Δ, between the union and non-union wage:

(4) $W_U = \Delta + W_{N,}$

Union dues may be used to improve on workers' bargaining power, for instance through the size of strike funds, such that: $\Delta = \delta P + d$ with $\delta > 0$ and d>0. A worker becomes a union member if V^U-V^N>0. The utility differential is given by:

(5) $V^U - V^N = K\{\Delta + g - (P - S)(1 + \varepsilon)\},$

whose sign is independent of K=$\tilde{\alpha}\left[\frac{1}{p_I^U}\right]^{\alpha} > 0$. g= $\left(1 - \left[\frac{p_I^U}{p_I^N}\right]^{\alpha}\right) W_N$ is the value of the price discount on insurance for union members and Δ is the difference between union and non-union wage. We may write the condition that $V^U - V^N > 0$ as:

(7) $\delta - 1 + \delta\left(\frac{S}{P-S}\right) + (d + g)\frac{1}{P-S} > \varepsilon,$

We define $\frac{S}{P-S}$ as the subsidy ratio. Equation 7) shows that conditional on the union membership fee, the probability of becoming a union member is increasing in the subsidy ratio. The choice of becoming a union member may thus be analyzed using a simple regression model of union membership on the inverse of the net membership fee and the subsidy ratio:

(8) P(U=1) = a + b$\frac{1}{P-S}$ + c$\frac{S}{P-S}$ + u.

We have b=d+g>0 and c=δ>0. Given this functional form, the relationship between membership and S and P are given by $\frac{\partial U}{\partial S}$=[$\frac{1}{P-S}$]^2[b+cP]>0 and $\frac{\partial U}{\partial P}$=-[$\frac{1}{P-S}$]^2[b+cS]<0.

4. THE NORWEGIAN TAX SYSTEM AND THE UNION MEMBERSHIP FEE

Union membership is subsidized in Norway as a deduction on taxable income. Table 1 shows the development of the deductions allowed for union membership given by the tax system over the period 2001-2012. Row 1 is the gross deduction. Employees benefit from the subsidy amount reported in row 2, calculated as 28% of the deduction in income, since that is the marginal tax rate on income after dedications.[11] The third row shows the average gross fee. The subsidy amount rose more than four-fold over the period, whereas the average membership fee rose 1.5 times, such that the subsidy was equivalent to 7% of the average membership fee in 2001, rising to 21% in 2012.

Table 1 Subsidy of union membership. (NOK)

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Deduction	900	900	1450	1800	1800	2250	2700	3150	3150	3660	3660	3750
Subsidy	250	250	410	500	500	630	760	880	880	1020	1020	1050
Union fee	3430	3580	3740	3860	3990	4060	4240	4360	4510	4640	4820	4980

Note: Deduction is the maximal deduction in taxable income. The subsidy amount is 28% of the deduction in income. The average union fee is calculated from our data (see Section 5). All measures in NOK (in 2011 1£=9.032NOK and 1$=5.607NOK).. Source: Barth et al. (2020).

The government determines the size of the subsidy at the end of the previous tax year. No explicit pronouncements were made as to why the tax subsidy rose, but it is linked to changes in political power in Norway. The tax subsidy associated with union membership was cut by 50% between 1998-99 by the liberal-conservative Bondevik-coalition government (from 1800 NOK to 900 NOK) leading to union protests. In the October 2005 election the Labour Party gained power at the expense of a liberal-conservative coalition. It retained power in the election of 2009.

[11] Norway has a progressive tax system, but the progressivity arises at the level of gross taxable income. For income after deductions, the tax rate is basically flat at 28 percent over the period we consider.

5. DATA

We exploit population-wide administrative register data provided by Statistics Norway. *The administrative register data*, collected by the Norwegian Tax Authorities and Social Services, comprise the whole Norwegian population of workers, workplaces and firms during the period 2001-2012 (around 2,500,000 worker observations each year) and provide information on individuals and jobs including income, earnings, work hours, occupations[12], wages and union membership fees. Unique identifying numbers exist for individual workers, workplaces, and firms, thus allowing us to track these units over time. We denote the workerXfirm-combination as a worker's job.

Workers' hourly wage is constructed from the tax data based on job- and spell-specific annual earnings, spell length and contracted weekly working hours.

Workers' union status is apparent from the administrative tax data containing annual union fees. To avoid volatility in union fees arising from spells of individuals not working, we focus on employed workers by October 15 reporting taxable income in year t, $t \in (2001,2012)$, above 1G (G is the Social Service's baseline figure, 1G is equivalent to £8685 in 2011), i.e., we restrict the analyses to roughly 2,000,000 jobs each year or 24,200,641 observations over the whole period.

Since it is not possible to know the union fee for union non-members we have followed the simple rule of designating each worker a job class (or union) based on their main economic activity (2-digit SIC code X 3-digit occupational code, resulting in a total of roughly 7,000 cells). We calculate the average union fee for each job class based on union members only, and then link this fee to every worker in the job class.

To utilize the public administrative register data in our analyses, we focus on workers aged 20-60 years of age. This sample is only used to present Table 2. We then discard public sector jobs, and in the remainder of the analyses focus on private sector jobs only. Thus, our final data set contains 12097568 job observations of 1731149 workers employed each year.

[12] Note that occupational codes are registered from 2003, but these identify occupations for workers employed previously (2001-2002). Of roughly 24 million observations, 286 000 workers have unidentified occupations, whereof 200 000 and 70 000 are employed in 2001 and 2002, respectively. For workers with missing information on occupation, we impute occupational codes based on 3-digit educational qualification codes (occupational codes and educational qualification codes do not overlap).

6. UNION MEMBERSHIP OVER TIME

While the OECD (2017, 2018) have shown that union membership is on the decline in many western economics, they also show that in Norway membership is more stable. Table 2 shows the development in union density separately for private and public sectors, and separately for major industries within these sectors.

In the public sector, union density hovered at a little above 80 percent by 2012 following a decade of differential growth which led to a convergence in density rates across parts of the public sector. In the private sector the picture is starkly different. Across the sector as a whole, union density was roughly static at around two-fifths of workers being union members – half the rate in the public sector. There is also substantial and persistent heterogeneity in union density rates across different parts of the private sector: almost six-in-ten workers in Manufacturing and Transport were members in 2012, compared with one-third in Construction and a quarter in Trade.

Table 2 Union membership across sectors (in percent). 2001 and 2012.

	2001	**2012**	**Growth**
Private sectors	**43.3**	**43.5**	**0.2**
Manufacturing	60.4	57.7	-2.7
Construction	34.4	33.9	-0.5
Trade	25.4	28.8	3.4
Transport	54.6	58.2	3.6
Public sectors	**77.4**	**81.5**	**4.1**
Public administration	85.5	86.0	0.5
Health	73.2	86.1	13.1
Education	77.1	83.8	5.7

Note: Population: Workers 20-60 years of age, employed by October 15th each year.

7. UNION MEMBERSHIP AND THE SUBSIDY RATIO

In this section, we establish empirically the relationship between the subsidy ratio and union membership as outlined in our theoretical discussion in Section 3. As discussed above, the interaction between the union membership fee (inverse) and the subsidy amount provides variation in the subsidy ratio across jobs (workers) within the same year, even if the subsidy amount in a given year is the same for all workers. Our data contain the union membership fees paid by all union members, as reported to the tax authorities.

We define the subsidy ratio for worker i belonging to job class c at time t as:

$$S\_ratio_{ict} = \frac{s_t}{\overline{p_{ct\not\ni\iota}} - s_t}$$

where s_t is the subsidy amount in year t, while $\overline{p_{ct\not\ni\iota}}$ expresses the leave-out-mean union membership fee of workers belonging to job class c (where worker i is excluded).[13] Similarly, define the net union fee inverse for worker i belonging to job class c at time t as:

