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# The Dynamics of Power in Labor Markets: Monopolistic Unions versus Monopsonistic Employers

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## Abstract

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JEL Classification: J23, J24, J42, J51, J52, J63

Keywords: monopsony, skills, Unions, market power



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By Samuel Dodini, Kjell G. Salvanes, and Alexander Willén*

December 20, 2021

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This paper brings together the modern literatures on monopsony power and labor unions by empirically examining the effects of unionization on the dynamics of worker earnings across differently concentrated markets. Exploiting tax reforms to union due deductions as exogenous shocks to unionization, we demonstrate that there is a steep unionization gradient over labor market concentration. We show that there is an equally steep gradient in the union wage premium over concentration and that the premium loads almost exclusively on highly concentrated markets. This result implies a potentially important role of unions as alleviating market failures induced by imperfect competition. To validate our findings and examine robustness to different types of shocks, we extend the analysis by exploiting the emergence of import competition from China as an exogenous shock to employer concentration. This analysis suggest that the negative earnings effect of labor market concentration is eliminated upon reaching a union density of approximately 63 percent at the firm.

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# 1 Introduction

Labor unions have played a pivotal role in the employer-employee dialogue for more than 200 years, and how they affect the dynamics of labor markets has attracted the attention of economists and social scientists for decades. However, while there exists a consensus on the purpose of unions—to advance the interest of their members through bargaining and rent extraction—controversy quickly emerges beyond this point. How successful are unions at serving the interest of their members and how do they impact the dynamics of labor markets more broadly?

In theory, labor unions possess monopolistic power over the supply of labor, and they can leverage this power to raise the wages of their members. However, the ability of unions to negotiate for higher wages depends not only on their own market power but also on the market power of the employers. Specifically, in a labor market characterized by monopsonistic competition, there will be significant rents for unions to extract, but little relative bargaining power. In a perfectly competitive market, on the other hand, there will be minimal rents, but the unions' bargaining power will be greater as they can use viable outside options in the market as leverage. Thus, while the ability of unions to raise wages depends both on their own as well as the employers' market power, the direction of the association between monopsonistic power and the union wage premium is theoretically ambiguous.

The goal of this paper is to bring together the modern literatures on monopsony power and labor unions by empirically examining the effects of unionization on the dynamics of worker earnings across differently concentrated markets. We take advantage of high-quality Norwegian employer-employee data and exploit changes in tax deductions for union dues as exogenous shocks to unionization. By interacting this exogenous shift in unionization with measures of labor market concentration, we are able to causally analyze the union wage premium as a function of the degree of market concentration. To complement our main findings, we extend the analysis by exploiting the emergence of import competition from China as an exogenous shock to local labor demand and therefore employer concentration.

That the union wage premium may depend on the degree of monopsonistic power in the labor market was originally proposed by Robinson (1933), and was further developed by Freeman and Medoff (1984). However, empirical research has focused either on labor market power[1] or union power[2] without considering the interaction of the two. While these two strands of literature provide extremely important insights on the role of unions and employer concentration in the labor market, the lack of understanding of how these two forces interact—monopolistic unions and monopsonistic employers—severely limits our understanding of the dynamics of labor markets. Specifically, the defining feature of a firm with monopsonistic power is the upward sloping labor supply curve that it faces, with the marginal cost of labor exceeding the opportunity cost of labor at each employment level. Under profit maximization, wages will therefore be set below the marginal revenue product of labor, and employment will be set below the competitive equilibrium. In such markets, unions may be able to correct an existing market failure by counter-balancing the monopsony power of employers, raising wages and pushing the economy closer to the competitive equilibrium, ultimately generating a more efficient allocation of resources conducive to higher economic growth. This stands in stark contrast to a union wage premium in a perfectly competitive market, in which union-induced changes in wage levels may give rise to a new imperfection in the labor market in the absence of pure productivity effects.

To perform our analysis, we use rich population-wide Norwegian register data that allow us to link the universe of employers and employees across time. The data further enable us to observe the local labor market in which an individual works and his/her background characteristics, union membership status, union dues, and occupation. Consequently, we can construct an extensive panel covering the universe of Norwegian workers over a long period of time and much of their demographic, education, and labor market information.

To obtain plausibly-exogenous variation in firm-level union density, we leverage changes in tax subsidies for union members in Norway, which led to significant changes in the net

[1] See, for example, Dodini et al. (2020); Schubert et al. (2020); Azar et al. (2020b).
[2] See, for example, Card et al. (2004); DiNardo and Lee (2004); Lee and Mas (2012).

price of union membership (Barth et al., 2020). Although workers endogenously select into firms and occupations, the shifts in union dues generated by the tax changes we exploit are orthogonal to firms. The change in union demand due to shifts in the price of union membership, therefore, yields exogenous variation in unionization across firms.

To obtain a proxy for monopsony power, we build on Dodini et al. (2020) and take a skill-based approach to calculate market concentration. Specifically, we combine the Norwegian register data with information on skill content from the Occupational Information Network (O*NET) database and implement a hierarchical clustering algorithm to split occupations into distinct skill groups that are characterized by different combinations of these skills.[3] Occupations within each skill group are similar in terms of their overall skills requirements. We then calculate a Herfindahl-Hirschman Index (HHI), which is the sum of squared employment shares across establishments in each skill cluster and labor market. We use this measure as a proxy for labor market concentration. We use commuting zones as our geography unit, of which there are 160 in Norway. This allows us to separate areas into distinct labor markets geographically.[4]

The core finding of this study is that high levels of unionization causally ameliorate the negative effects of labor market concentration on earnings, suggesting that unions may play an important role in correcting market failures induced by imperfect competition. Figure 1 illustrates this novel result in detail, demonstrating that as predicted unionization from our instrument increases, the slope on the concentration-earnings gradient becomes flatter and far less significant. We find that this is because unions can extract more rents when labor

[3]In this algorithm, we consider six different skills based on Autor et al. (2003) as well as Acemoglu and Autor (2011): non-routine cognitive analytical; non-routine cognitive interpersonal; routine manual; routine cognitive; non-routine manual, physical adaptability; and non-routine interpersonal adaptability. We note that similar results are obtained when using a more data-driven approach in which we run the hierarchical clustering algorithm over all principal components of the O*NET (see Dodini et al. (2020).

[4]Dodini et al. (2020) argue that examining industry or occupational concentrations essentially proxies for worker type using these classifications. Such approaches are limiting because worker skills are substitutes across firms, occupations, and industries. For example, an administrative assistant in one firm or industry can perform that job in another firm or industry as well. His skills also can translate to other occupations, such as a bookkeeper, office manager, or receptionist. Thus, we argue that the concentration of skill demand is a more relevant measure of labor market concentration. Nevertheless, our results are robust to using labor market concentration measures based on occupations as well. We discuss this in Section 7.

market concentration is high, such that the union earnings premium is substantially larger in labor markets with high levels of concentration than in more competitive markets. This implies that unions are able to "level the playing field" in concentrated markets.

We present five key results in support of this finding. First, we demonstrate that the changes in tax subsidies for union members in Norway had a substantial effect on workers' willingness to unionize. Specifically, increasing the annual union subsidy by NOK 1,000 leads to an increase in a worker's probability of unionizing by 21.9 percentage points. The price elasticity of unionization with respect to the union subsidy is considerably larger in markets that experience monopsonistic competition. Specifically, going from a perfectly competitive market to a fully concentrated market increases the effect of the subsidy on unionization by almost 70 percent. These results are consistent with the notion that workers are more concerned about employer exploitation in markets where there are limited outside options.

Second, using the changes in tax subsidies as an instrument for firm-level union density, we find that a 10 percentage point increase in union density is associated with an increase in annual earnings of 6 percent. Examining heterogeneous effects across labor market concentration reveals that most of the union wage premium loads upon highly concentrated markets. Specifically, a 10 percentage point increase in union density raises annual earnings by 3 percent in non-concentrated markets and by 8 percent in concentrated markets. This result supports the theory that the greater the market imperfection, the greater is the amount of firm rent that unions are able to extract. This is a particularly interesting result in light of the theoretical ambiguity surrounding the union wage premium in concentrated markets. Specifically, even though there are significant rents for unions to extract in monopsonistic markets, the lack of outside options for workers in concentrated markets suggest that unions have little relative bargaining power. Our finding that the union wage premium loads on concentrated markets suggests that unions may be able to correct market failures driven by firm concentration.

Third, we combine our primary labor market data with firm-level revenue data and ex-

plore the relative impact of product market concentration and labor market concentration on the union wage premium across markets that face different degrees of labor demand concentration. We do this by running horse-races between our measures of labor HHI and product HHI (based on revenues in each firm's industry). Prior literature has provided suggestive evidence of a strong correlation between labor and product concentration at the firm level, and understanding to what extent unions are able to extract product rent versus labor rent is of independent interest (e.g., Marinescu et al. (2019); Lipsius (2018); Qiu and Sojourner (2019)). Our results suggest that unions are considerably more effective in extracting labor rent relative to product rent, though both sources have an important role to play. That we are able to identify different effects across these two sources of market power highlights that they are substantively different. That we observe a small union wage premium as a function of a firm's product market power is consistent with Breda (2015) in which the author constructs a simple bargaining model between employers and unions, and argues that the union wage premium should increase with the amount of quasi-rents available in the firms.