$$N\_fee_{ict} = \frac{1}{\overline{p_{ct\not\ni\iota}} - s_t}$$

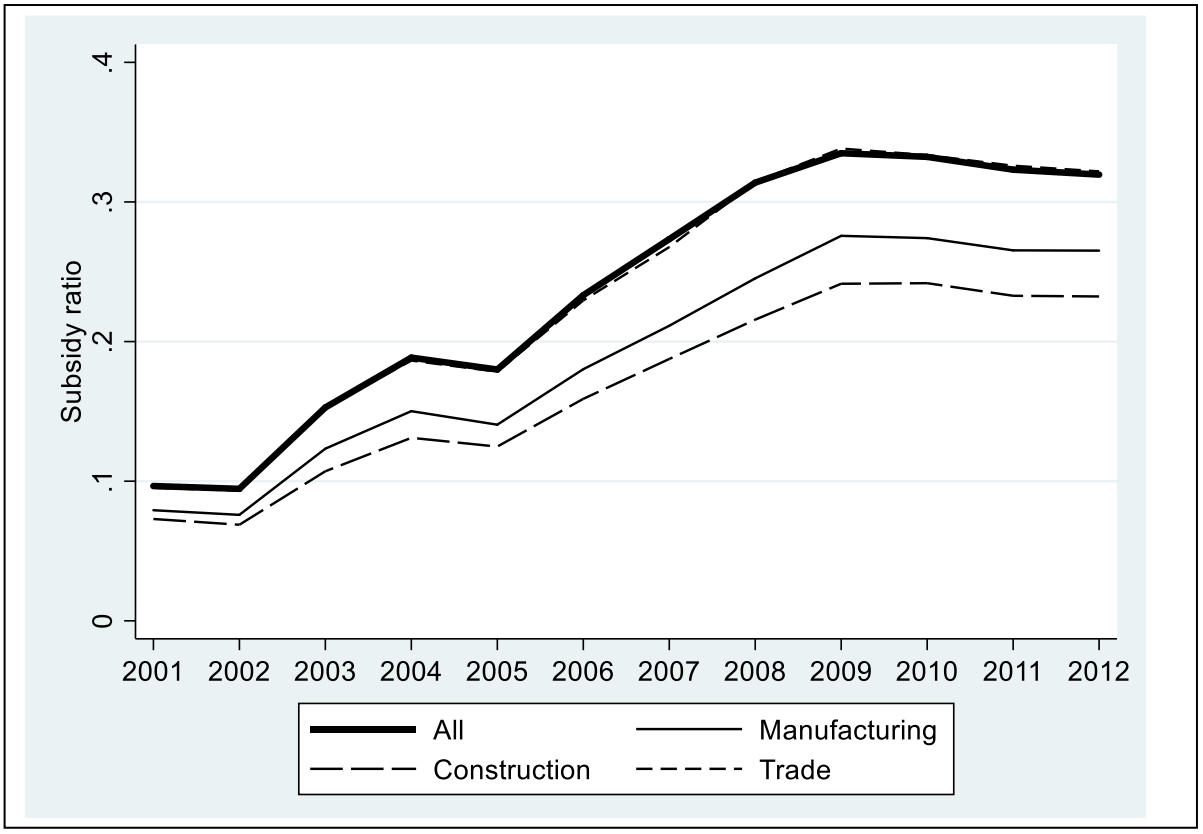
where s_t is the subsidy amount in year t, while $\overline{p_{ct\not\ni\iota}}$ expresses the leave-out-mean union membership fee of workers belonging to job class c.

Figure 1 shows the subsidy ratio for all, and for three major private industries – Manufacturing, Construction and Trade – based on the wage distribution among union members. The subsidy ratio amounts to 5-10% in the beginning of the period, increasing to around 15-30%. For all three groups the subsidy appears sizeable enough to affect union membership.

[13] The leave-out-mean can be expressed $\overline{p_{ct\not\ni\iota}} = \frac{(\Sigma_{jc} f_{jct} - f_{ict})}{(n_{jct} - 1)}$, where j denote all workers in job class c (including worker i)

Since we calculate membership fees among union members by job class, we may allocate a potential fee to non-members as well, using information on their job class. We thus use information on membership fees to calculate the subsidy ratio for all workers.

Figure 3 Subsidy ratio for all and across main industries. Private sector.



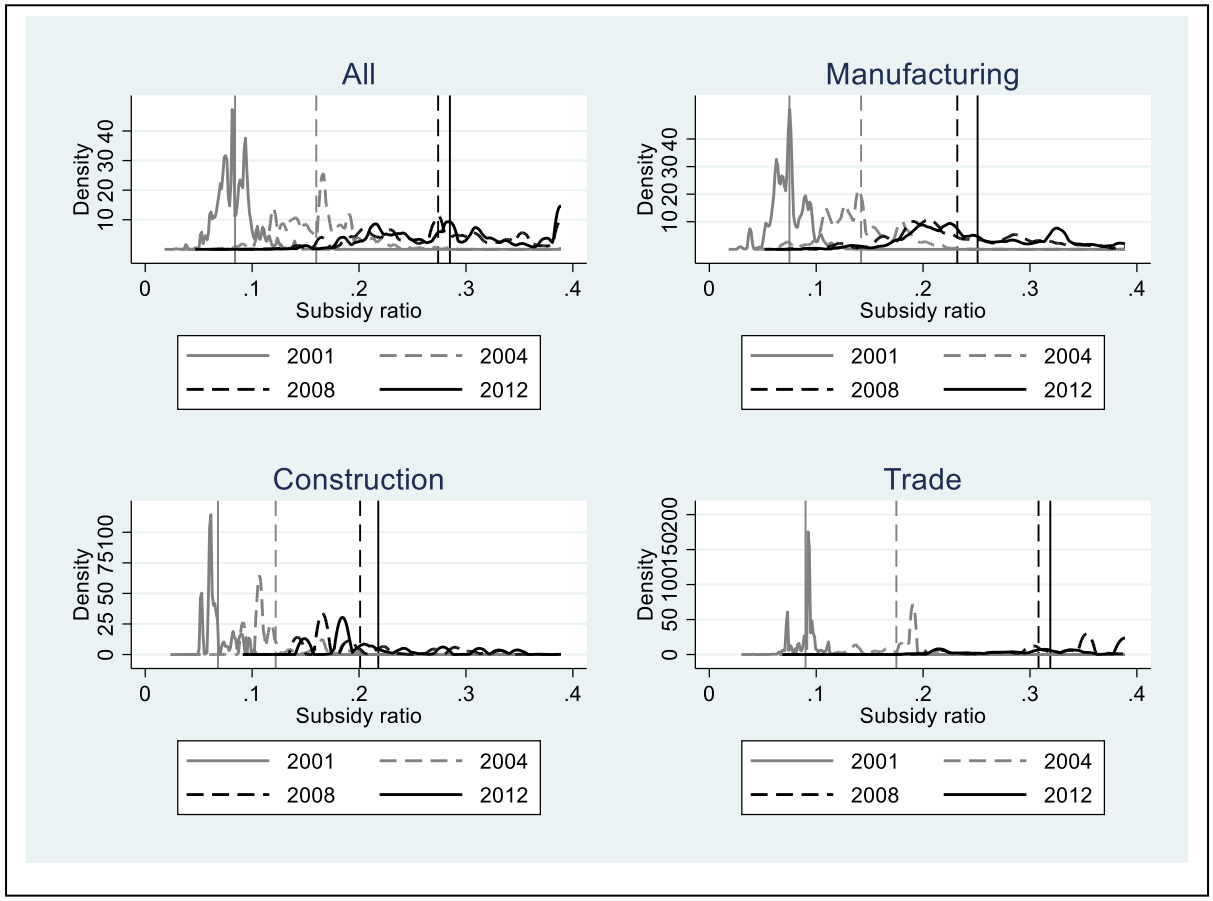
Note: Population: Private sector workers 20-60 years of age, employed by October 15th each year.

The distribution of the subsidy ratios for all workers and for the three major industries are presented in Figure 2. The distribution is shown for four different years, 2001, 2004, 2008 and 2012. The figure shows that the subsidy ratio rises from a little under a median of 10% at the beginning of the period to between 25% and 30% at the end of the period. We also see that the distribution of the subsidy ratio becomes more dispersed over time.

However, the differences in unionization and in the subsidy ratio are not the only differences between the private sector industries. In Table 3 we present descriptive statistics on all workers and separately for the different industries. We see that, on average, Manufacturing is more unionized, better paid, and employs older workers and more immigrants than the other industries. Trade pays more poorly than the other three industries and employs more women.

Furthermore, wage growth is ten-times greater in Manufacturing than it is in Construction and Trade. All three industries reveal positive average growth in unionization, but less so in Construction.

Figure 2 Distribution of the subsidy ratio over time. Across workers.



Note: Population: Private sector workers 20-60 years of age, employed by October 15th each year. The vertical lines express the mean subsidy ratio for the given year as indicated by the legend.