Fourth, we document important heterogeneity with respect to the types of workers that benefit from union membership as a function of labor market concentration. Specifically, we show that the modest union wage premiums that exist in competitive labor markets are isolated to high-skilled and white-collar workers. As the degree of market concentration increases, more and more of the additional rent that unions extract go to lower-ability and blue-collar workers. This implies that unions have an inequality-enhancing effect on wages within narrow sub-sectors in competitive markets, while this is not the case in concentrated markets characterized by monopsonistic competition. In addition, we show that while unionization yields larger wage premiums for men in competitive markets, due to differential sorting into concentrated markets across occupations and industries, high levels of unionization reduce the gender earnings gap at the macro level, with an effect that is considerably stronger in concentrated markets.

Finally, we use the so-called "China shock" as a shift-share instrument for exogenous

variation in labor market concentration. We then examine if the change in market concentration generated by exposure to import competition from China leads to a change in the union wage premium consistent with the results presented above. We find a negative association between exposure to the China shock and a firm's labor share of local employment due to reshuffling of labor demand, and that this is associated with a sizable reduction in the union wage premium. This empirical exercise helps cement the relationship between unions and monopsonistic employers and provides a better understanding of the dynamic interplay between monopolistic unions and monopsonistic employers in the economy.

We are the first to empirically bring together the modern literatures on monopsony power and unionization in labor markets. This allows us to substantially advance the existing understanding of the role of unions and their impact on the dynamics of labor markets. Our main contribution is to provide a method for identifying the union wage premium as a function of employer concentration, demonstrating that the larger wage premium that unions negotiate in concentrated markets ameliorates the negative earnings effects of labor market concentration.

We contribute to the existing literature in several ways. First, there is a small but impressive literature that causally identifies the union wage effect through quasi-experimental research designs. The studies in this literature have relied either on regression discontinuity designs related to close union elections (e.g., DiNardo and Lee (2004); Lee and Mas (2012); Frandsen (2021); Sojourner et al. (2015)), or on propensity score matching techniques that directly control for endogenous selection of workers into unions (e.g., Card and De La Rica (2006); Bryson (2002)). Recently, Barth et al. (2020) has exploited changes in national union due subsidies as an instrument for unionization probability, an approach we adopt in this paper as well.

We complement the union wage premium literature by providing the first causal estimates of the union wage premium in an entire country across all sectors and industries. We then advance the literature by considering how this union wage premium differs across differently

concentrated markets, a question that is theoretically ambiguous. The results have important implications for how we view the role of unions in labor markets, as a union wage premium in a monopsonistic market may point to unions correcting a market failure induced by imperfect competition. We see our paper as opening up a new avenue of research, exploring the dynamics of how the balance of power between employers and unions may impact not only wages, but also other types of non-pecuniary benefits, employment levels, and social goods.

Second, there is a rapidly-growing literature that has attempted to directly measure labor market concentration and then examine how concentration affects wages and employment (e.g., Dodini et al. (2020); Schubert et al. (2020); Azar et al. (2019a; 2020b;a); Benmelech et al. (2018); Marinescu et al. (2019); Qiu and Sojourner (2019); Rinz (2018); Hershbein et al. (2018)). On average, these studies show that labor market concentration reduces worker wages and has negative effects on workers' careers. We complement these papers by demonstrating that unionization rates, as well as union wage premiums, are substantially larger in monopsonistic markets. This implies that researchers interested in accurately measuring the wage effects of monopsonistic competition need to carefully account for the dynamics of unions across markets that face different labor concentration. More specifically, our results reveal that understanding the interplay between employer and employee power is imperative for backing out the impact that concentration may have on the dynamics of labor markets.

Understanding the link between labor unions and monopsonistic employers is of key importance. Over recent decades, labor markets have become less dynamic and one consequence of this has been a significant increase in employer concentration (Langella and Manning, 2021). At the same time, union density is at an all-time low in several key economies, including the US in which we have seen a precipitous decline in private-sector unionization over the last fifty years (Dodini et al., 2021). Thus, understanding how these two forces interact with each other and impact the dynamics of labor markets is of particular interest

to policymakers and researchers alike.

The rest of the paper proceeds as follows: In Section 2, we provide institutional background on the Norwegian labor market, union structure, collective bargaining, and the union due subsidies that we exploit to secure exogenous variation in union density. In Section 3, we provide a detailed overview of our data. In Section 4 we introduce our empirical method. In Section 5, we present all our main results. In Section 6, we present results from a supplemental analysis in which we use the China shock as a shift-share instrument for obtaining exogenous variation in labor market concentration. In Section 7, we summarize our results, discuss policy implications, and suggest avenues for future research.

# 2 Background

## 2.1 Unions in Norway

Norway's Working Environment Act governs worker rights in Norway and provides regulations both in terms of individual employees and their contracts, and unions and their collective bargaining agreements. Unions have had a long and stable presence in the country and represent one of the most important features of the Scandinavian welfare model. Similar to other countries, the stated goal of labor unions in Norway is to strengthen members' rights and work conditions, and they play an important role in, for example, wage negotiations.

All workers in Norway have the legal right to unionize. However, private companies are not always legally required to negotiate with unions. Specifically, according to an agreement from 1998, firms are only required to enter a collective bargaining agreement if at least 10 percent of the workers at the firm requests it. Once a collective bargaining agreement has been reached, it applies to all workers at the firm, irrespective of union status.

Unions have a number of legal measures at their disposal should they be dissatisfied with a particular establishment. The most common measures are boycotts and strikes, though there are also several less severe legal actions that can be taken. On behalf of their members, unions can negotiate not only wages but also help settle legal employment disputes and push

for better working conditions.

Unions are commonly structured by professional area or sector, and each individual union is linked to one of four much larger, national confederations of trade unions. The largest such employee association is the Norwegian Confederation of Trade Unions, covering approximately 22 individual unions and 50 percent of all unionized workers. While the organizational structures of unions have changed over time, there have been no significant changes to their structure during our sample period.

In the private sector, union density is approximately 40 percent, and this has been stable over time. In the public sector, union density is 79 percent. The union density rate differs across sectors and industries, with almost 60 percent in the manufacturing sector and less than 30 percent in the private services sector. More women than men are members of labor unions (57 percent versus 44 percent). The unionization rate in Norway is not particularly high relative to other OECD countries and is smaller than the unionization rate in other Nordic countries such as Sweden.[5]

In terms of collective wage bargaining, this has traditionally been done at the national level by sector or industry. However, since the 1990s, a large proportion of total wage gains is realized at the local level through local bargaining between unions and individual employers. Since the early 2000s, local negotiations account for approximately 70 percent of total negotiated wage increases. This local wage bargaining component is important for the purpose of our study, as it enables firms and unions to adjust wages and wage demands depending on the degree of labor concentration in the market.

## 2.2 Union Tax Deductions

A fixture of Norwegian government policy regarding labor unions is a tax deduction for union dues that acts as a subsidy for union membership. This deduction is automatically entered and announced on an individual's annual tax return, making it very salient to the

[5]One reason for this is that unemployment benefits are part of a union's purview in Sweden, while they are governed by national law in Norway.

worker. In the mid-2000s, the Norwegian government enacted a series of large increases in the maximum allowable tax deduction for union dues. This maximum nearly quadrupled from 2001 to 2010. Changes in these subsidies substantially reduced the monetary cost of joining a union. The realized value of the subsidies to workers depends on the union dues required of prospective members.

Our empirical strategy exploits these national changes in the maximum allowable tax deduction for union dues. These changes strongly reduce the monetary cost of joining a union and generate exogenous variation in predicted unionization rates at the firm. We use this plausibly-exogenous variation in union density to identify the effects of unionization on earnings for different types of workers in concentrated versus more competitive labor markets.

## 2.3 Conceptual Framework

In this Section, we conceptualize the relationship between monopsony power in the labor market and the functioning of labor unions to provide context for our models and results. We do this by combining a simple theoretical framework of monopsony power with that of labor unions, something which we illustrate in Figure 2. Panel A shows a basic monopsony model, in which the firm is a price-setter in the factor market. The defining feature of a firm with monopsonistic power is the upward sloping labor supply curve that it faces, with the marginal cost of labor exceeding the opportunity cost of labor at each employment level. Under profit maximization, wages will be set below the marginal revenue product of labor, and employment will be set below the competitive equilibrium. Specifically, rather than being at a market equilibrium in a perfectly competitive setting with wage $W^*$ and employment level $L^*$, workers provide labor supply to the firm at the steeper $S(\uparrow Concentration)$. This curve intersects the labor demand curve at $L'$, resulting in monopsony wages to the workers of $W^M$.