Table 3 Descriptive statistics

	All	Manufacturing	Construction	Trade	Transport
Level					
Subsidy ratio	0.2240	0.1857	0.1716	0.2377	0.2025
	(0.1039)	(0.0908)	(0.0852)	(0.1030)	(0.0913)
Net union fee inverse	0.0003	0.0003	0.0003	0.0004	0.0003
	(0.0012)	(0.0004)	(0.0003)	(0.0007)	(0.0001)
Union	0.4345	0.5809	0.3585	0.2636	0.5734
	(0.4957)	(0.4934)	(0.4796)	(0.4406)	(0.4946)
Log hourly wage	5.1699	5.2141	5.1517	5.0743	5.1446
	(0.5684)	(0.4696)	(0.4650)	(0.5667)	(0.6406)
Women	0.3692	0.2437	0.0845	0.4516	0.2694
	(0.4835)	(0.4293)	(0.2781)	(0.4976)	(0.4436)
Immigrant	0.0958	0.0900	0.0764	0.0753	0.0884
	(0.2943)	(0.2862)	(0.2657)	(0.2638)	(0.2838)
Age	39.8936	41.3496	38.6873	39.7258	41.6568
	(10.4246)	(10.1001)	(10.6410)	(10.7672)	(10.4771)
N (observations)	12097568	2295103	1187546	2527912	1363277
Growth					
Subsidy ratio	0.0179	0.0161	0.0131	0.0197	0.0184
	(0.0342)	(0.0282)	(0.0292)	(0.0339)	(0.0307)
Union	0.0086	0.0075	0.0023	0.0087	0.0109
	(0.1901)	(0.1752)	(0.1804)	(0.1838)	(0.2094)
Log hourly wage	0.0099	0.0191	0.0016	0.0017	-0.0197
	(0.3303)	(0.2706)	(0.3146)	(0.3580)	(0.4412)
N (observations)	8233345	1399642	710638	1473083	1045413

Note: Private sector workers 20-60 years of age, employed by October 15th each year. Otherwise, population denoted by column head.

Next, consider the following simple but detailed linear probability model:

$$(9) \qquad I(U_{ijt}) = \beta^X X_{ijt} + \beta^S \frac{S_t}{P_{ct\not\ni i} - S_t} + \beta^F \frac{1}{\overline{p_{ct\not\ni i}} - S_t} + \gamma_t + T_{jt} + \theta_j + \varepsilon_{ijt},$$

where I(U) expresses a dummy for union membership, $\frac{1}{\overline{p_{ct\not\ni i}} - S_t}$ expresses the net union fee inverse, θ_j denote fixed workerXfirm effects, γ_t and T_{jt} express time dummies and linear workerXfirm-specific time trends. X_{ijt} is a control vector comprising age vigintile dummies and a dummy for part-time work, and ε_{ijt} is a standard error term.

Table 4 presents the results from the estimation of Equation 9) for all private sector workers, as well as separately for Manufacturing, Construction, Trade and Transport workers. Models 1 and 2 present the results from the estimation of slightly less complex equations. In Model 1 we

drop linear time trends but incorporate a dummy for being a woman and fixed job cell effects instead of fixed workerXfirm effects. In Model 2 we drop the linear time trends.

Table 4 The impact of the subsidy ratio on the probability of union membership

	All	Manufacturing	Construction	Trade	Transport
Model 1 – age, time and job cell fixed effects					
Subsidy ratio	0.4476***	0.9419***	0.3760**	0.2795***	0.0585
	(0.0538)	(0.0756)	(0.1663)	(0.1340)	(0.0966)
Net union fee inverse	90.3731***	50.9284**	81.7055	198.1015**	242.9816***
	(29.0105)	(22.8579)	(174.2446)	(73.5293)	(56.3697)
Model 2 – age, time and workerXfirm fixed effects					
Subsidy ratio	0.2052***	0.2349***	-0.1595	0.2073*	0.2194***
	(0.0334)	(0.0353)	(0.0942)	(0.1169)	(0.0595)
Net union fee inverse	11.8736**	7.5277***	52.6901	17.2687	7.6722
	(4.9478)	(2.7971)	(62.6907)	(24.1170)	(17.4506)
Model 3 – age, time and workerXfirm fixed effects and linear workerXfirm time trends					
Subsidy ratio	0.1056***	0.1706***	-0.0628	0.0053	0.0656
	(0.0226)	(0.0235)	(0.0432)	(0.0373)	(0.0591)
Net union fee inverse	20.9427**	11.5217*	38.3731	50.7657***	25.1156
	(8.6637)	(6.3537)	(29.0385)	(20.3313)	(19.8653)
W (job cell)	3295	1175	95	254	350
J (jobs)	2558408	451596	265785	600520	289367
N (observations)	12163343	2423499	1295581	2795857	1363265

Note: Population denoted by column head. FE (within)- linear regressions. Panel unit: job (workerXfirm). Dependent variable: dummy taking the value of 1 if worker is a union member. All models comprise the following control-vector: year dummies, part-time dummy, age vigintile dummies. Standard errors adjusted for worker-clustering presented in parentheses. ** and * denote 1 and 5 percent level of significance.

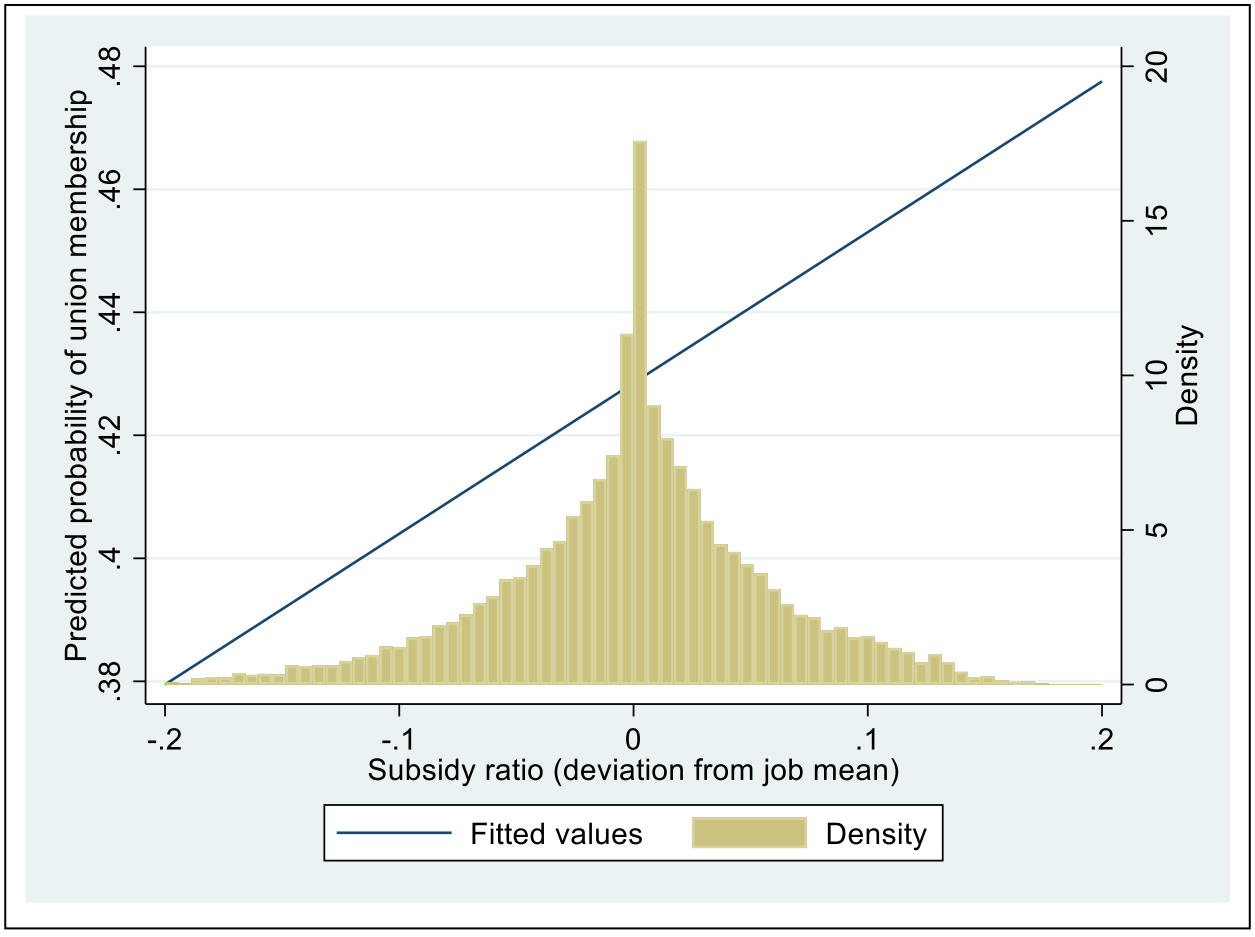
We see that in most specifications and for all workers as well as for several of the separate industries, we find that the subsidy ratio is significantly positively associated with union membership. Although the impact is nearly halved when adding workerXfirm-specific linear time trends (Model 3), we still identify a positive significant coefficient for all workers and in Manufacturing. Thus, by increasing the subsidy ratio, workers join unions. However, we also see that the impact varies quite markedly across industries. The biggest coefficient is found in Manufacturing. Within job (workerXfirm fixed effects), the coefficient turns non-significant and even negative in Construction.[14] We treat Model 2 as our preferred model in the remaining

[14]Construction experiences a 50% employment growth and entry of new establishments during the latter half of our observation period, partly filled by labour migration due to the EU-enlargement in 2004 and 2007. From

analyses, since incorporating workerXfirm-specific linear time trends is very data demanding, and when doing analyses on selected populations (e.g., selected industries, worker and firm groups) data might not contain enough variation for robust analyses.

Does the subsidy ratio matter economically? Figure 3 depicts the relationship between the subsidy ratio and union membership based on Model 2 of Table 4. We see that the main variation in the subsidy ratio (-0.2 – 0.2) yields close to 10 percentage point variation in the predicted union membership rate.

Figure 3 The impact of the subsidy ratio on the union membership rate.



Note: Population: all private sector workers. Both the histogram of the subsidy ratio and the relationship between the subsidy ratio to union membership are based on within job-group transformed variables. Based on the relationship presented by Model 2 for all workers in Table 4.

2008, the changes to the tax deductions were much smaller than the period before. Thus these workers and firms were less exposed to the tax changes. In addition, one could argue that the union good is experience-related.

Another way of assessing the size of the impact, is to estimate the marginal effects associated with an increase in the subsidy and an increase in the union fee. The marginal effects are non-linear, and vary depending on subsidy- and fee-level. In Table 5 we present the estimated marginal effects associated with an increase of 100 NOK in the subsidy (roughly 10 percent of the 2012-level) and an increase of 10 percent in the union fee. We estimate these marginal effects based Model 2 of Table 4 using values (for the average union fees and subsidies) for the beginning and the end of our observation period (2001 and 2012). For all workers and for the major industries with the exception of Construction (where the underlying parameters are highly non-significant), we see that by increasing the subsidy the number of union members grows, while by increasing the union membership fee one achieves a reduction in the number of union members. On one hand, we thus see that workers behave as expected when it comes to variation in the price for union membership. On the other hand, we see that the estimated marginal effects are not strong and vary considerably between industries.

In the beginning of our observation period aggregate union density was 44.6 percent. At the end, it had dropped to 42.9 percent. The average union fee increased from 3532 Nok to 5083 Nok during the same period. Using these figures and the marginal effects calculated for a ten percent increase in the union fee, we can calculate the price elasticity of union demand as -2.1 percent in 2001 and -7.3 percent in 2012. We can also calculate the subsidy elasticities of union demand using the subsidy figures: we get elasticities of 1.8 and 6.7 percent for 2001 and 2012, respectively. Thus, the price and subsidy elasticities mirror each other, but with opposite signs.

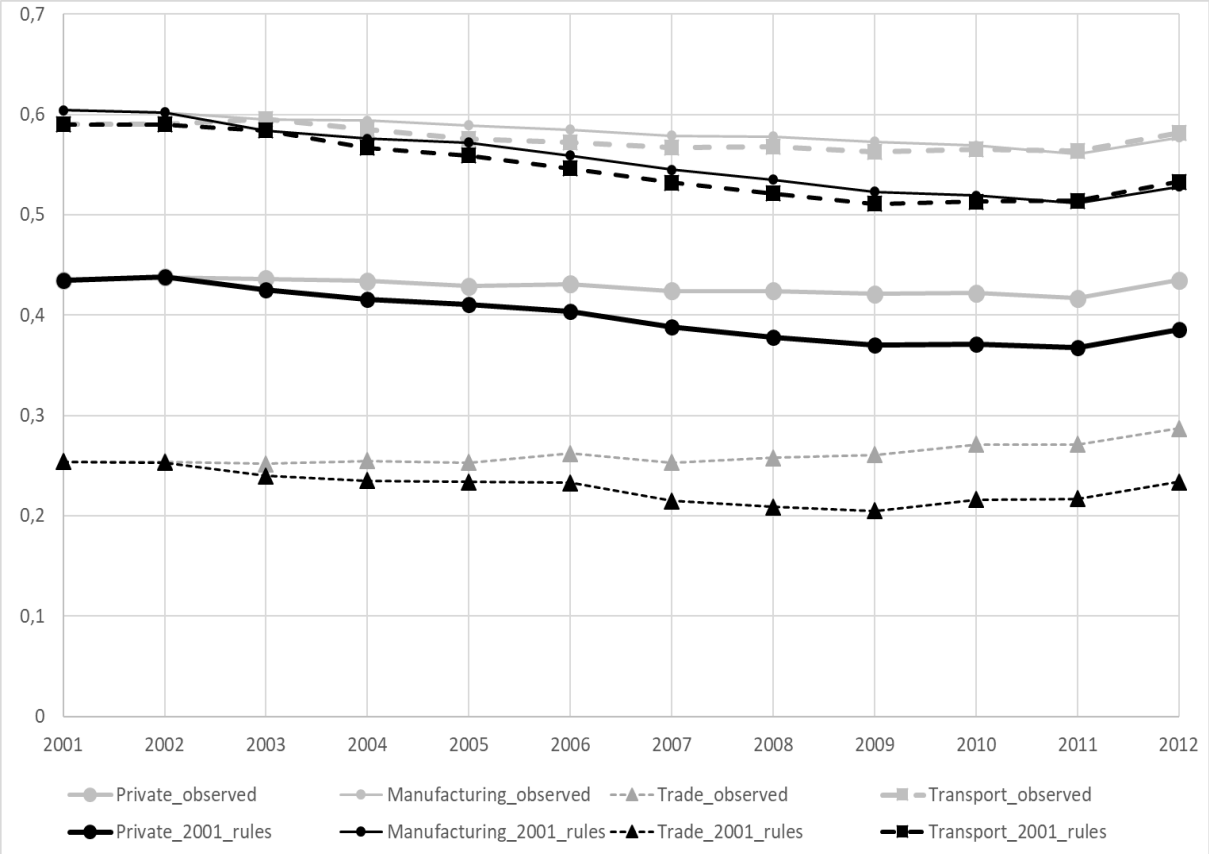
Table 5 Marginal effects of raising the union fee and the subsidy on union membership. 2001 and 2012.

	All	**Manufacturing**	**Construction**	**Trade**	**Transport**
Increasing the subsidy by 100 NOK					
2001	0.0071**	0.0073***	-0.0041	0.0082*	0.0077***
	(0.0011)	(0.0011)	(0.0023)	(0.0043)	(0.0020)
2012	0.0067***	0.0067***	-0.0035	0.0081*	0.0063***
	(0.0011)	(0.0010)	(0.0020)	(0.0043)	(0.0017)
Increasing the union fee by 10%					
2001	-0.0021***	-0.0021***	0.0004	-0.0027**	-0.0022***
	(0.0002)	(0.0003)	(0.0013)	(0.0007)	(0.0018)
2012	-0.0073***	-0.0072***	0.0027*	-0.0090**	-0.0076***
	(0.0011)	(0.0010)	(0.0014)	(0.0007)	(0.0018)

Note: The marginal effects are calculated based on the figures of Model 2 in Table 3, and the average gross union fees for 2001 and 2012. ***, ** and * denote 1, 5 and 10 percent level of significance.

A third way of assessing the impacts of these tax changes is to simulate what would have happened if no tax changes occurred. Thus, we use our estimates to predict the development in unionisation based on the 2001 tax rules. This counterfactual analysis is seen in Figure 4, where *observed* denotes the development in unionisation with the observed tax changes while 2001_rules denotes the predicted unionisation based on 2001 tax rules. Our estimates are from within-job FE regressions, thus all fixed characteristics of a job are controlled for (e.g., fixed firm characteristics such as industry and location, and individual characteristics such as gender, educational qualification and other unobserved fixed traits). We see that over time private sector unionization would have dropped by nearly 5 percentage points. Declines would have occurred in all three sub-sectors and may have been particularly problematic in Trade where unionization rates were already low.