A conventional intervention in the presence of monopsonistic market power is the minimum wage. By restricting firms' wage-setting ability at the lower end of the wage distribu-

tion, policymakers can increase wages for low-paid workers and encourage higher wages for those just above them. In addition, modest increases in the minimum wage can lead to gains both in wages and employment.[6] These positive employment effects are typically rationalized in a similar monopsony framework as Panel A in Figure 2. Panel B shows the general result of setting a wage floor where there is imperfect competition in the labor market. The only difference between a minimum wage and a union-negotiated wage is that unions negotiate wage floors for different types of workers at the firm, and the wage floor is applicable to different labor market segments. Any wage floor that sets a wage between $W^M$ and $W^*$ will result not only in higher wages to the worker but higher employment as well, moving along the blue arrow towards $L^*$.[7] If negotiated wages are exactly at $W^*$, the negative wage effects (and market failure) of imperfect competition have been eliminated. However, wages above $W^*$ may have disemployment effects relative to the competitive equilibrium as employment moves along the demand curve to the left along the red arrow. If wages are set above $W^C$, employment may therefore fall further.[8]

This study focuses on the wage and earnings effects of unions and their power to negotiate wages in competitive versus concentrated labor markets.[9] In this framework, if union density is high, unions will have a greater ability to negotiate wages up. In concentrated markets, that same density *differentially* leaves them more room to move from $W^M$ towards $W^*$ because the labor supply curve $S \uparrow Concentration$ is steeper. In more competitive markets, wages are closer to $W^*$. If union power dominates firm labor market power, wage gains should be larger in more concentrated markets than in competitive markets. If firm power

[6]The large literature on minimum wages has generally found small, negative employment effects with the imposition of a wage floor for low-wage workers. However, there is significant heterogeneity in these effects across studies and contexts, with some studies finding strongly negative employment effects while others find zero or even positive employment effects.

[7]This is precisely the result found in Azar et al. (2019b): low-wage labor markets with higher concentration experience employment gains in response to minimum wage hikes.

[8]This may explain some negative employment effects from the minimum wage even if firms have labor market power, as well as some negative union employment effects in the prior literature (Frandsen, 2021).

[9]Norway generally has strong employment protection policies, meaning that the employment effects of unionization may appear only in the medium or long run. For this reason, we focus on contemporaneous wage effects in this paper, leaving dynamic employment effects to future work.

dominates, this pattern will not hold and may even reverse. This is the first study of which we are aware to investigate this dynamic, which is ambiguous ex ante.

# 3 Data

## 3.1 Data

Our primary data come from linked employer-employee registers covering the universe of workers in Norway between the ages 16 and 74 in the years 2001 and 2015. Using a unique individual identifier, we follow individuals over time and across registers, enabling us to combine information from various population-wide administrative registers. We obtain demographic characteristics from the central population register, we collect education information from the national education register, we use labor earnings information from the tax register, and we obtain information on hours worked, establishment, and employer from the linked employer-employee register.

The linked employer-employee data allow us to identify each worker's employer and construct labor market concentration measures for each establishment in the Norwegian economy. We construct these at the local labor market level, which is defined based on commuting distance. The local labor markets effectively divide Norway into 160 regions (Gundersen and Aarhaug, 2013). By linking the unique establishment identifiers to the universal firm accounting data register, we also are able to construct measures of product market concentration for each establishment in their industry. As we will explain in Section 4, we use this measure to run horse-races between labor market power and product market power to better understand which types of rents unions are able to extract.

Crucial to our analysis is the ability to observe individual-level union information over time. We obtain this data from a register-based union membership data set, which provides detailed information on each individual's involvement with labor unions and how much they have paid into the labor union to become a member for each year we have data. Our data contains detailed earnings information on all Norwegian residents. Labor earnings are

measured as pre-tax income (income from labor and self-employment) including taxable government transfers (parental leave, sick leave, and unemployment benefits).

In terms of sample construction, we make a few key restrictions. First, we limit our sample to full-time workers (defined as working 20+ hours per week). We impose this restriction to ensure a more precise measure of the potential union wage premium. Second, we limit the sample to individuals working in firms that had at least ten workers employed each year. This excludes small family businesses and sole proprietorships. We impose this restriction to ensure that our results and concentration measures are not driven by small establishments that have little impact on the larger economy. However, our results are robust to relaxing this restriction. Third, we truncate the sample to those with earnings that would qualify them for the "1G" designation in the Norwegian benefit system, which is approximately 90,000 NOK based on 2015 values. This ensures that those without meaningful attachment to the labor market do not affect our results.