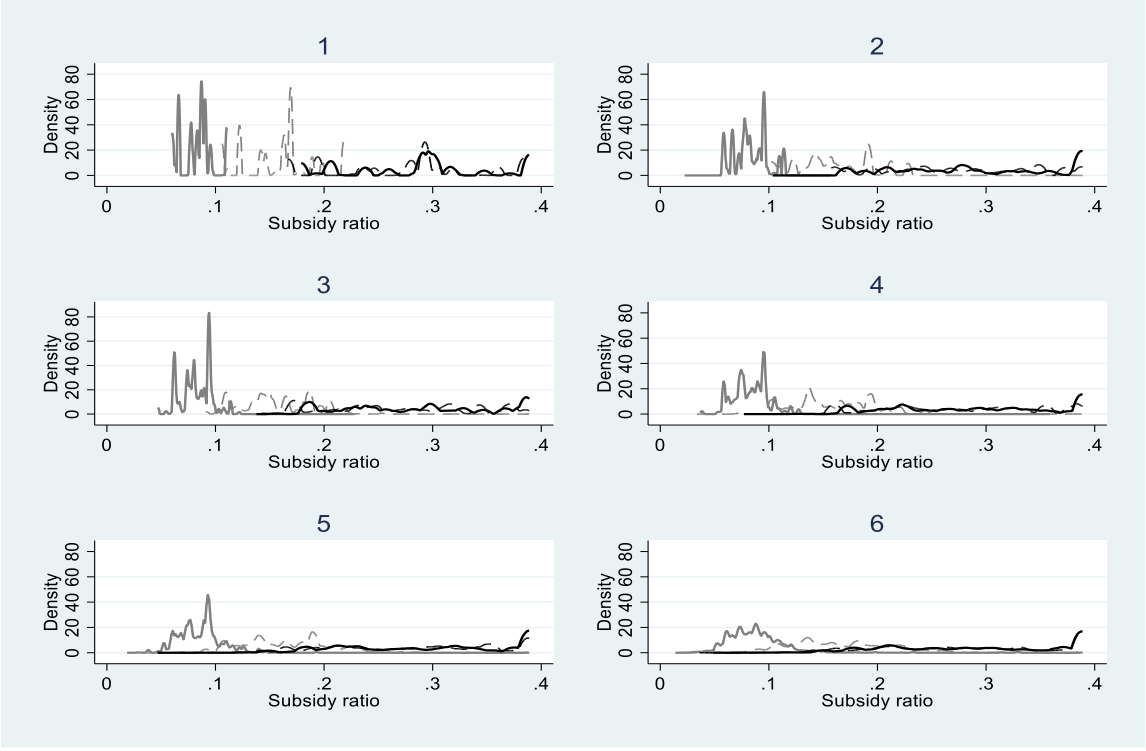
Figure 4 Counterfactual analysis of union membership. Constant compositions of jobs.



Note: Simulation based on Model 2 of Table 4. This is a within-job FE regression, thus all fixed characteristics of a job is controlled for (e.g., fixed firm characteristics such as industry and location, and individual characteristics such as gender, educational qualification and other unobserved fixed traits).

Finally, our estimates in this section rests on being able to attribute the union price to non-members correctly. We have done so by defining a job class (or union) based on their main economic activity (2-digit SIC code X 3-digit occupational code, resulting in a total of roughly 7,000 cells), and then measuring the price for the union members in this class. As a robustness check, we end this section by seeing how sensitive our results are to other definitions of a job class (or union). We do this for 6 different definitions: 1) Blue/white collarX14 main industriesXprivate sector, 2)1-digit occupational codeXmain industryXprivate, 3)Blue/white collarX2-digit SIC code, 4) 1-digit occ. code X2-digit SIC code, 5) 2-digit SIC code X 3-digit occ. code Xprivate, and 6) 5-digit SIC code X 3-digit occ. code Xprivate. Thus the number of job class varies from 36 in 1) to over 20000 in 6). In Figure 5 we show the distribution of the subsidy ratio across workers over time (similar to Figure 4) based on these 6 job class definitions. We see that the arising distributions are quite similar, but as the job classes get more aggregated (and thus fewer), the distributions get more compressed.

Figure 5 The distribution of the subsidy ratio over time for different job class definitions.. Across all workers.



Note: Population: Private sector workers 20-60 years of age, employed by October 15th each year. The figure is similar to Figure 2, but for 6 different job class definitions: 1) Blue/white collarX14 main industriesXprivate sector, 2)1-digit occupational codeXmain industryXprivate, 3)Blue/white collarX2-digit SIC code, 4) 1-digit occ. code X2-digit SIC code, 5) 2-digit SIC code X 3-digit occ. code Xprivate, and 6) 5-digit SIC code X 3-digit occ. code Xprivate.

We then repeat the analysis of Model 2 of Table 4 and those of Table 5 for all workers (due to the broader job class definitions of 1)-4), industry-specific analysis become less robust)[15]. Table 6 presents our results.

Table 6 The impact of the subsidy ratio on the probability of union membership and the corresponding marginal effects of increasing the union subsidy and the union price for different job class definitions. All workers

	1	2	3	4	5	6
Parameter estimates						
Subsidy ratio	0.2021*	0.2553***	0.2402***	0.2510***	0.2040***	0.3266***
	(0.109)	(0.0883)	(0.0942)	(0.0695)	(0.0323)	(0.0151)
Net union fee inverse	-96.302	-135.089	-127.800	-113.677**	12.884***	0.7503
	(142.633)	(88.304)	(88.304)	(55.966)	(4.845)	(0.722)
Marginal effect on the union probability of increasing the subsidy by 100 NOK in 2012						
	0.0059**	0.0073***	0.0069***	0.0074***	0.0067***	0.0105***
	(0.0028)	(0.0024)	(0.0026)	(0.0020)	(0.0010)	(0.0004)
Marginal effect on the union probability of increasing the union fee by 10% in 2012						
	-0.0037	-0.0043***	-0.0040***	-0.0048***	-0.0073***	-0.0111***
	(0.0026)	(0.0016)	(0.0021)	(0.0014)	(0.0010)	(0.0005)
W (job cell)	26	123	114	503	3323	13619
J (jobs)	2501906	2501903	2558408	2558408	2557970	2499103
N(observations)	11872410	11872397	12163426	12163426	12161435	11823901

Note: Job class definition denoted by column head. These are: 1) Blue/white collarXmain industryXprivate, 2)1-digit occupational codeXmain industryXprivate, 3)Blue/white collarX2-digit SIC code, 4) 1-digit occupational code X2-digit SIC code, 5) 2-digit SIC code X 3-digit occupational code Xprivate, and 6) 5-digit SIC code X 3-digit occupational code Xprivate. FE (within)- linear regressions similar to Model 2 of Table 4. Panel unit: job (workerXfirm). Dependent variable: dummy taking the value of 1 if worker is a union member. All models comprise the following control-vector: year dummies, part-time dummy, age vigintile dummies and fixed workerXfirm effects. Standard errors adjusted for worker-clustering presented in parentheses. ***, ** and * denote 1, 5 and 10 percent level of significance.

As we see from Table 6, our main results remain qualitatively unchanged across different definitions of the job class (union). Even with our most broad definition, Blue/white collarX14 main industriesXprivate sector, with variation in the union price across only 26 different job classes or unions, we still identify qualitatively similar albeit somewhat weaker estimates to those we found in Tables 4 and 5.[16] When we use more disaggregated cells to proxy the price

[15] For example, within Construction job class 1, 2 and 3 yield 2, 10 and 2 different job classes, respectively, and thus consequently little variation in the subsidy ratio and the inverse of the net union fee when we take into account years, part-time, age (vigintile dummies) and fixed workerXfirm effects.

[16] For example, the parameter estimate associated with the subsidy ratio is 0.2021 compared to 0.2052 found in Table 4.

of membership for non-members our estimates become very similar to our previous estimates. Thus, our key findings are, at least on aggregate, robust to changes in the definition of the job class. In general, increased subsidization increases the probability of union membership, while an increased union fee reduces the enrolment in unions.

8. HETEROGENEOUS IMPACT OF UNION SUBSIDIZATION

How does the impact of union subsidization vary across worker and firm groups? Does the public tax policy stimulate membership in some groups more than others? To answer this question, in this section, we repeat the analyses based on Model 2 of Table 4, but do these separately for different worker and firm groups. We have selected groups depending on worker, occupational, plant/firm- and industry-characteristics. Table 7 presents the trends in unionization for these groups, by presenting the aggregate group-specific union density for 2001 and 2012, respectively. We see that mostly the differences in unionisation between 2001 and 2012 are minor, but the biggest differences are seen among the high-skills workers (increase by 4 percentage points), among industries with growing unionization (increase by 4 percentage points) and high-wage workers (decline by 5 percentage points).

The results from the regressions are presented in the Appendix, where Table A1 presents the results for different worker characteristics, while Table A2 presents the similar figures for different firm characteristics. These tables show that the subsidy ratio in the majority of cases is positive and statistically significant. The subsidy ratio influence union membership more strongly for women, the young, the high skilled and workers in occupations with a high share of temporary workers, compared to those who are male, older, low skilled, and workers in occupations with a lower share of temporary workers.

As pointed out earlier, one cannot directly infer the impact of the subsidy from the regression coefficients, similar to those reported in Table 5. Thus, Table 8 presents the marginal effects associated with the subsidies. We only present the marginal effects for 2012. We see that for all groups the marginal effects associated with the subsidy are significantly positive. Increasing the subsidy by 100 Nok (equivalent to a rise of roughly X percent in mean union fees) yields 0.5-1.5 percentage points higher unionization. For women, the young, the high skilled and workers in occupations with a high percentage of temporary workers, 100 Nok yields roughly 0.5 percentage point higher growth in membership compared to men, older workers, the low-skilled and workers in occupations with a low share of temporary workers.

Table 7 Union density for different groups. 2001 and 2012.

		Union density			Union density	
	Group	**2001**	**2012**	**Group**	**2001**	**2012**
Worker characteristics						
Gender	Women	0.409	0.423	Men	0.447	0.441
Country of origin	Native	0.438	0.446	Immigrant	0.367	0.357
Age	Young	0.374	0.389	Old	0.497	0.469
Skills	Low skills	0.438	0.405	Medium skill	0.448	0.446
	High skills	0.393	0.433			
Wage level	Low wage	0.448	0.465	High wage	0.426	0.377
Occupational characteristics						
Temporary work	Low share	0.474	0.493	High share	0.416	0.410
Part-time work	Low share	0.495	0.459	High share	0.385	0.406
Physical strain	Low	0.344	0.365	Medium	0.428	0.435
	High	0.543	0.513			
Psychological strain	Low	0.376	0.403	Medium	0.427	0.403
	High	0.508	0.504			
Plant/firm characteristics						
Workforce size	Small	0.174	0.194	Medium	0.467	0.437
Workforce size	Large	0.674	0.650			
Sales per worker	Low	0.379	0.409	High	0.427	0.415
Capital per worker	Low	0.343	0.330	High	0.448	0.450
Productivity	Low	0.425	0.450	High	0.371	0.370
Age of plant	< 5 years	0.361	0.328	>5 years	0.457	0.452
Industry characteristics						
Pre-period union growth	Diminishing	0.543	0.514	Stable	0.427	0.427
	Growing	0.355	0.408			

Note: Old/young worker defined by below/above 40 years of age. Medium and high skills defined by educational qualification on high-school- or college-level, respectively. Low/high wage defined as below/above median log hourly wage. Temporary work is defined as completed job spells lasting less than 2 years. Physical and psychological demand are derived from the Level of living surveys 2003, 2006, 2009 and 2013, and questions on work. Q1-Q4 divide the occupations into the 4 quartiles related to the share of workers exposed. Temp and part-time work are based on occupational shares, where we define low/high as below/above median share. Size is defined by three equal sized groups from the firm workforce size distribution. Sales per worker, capital per worker and productivity are similarly defined as below/above median in the firm distribution of the respective variable. Pre-period is 1997-2000, where the industry growth in unionization has been split in tertiles. ***, ** and * denote 1, 5 and 10 percent level of significance.

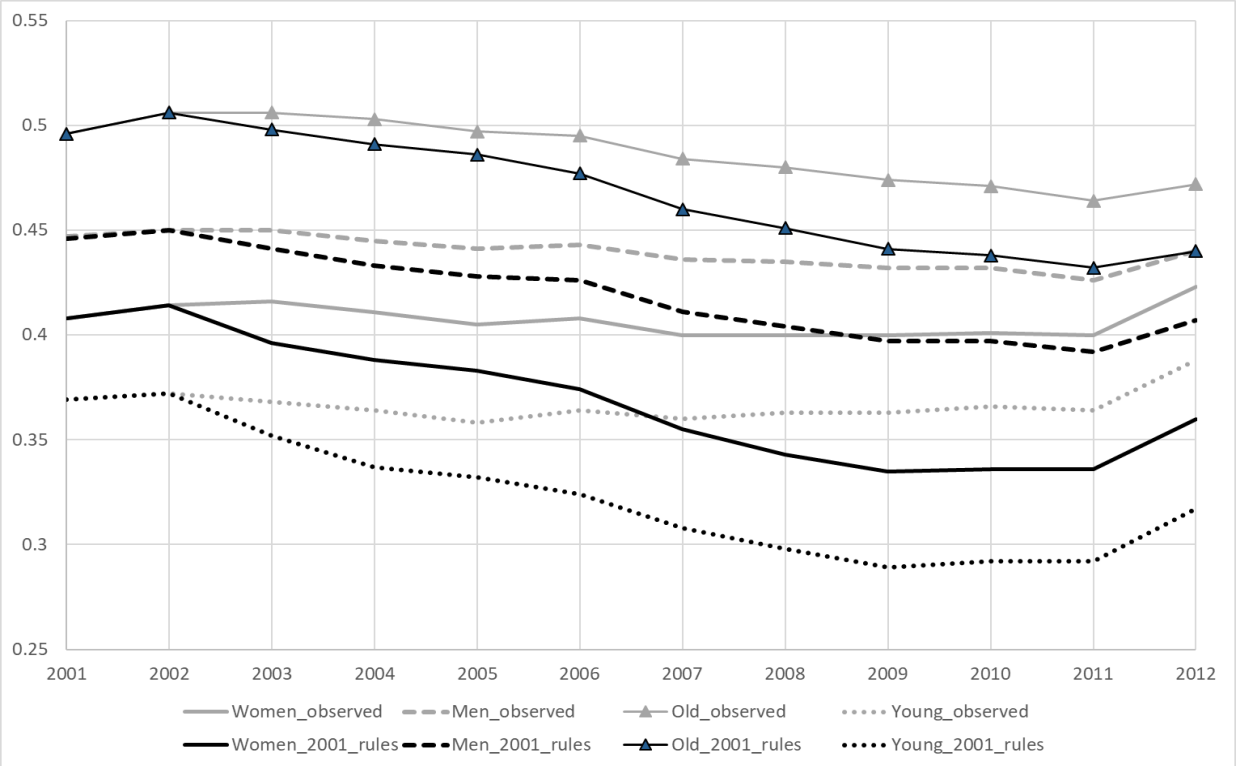
Table 8 Union membership impacts following an increase in the subsidy by 100 Nok for different groups.

	Group 1	Estimate(SE)	Group 2	Estimate(SE)	Diff. (SE)
Worker characteristics					
Gender	Women	0.0096***	Men	0.0046***	0.0050**
		(0.0020)		(0.0007)	(0.0021)
Country of origin	Native	0.0066***	Immigrant	0.0077***	-0.0011
		(0.0011)		(0.0028)	(0.0029)
Age	Young	0.0101***	Old	0.0045***	0.0056**
		(0.0016)		(0.0010)	(0.0018)
Skills 1	Low skills	0.0061***	Medium skill	0.0050***	0.0011
		(0.0014)		(0.0011)	(0.0018)
Skills 2	High skills	0.0098***	Medium skill	0.0050***	0.0048**
		(0.0019)		(0.0011)	(0.0022)
Wage level	Low wage	0.0066***	High wage	0.0068***	0.0002
Occupational characteristics		(0.0016)		(0.0011)	(0.0019)
Temporary work	Low share	0.0032***	High share	0.0086***	-0.0054**
		(0.0005)		(0.0016)	(0.0017)
Part-time work	Low share	0.0055***	High share	0.0069***	-0.0014
		(0.0010)		(0.0016)	(0.0019)
Physical strain	Low	0.0104***	Medium	0.0047***	0.0057*
		(0.0025)		(0.0021)	(0.0032)
Physical strain	High	0.0078***	Medium	0.0047**	0.0030
		(0.0009)		(0.0021)	(0.0022)
Psychological strain	Low	0.0081***	Medium	0.0104**	-0.0023
		(0.0015)		(0.0025)	(0.0027)
Psychological strain	High	0.0086***	Medium	0.0104***	-0.0018
		(0.0020)		(0.0025)	(0.0028)
Plant/firm characteristics					
Workforce size 1	Small	0.0069***	Medium	0.0077***	-0.0011
		(0.0011)		(0.0014)	(0.0018)
Workforce size 2	Large	0.0076***	Medium	0.0077***	-0.0001
		(0.0017)		(0.0014)	(0.0022)
Sales per worker	Low	0.0075***	High	0.0068***	0.0007
		(0.0014)		(0.0018)	(0.0023)
Capital per worker	Low	0.0073***	High	0.0060***	0.0013
		(0.0017)		(0.0011)	(0.0020)
Productivity	Low	0.0062***	High	0.0059***	0.0003
		(0.0015)		(0.0010)	(0.0018)
Age of plant	< 5 years	0.0092***	>5 years	0.0067***	0.0025
		(0.0015)		(0.0011)	(0.0019)
Industry characteristics					
Pre-period union growth	Diminish	0.0116***	Grow	0.0075***	0.0041
		(0.0024)		(0.0023)	(0.0033)
Pre-period union growth	Diminish	0.0116***	Stable	0.0088***	0.0028
		(0.0024)		(0.0020)	(0.0028)

Note: The marginal effects are based on the figures of Table A1 (Worker/occupational characteristics) and A2 (Plant/firm/industry characteristics). Difference (SE) denote the difference between the estimate of group 1 and the estimate of group 2 and the corresponding standard error. Old/young workers: below/above 40 years of age. Medium and high skills defined by educational qualification on high-school- or college-level, respectively. Low/high wage: below/above median log hourly wage. Temporary work: completed job spells lasting less than 2 years. Physical and psychological strain: derived from questions on work in the Level of living surveys 2003, 2006, 2009 and 2013, and principal component analysis. Low, medium and high divide the workers into tertiles. Temp/part-time work: based on occupational shares, low/high= below/above median share. Size: three equal sized groups from the firm workforce size distribution. Sales per worker, capital per worker and productivity: below/above median in the firm distribution of the respective variable. Pre-period is 1997-2000, where the industry growth in unionization has been split in tertiles. ***, ** and * denote 1, 5 and 10 percent level of significance.