## 3.2 Union Dues and Tax Subsidies

To obtain plausibly-exogenous variation in firm-level union density, we leverage changes in tax subsidies for union members in Norway which led to significant changes in the net price of union membership (Barth et al., 2020). Specifically, the tax deduction for union dues nearly quadrupled between 2001 and 2010. Although workers endogenously select into firms and occupations, the shifts in union dues generated by the tax treatments we exploit are orthogonal to firm characteristics. The change in union demand due to shifts in the price of union membership provides exogenous variation in unionization across firms.

The Norwegian registers only contain information on union dues for those who are union members. We, therefore, begin by constructing a measure of union dues for those who were not part of a union had they been part of a union. To construct this imputed measure of union dues, we take the mean union due paid by workers in each occupation-industry cell in each year and apply this to union members and non-members alike. This imputation approach is identical to that implemented in (Barth et al., 2020), and has two advantages: first, it allows

us to predict the counterfactual costs of unionization faced by those who were not part of the union; second, we can abstract away from endogenous, individual determinants of union dues for union members.

One concern with utilizing changes in union tax subsidies is that unions may recognize the change in the statutory maximum deduction and respond by raising the union dues to leverage some of the subsidies away from members. Firms also may change the composition of occupations they employ in response. To avoid these potential endogeneity issues, we fix each firm's union dues to the imputed dues set in the first year in which the firm appears in the data. We then adjust this cost forward for inflation to each observation year. This implicitly weights the union dues for the occupational mix that existed in the firm in its first year in our data set. For the vast majority of firms, this base year is 2001.

Once we have obtained our union due measure, we calculate the value of the subsidy for all individuals in the data set as the lesser of either the legislated maximum deduction or the imputed union due multiplied by the base tax rate (28 percent from 2001 to 2013 and 27 percent in 2014 and 2015). We apply this base tax rate in order to isolate changes in the guaranteed *statutory* subsidy from changes in the *realized* subsidy that may depend on marginal tax rates. This helps us avoid an endogenous instrument because marginal tax rates may be determined in part by unionization and other within-firm dynamics that determine wages. Our measure of subsidy value, therefore, captures changes that only are coming through legislative channels and not changes within firms.

Our subsidy measure is expressed as follows:

$$S_{ft} = T_t * (min\{\overline{D_f^0}, MaxDeduction_t\}) \ , \tag{1}$$

where $T_t$ is the base tax rate in year $t$, $\overline{D_f^0}$ is the imputed firm union due at baseline, and $MaxDeduction_t$ is the maximum statutory deduction.

To control for the remaining cost of unionization, which may dissuade workers from

joining a union even in the presence of a significant subsidy, we also calculate the net-of-subsidy union due. We calculate this measure by subtracting the value of the subsidy from the gross imputed union due. We include this control in all of our first stage specifications. This also disentangles the mechanical relationship between the size of the subsidy and the size of the union dues. We express the net-of-subsidy union due as $ND_{ft} = \overline{D_f^0} - S_{ft}$. We scale our subsidy and union dues measures to a basis of 1,000 Norwegian crowns (NOK), which was approximately 120 US dollars in 2015 at the end of our sample period.

Figure 3 illustrates the drastic increase in the maximum union due deduction and imputed subsidy over our sample period. While the maximum deduction increased from just below 1,000 NOK to almost 4,000, the average imputed subsidy went from approximately 300 NOK to over 1,000 NOK.

### 3.3 Defining Concentration

The Norwegian registers do not contain information on occupation-specific skill characteristics. We follow Dodini et al. (2020) and use data from the US Department of Labor's Occupational Information Network (O*NET) survey to incorporate skills information into the Norwegian registers. The O*NET survey asks workers and occupational experts about the knowledge, skills, and tasks associated with each occupation. We connect Norway's STYRK occupation classification system to the O*NET survey's Standard Occupation Classification (SOC) system using the crosswalk in Hoen (2016).

We focus on six skill categories similar to those in Autor et al. (2003) and Acemoglu and Autor (2011). We use these skills to group together occupations based on their skill content. These skills are routine, manual; non-routine, physical adaptability, manual; non-routine, interpersonal adaptability; routine, cognitive; non-routine, cognitive, interpersonal; and non-routine, cognitive, analytical skills. We focus on these skills because the prior literature documents their importance in explaining labor market segmentation and wage trends over time. We create composite measures of each of these skills standardized to have a mean of zero and a standard deviation of one. We then use a Hierarchical Agglomerative

Clustering (HAC) algorithm to split occupations in the Norwegian register into 20 distinct skill groups. As a test of robustness, we also generate estimates based on 40 clusters.

The HAC clustering technique starts by treating each occupation as a separate cluster. It then non-parametrically merges the two closest occupations together into clusters based on their correlative distance, which is one minus the Pearson correlation between the two occupations based on the six skill characteristics. The process continues until we reach 20 (40) skill clusters. Following Dodini et al. (2020), our choice of 20 skill clusters is based on a set of validation exercises that put the data-driven "optimal" number of clusters near 20, though we show that using 40 skill clusters generates similar estimates with matching conclusions.[10]

For each occupation at the firm, we calculate the firm's employment shares in that occupation's skill cluster and local labor market in each year. This measure of labor market concentration takes into account a worker's set of local counterfactual outside options that use similar sets of skills to their current occupation. This is important because a worker's skills can be transferable not only between firms but also between occupations and industries. We argue that this makes a purely occupation-based measure of concentration less representative of the relevant labor market. However, we also show results using the more conventional occupation-based concentration measure in the appendix.

To characterize the overall local labor market power held by the firm and to facilitate comparisons to product market HHI, we generate a composite measure of concentration at the firm level by taking the mean HHI for the firms over their entire existence in our sample period. This results in us leveraging a single measure of labor market power that we can interact with predicted union density to examine the marginal earnings effects of unionization across labor market concentration without being concerned about endogenous concentration (in reaction to unionization) or intra-firm occupation composition effects in any particular year.

[10]Dodini (2020) also validates the optimal cluster number in a US context at approximately twenty clusters.

Table 1 contains a set of basic summary statistics for our analysis sample.[11] Nearly 60% of our sample of workers are members of unions, and their earnings, on average, are approximately 465,000 NOK. The imputed tax subsidy for our sample is on average 760 NOK with a net-of-subsidy union due of approximately 3,200 NOK. The average labor HHI at a worker's establishment in their local labor market is approximately 0.05, with a standard deviation of 0.05. Product revenue shares in a firm's industry (which we use as a proxy for product market power) is approximately 0.05 as well, with a standard deviation of 0.09.

# 4 Empirical Strategy

Our empirical strategy relies on leveraging exogenous changes to the costs of joining a labor union that came through the Norwegian tax code between 2001 and 2015. We use the value of the imputed subsidy for union members and nonmembers, as well as the net-of-subsidy union due, as instruments for the probability of joining a union for each worker in the sample.

The empirical method we employ relies on two core assumptions: first, that the subsidies did, in fact, increase the rate at which workers joined labor unions (i.e. the relevance criterion); and second, that the only channel through which the union subsidies affected worker earnings and firm performance was through the channel of unionization within the firm (i.e. the exclusion restriction). Though it is impossible to verify that our approach meets the exclusion restriction, the careful construction of our subsidy and net-of-subsidy union dues variables allow us to control for any possible endogeneity of the posted union dues in response to legislative action. This allows us to isolate variation in subsidies that come from the legislation itself. We argue that this satisfies the exclusion restriction, an argument that has been made by Barth et al. (2020) as well.

To test for the relevance criterion, we first show that the subsidies do have a significant effect on the probability that workers join a union. Our first stage regression is expressed

[11] To reduce computational costs, we take a 70% random subsample of workers in the data.

for individual $i$ in occupation $o$, industry $c$, and firm $f$, at time $t$, as:

$$Union_{iocft} = \beta_0 + \beta_1 S_{ft} + \beta_2 ND_{ft} + \delta_{Ed} + \pi_{Age} + \gamma_{oc} + \tau_t + \varepsilon_{iocft} \tag{2}$$

we include fixed effects for highest completed educational program ($\delta_{Ed}$), which includes indicators for secondary education tracks, post-secondary majors, and tertiary concentrations; discrete age buckets ($\pi_{Age}$); occupation-by-industry fixed effects ($\gamma_{oc}$); and year fixed effects $\tau_t$.[12] The education fixed effects allow us to non-parametrically compare workers with the same educational credentials. The age fixed effects flexibly control for differential determinants of unionization over the age profile. The occupation-by-industry fixed effects control for any cross-sectional differences in baseline propensity to unionize and other unobserved, time-invariant factors. The year fixed effects absorb any systematic changes in unionization propensity over time that concerns all workers.