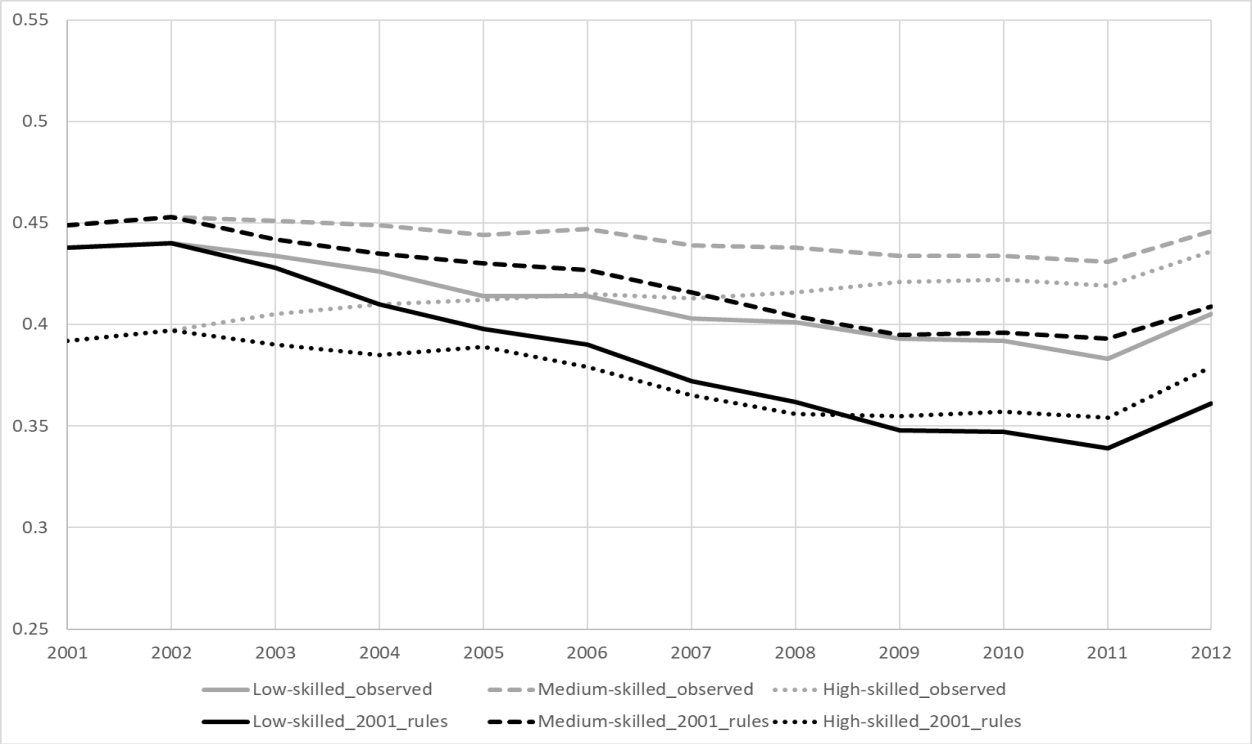
How important are these group differences in union membership sensitivity to subsidies for explaining trends in unionization over time? To answer this question, we predict union density contingent on the 2001 tax rules, and compare the counterfactual development in union density with the observed development (based on the changing tax rules). We have selected four dimensions: age, gender, skills, and pre-period industry unionization changes. Figures 6-8 present this analysis for the selected groups. In Figure 6 (age and gender) we see that the aggregate union density for young workers would have been 8 percentage points lower under the 2001 tax rules, while union density for older workers would have been 4 percentage points lower. Similarly, unionization among women would have dropped by 7 percentage points, while the unionization among men would have dropped by 4 percentage points.

Figure 6 Counterfactual analysis of union membership for age and gender groups. Constant compositions of jobs.



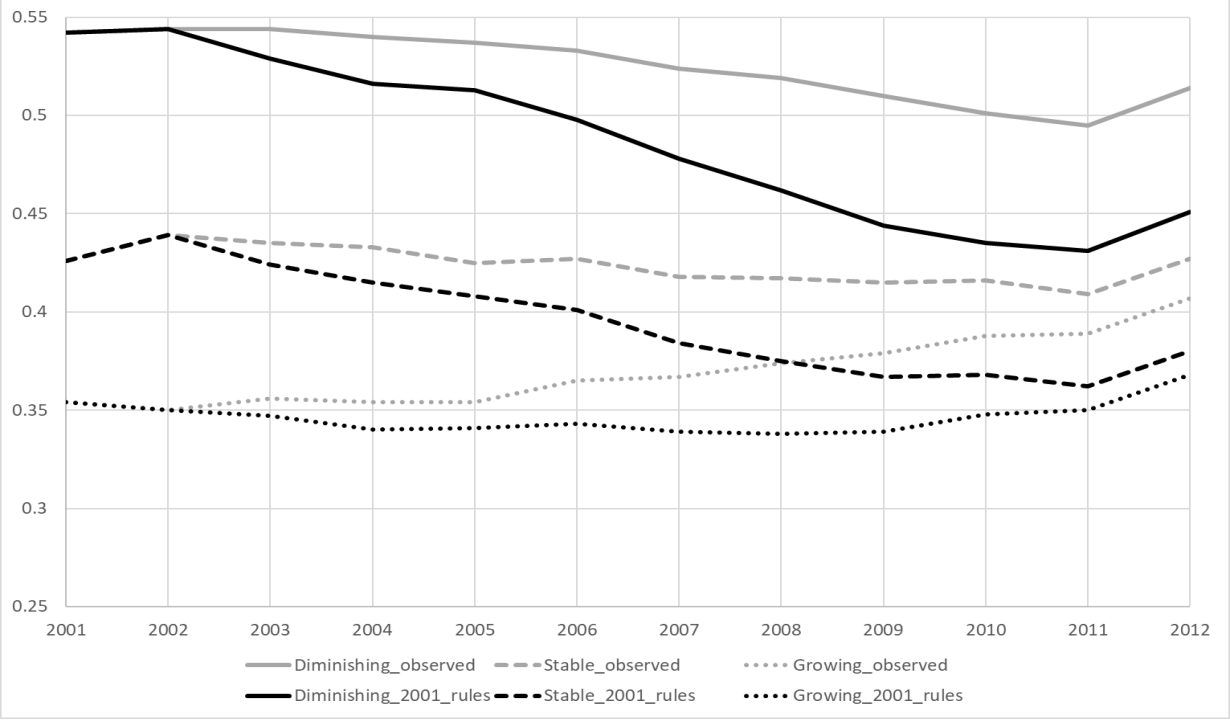
Note: Simulation based on Table A1. This is a within-job FE regression, thus all fixed characteristics of a job is controlled for (e.g., fixed firm characteristics such as industry and location, and individual characteristics such as gender, educational qualification and other unobserved fixed traits).

Figure 7 Counterfactual analysis of union membership for skill groups. Constant compositions of jobs.



Note: Simulation based on Table A1. This is a within-job FE regression, thus all fixed characteristics of a job is controlled for (e.g., fixed firm characteristics such as industry and location, and individual characteristics such as gender, educational qualification and other unobserved fixed traits).

Figure 8 Counterfactual analysis of union membership for pre-period industry unionisation development. Constant compositions of jobs.



Note: Simulation based on Table A2. This is a within-job FE regression, thus all fixed characteristics of a job is controlled for (e.g., fixed firm characteristics such as industry and location, and individual characteristics such as gender, educational qualification and other unobserved fixed traits).

Figure 7 shows the figures for the different skill groups. We see that observed union density unionization for low and medium-skilled workers drop slightly time, while the union density for high-skilled workers actually increase 3-4 percentage point from 2001 to 2012. However, contingent on the 2001-rules, we would have observed a stronger drop for low- and medium-skilled workers (by additional 2-3 percentage points), and high-skilled unionization would also experienced a decline from 2001 to 2012 (by 2-3 percentage points).

Finally, Figure 8 describes the importance of the tax policy for the three pre-period unionisation trend groups. The tax policy had the biggest impact measured in percentage points for those industries experiencing unionization decline. However, we see that industries that during the pre-period experienced stable unionization would have experienced a drop in unionization, and those industries experiencing growth, they would have experienced no change. Thus, arguably one might say that qualitatively these two latter groups experienced bigger effects.

9. CONCLUSION

Public policies often rely on trade unions to supply worker voice, both in fashioning policy and in delivering what the European Union often refers to as "social dialogue", that is, discussions between representatives of workers on the one hand and employers on the other. However, across the OECD unionisation rates are in decline, raising the prospect that unions may become less effective at supplying union voice and, in many cases, workers will simply lack credible representation, raising questions about the viability of a policy approach based on social dialogue (Forth et al., 2017).

Although tax subsidisation of the union good is present in several countries in Europe and North America, it is not always a policy tool that has been actively deployed to support union membership and counter the decline in unionism. Furthermore, little is known about how sensitive unionisation is to union membership fees, and thus how effective tax subsidies would be in countering union decline.

This is the first study to address this issue by investigating the role of tax subsidies in reducing the net costs of unionisation, and how this affects the demand for the union good. Using population-wide linked employer-employee administrative register data, we exploit changes in tax subsidies for union members in Norway to estimate the price elasticity of demand for the

union good. The rate of subsidisation varies year on year and is set by politicians as part of their announcements of their annual budgets. As such, unions are unable to respond prior to net price adjustments with changes in the quality of the good they provide. Consequently, we identify the impact of a pure price adjustment, rather than a quality-adjusted price adjustment.

We find that increased deductions for the union fee in taxable income lead to higher membership rates across the private sector and for major industries such as Manufacturing, Construction, Trade and Transport. The impacts do vary across industries. For example, we find no impact in Construction and the strongest impact in Manufacturing. The lack of impact in Construction maybe not such a big surprise, since the industry experienced major growth, partly through labour migration, during this period. Thus, many construction workers were exposed to only minor changes in tax subsidisation occurring in the late in our period of observation.

It would be wrong to say that the subsidization of union membership is what determines the rather high union density level in Norway, since other factors interfer, and other countries have similar tax treatment of unionisation. However, the growth in subsidization clearly counteracts an otherwise negative trend. In the absence of the hikes in tax subsidies, aggregate private sector union membership density, while keeping the job composition fixed, would have fallen by 5 percentage points since 2001.

Increased union fees, by contrast, reduce the demand for unionisation. This impact also varies across industries but, on average, the price elasticity of demand for union membership is -7 percent in 2012. The corresponding subsidy elasticity of union demand is naturally of opposite sign, but equal in size, i.e., around 7 percent.

Finally, how do these elasticities compare to what we know about other employer-provided benefits? Consider for example health-related benefits. In their review article, Pendziak et al. (2016) find optional primary health care elasticities ranging from -0.1 to -1 in the U.S., and between -0.6 and -4.2 in Germany. In this respect, the demand for union membership is fairly in-elastic.

Appendix

Table A1 The heterogeneous impact of the subsidy ratio on the probability of union membership. Worker and occupational heterogeneity. Linear fixed job effect regressions.

	Estimate (SE)		Estimate (SE)
Men		**Women**	
Subsidy ratio	0.1499**	Subsidy ratio	0.2285**
	(0.0243)		(0.0480)
Net union fee inverse	9.6168	Net union fee inverse	25.3317*
	(4.9597)		(11.6306)
Immigrants		**Natives**	
Subsidy ratio	0.2209**	Subsidy ratio	0.1967**
	(0.0853)		(0.0321)
Net union fee inverse	29.8837	Net union fee inverse	11.6442*
	(18.9421)		(4.7017)
Old		**Young**	
Subsidy ratio	0.1352**	Subsidy ratio	0.2959**
	(0.0296)		(0.0505)
Net union fee inverse	6.6819	Net union fee inverse	19.3660*
	(3.6954)		(9.3660)
Low skill		**Medium skill**	
Subsidy ratio	0.1879**	Subsidy ratio	0.1631**
	(0.0454)		(0.0359)
Net union fee inverse	10.8250	Net union fee inverse	7.2380
	(7.8952)		(6.6491)
High skill			
Subsidy ratio	0.2385**		
	(0.0474)		
Net union fee inverse	21.8484*		
	(9.9756)		
Low share part-time occupations		**High share part-time occupations**	
Subsidy ratio	0.1745**	Subsidy ratio	0.1803**
	(0.0316)		(0.0452)
Net union fee inverse	13.4694	Net union fee inverse	26.7619*
	(9.7880)		(6.6782)
Low share temp. jobs occupations		**High share temp. jobs occupations**	
Subsidy ratio	0.1617**	Subsidy ratio	0.2534**
	(0.0252)		(0.0493)
Net union fee inverse	14.7965*	Net union fee inverse	11.6711
	(7.0417)		(6.6782)
Low psychically demanding occup.		**Medium psychically demanding occup.**	
Subsidy ratio	0.1844**	Subsidy ratio	0.2964**
	(0.0362)		(0.0783)
Net union fee inverse	53.6467*	Net union fee inverse	24.9362
	(21.4317)		(25.8039)
High psychically demanding occup.			
Subsidy ratio	0.3113**		
	(0.0730)		
Net union fee inverse	1.5484		
	(4.6454)		
Low physically demanding occup.		**Medium physically demanding occup.**	
Subsidy ratio	0.2109**	Subsidy ratio	0.1242*
	(0.0580)		(0.0578)
Net union fee inverse	94.6766**	Net union fee inverse	13.6279*
	(24.8001)		(6.8884)

continued…..

..continued			
High physically demanding occup.			
Subsidy ratio	0.3225**		
	(0.0409)		
Net union fee inverse	4.4319		
	(3.9945)		
High wage		**Low wage**	
Subsidy ratio	0.2045**	Subsidy ratio	0.1897**
	(0.0339)		(0.0284)
Net union fee inverse	12.3489**	Net union fee inverse	5.6885
	(4.3081)		(8.0288)

Note: Population denoted by column head. FE (within)- linear regressions. Panel unit: job (workerXfirm). Separate regression based on populations defined by group names in bold. Old/young worker defined by below/above 40 years of age. Medium and high skills defined by educational qualification on high-school- or college-level, respectively. Low/high wage defined by below/above median log hourly wage. Dependent variable: dummy taking the value of 1 if worker union-member. All models comprise the following control-vector: year dummies, age vigintile dummies, net union fee inverse, fixed job effects and linear job-trends. Standard errors adjusted for worker-clustering presented in parantheses. ** and * denote 1 and 5 percent level of significance.

Table A2 The heterogeneous impact of the subsidy ratio on the probability of union membership. Firm heterogeneity. Linear fixed job effect regressions.

	Estimate (SE)		**Estimate (SE)**
Small firms		**Medium firms**	
Subsidy ratio	0.1974**	Subsidy ratio	0.2363**
	(0.0343)		(0.0429)
Net union fee inverse	17.7809**	Net union fee inverse	16.4509
	(6.6511)		(11.1418)
Large firms		**Pre-period declining unionisation**	
Subsidy ratio	0.2261**	Subsidy ratio	0.0593**
	(0.0499)		(0.0056)
Net union fee inverse	-7.9985	Net union fee inverse	0.3120
	(7.9437)		(0.4738)
Pre-period stable unionization		**Pre-period increasing unionisation**	
Subsidy ratio	0.0593**	Subsidy ratio	0.0593**
	(0.0056)		(0.0056)
Net union fee inverse	0.3120	Net union fee inverse	0.3120
	(0.4738)		(0.4738)
Low sales per worker		**High sales per worker**	
Subsidy ratio	0.2037**	Subsidy ratio	0.2120**
	(0.0392)		(0.0566)
Net union fee inverse	8.7377	Net union fee inverse	7.7561
	(5.5105)		(5.4279)
Low capital per worker		**High capital per worker**	
Subsidy ratio	0.2098**	Subsidy ratio	0.1891**
	(0.0510)		(0.0336)
Net union fee inverse	8.1937	Net union fee inverse	7.5132
	(6.8025)		(3.9075)
Low productivity		**High productivity**	
Subsidy ratio	0.1851**	Subsidy ratio	0.1845**
	(0.0455)		(0.0456)
Net union fee inverse	11.6167*	Net union fee inverse	6.3193
	(5.2851)		(4.9559)
Young plants (age<5 years)		**Old plants (age >5 years)**	
Subsidy ratio	0.2569**	Subsidy ratio	0.1998**
	(0.0423)		(0.0342)
Net union fee inverse	12.3437**	Net union fee inverse	11.4522
	(4.0360)		(5.6489)

Note: Population denoted by column head. FE (within)- linear regressions. Panel unit: job (workerXfirm). Separate regression based on populations defined by leftmost column in bold. Size defined by three equal sized groups from the firm workforce size distribution. Dependent variable: dummy taking the value of 1 if worker union-member. All models comprise the following control-vector: year dummies, age vigintile dummies, net union fee inverse, fixed job effects and linear job-trends. Standard errors adjusted for worker-clustering presented in parantheses. ** and * denote 1 and 5 percent level of significance.

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