We next estimate a similar equation to Equation 2 but include a control for the employment concentration relevant to each firm and a full set of interactions between concentration and the subsidy as well as the net-of-subsidy union due. We estimate this regression as individual workers may perceive differential gains to unionization as a function of the employer's power over labor demand. Specifically, we estimate the following equation:

$$\begin{aligned} Union_{iocft} =& \beta_0 + \beta_1 Subsidy_{ft} + \beta_2 ND_{ft} + \beta_3 \overline{HHI}_f + \beta_4 \overline{HHI}_f * Subsidy_{ft} \\ &+ \beta_5 \overline{HHI}_f * ND_{ft} + \delta_{Ed} + \pi_{Age} + \gamma_{oc} + \tau_t + \varepsilon_{iocft} \end{aligned} \tag{3}$$

After having estimated the first stage regressions and confirmed the relevance criterion, we use the predictions from these first stage regressions to calculate the predicted union density for each firm in the data in each year, which we call $\widehat{UD}_{ft}$. Importantly, this predicted value jointly takes into account the individual characteristics of workers at the firm but allows the

[12] The age categories are under age 25, 25-35, 36-45, 46-55, 56-65, and 65 and over.

effect of an increase in unionization to only affect earnings in the second stage estimates through changes in union density at the firm. This is particularly important because a union's power is not contingent on a single worker's membership, but rather on the share of workers represented by the union (Freeman and Medoff, 1981).

Having obtained predicted values of union density for each firm in the data in each year, we then estimate the effects of union density on log annual earnings for each worker:

$$Log(Earnings)_{iocft} = \alpha_0 + \alpha_1 \widehat{UD}_{ft} + \delta_{Ed} + \pi_{Age} + \gamma_{oc} + \tau_t + \phi_f + \eta_{iocft} \tag{4}$$

We include a firm fixed effect such that we are comparing the effects of union density within the same firm over time, as well as the difference in the marginal effects of unionization after holding constant time-invariant characteristics of the firm.

After having obtained a causal estimate of the average union wage premium, we allow the effects of union density ($\widehat{UD}_{ft}$) to differentially affect earnings in concentrated markets. This is accomplished by including an interaction between the predicted firm union density from Equation 3 and our HHI measure in this equation:

$$\begin{aligned} Log(Earnings)_{iocft} =& \alpha_0 + \alpha_1 \widehat{UD}_{ft} + \alpha_2 \widehat{UD}_{ft} * \overline{HHI}_f \\ &+ \delta_{Ed} + \pi_{Age} + \gamma_{oc} + \tau_t + \phi_f + \varepsilon_{iocft} \end{aligned} \tag{5}$$

Under the assumption that unions negotiate rent-sharing with employers, a union would have more room to bid up wages of its workers in markets where there is substantial firm rent due to monopsonistic competition. In other words, unions have space to negotiate from the rents that the firms previously extracted from labor through monopsonistic wage setting. At the same time, the relative bargaining power of the labor union is weaker the greater is the employer power because outside offers cannot be called upon in negotiations, and the threat of leaving the firm is less credible. A priori, it is therefore unclear what the relationship

between labor market concentration and the union wage premium is.

Conditional on the composition of workers at the firm, a union wage premium can stem from three distinct sources: recapturing rents from labor market power, capturing rents from the product market, or productivity gains. To test for the relative contributions of possible rents from labor market power as opposed to product market power, we run a horse-race in which we interact our measure of predicted union density with our measure of labor concentration as well as with our measure of product market concentration—an HHI for each firm based on their sample average share of total industry operating revenues in Norway ($\overline{HHI}_f^P$):

$$\begin{aligned} Log(Earnings)_{iocft} =& \alpha_0 + \alpha_1 \widehat{UD}_{ft} + \alpha_2 \widehat{UD}_{ft} * \overline{HHI}_f + \alpha_3 \widehat{UD}_{ft} * \overline{HHI}_f^P \\ &+ \delta_{Ed} + \pi_{Age} + \gamma_{oc} + \tau_t + \phi_f + \eta_{iocft} \end{aligned} \tag{6}$$

where $\alpha_1$ captures the marginal effect of union density on earnings in a firm in which both product market and labor market concentration are zero. The coefficient $\alpha_2$ captures the change in the marginal effect as labor market concentration increases holding constant the differential marginal effects from product market concentration. Finally, $\alpha_3$ conveys the difference in the marginal effects of union density as product market concentration increases after netting out differences in the marginal effects from labor market concentration. Thus, this specification allows us to disentangle the relative importance of labor market power and product market power in explaining the earnings effects of union density.

Finally, we investigate what types of workers most benefit from union density within the firm. We do this by interacting our predicted union density and labor market HHI measures with indicators for different groups. First, we examine heterogeneity with respect to those whose earnings are below or above the occupation-specific median earnings at the firm. Above-median earnings in the firm-occupation cell may indicate differences in productivity,

attachment to the firm, or labor market attachment more generally. Second, we include indicators for white-collar occupations to separate out the effects across job classes. Third, we allow the marginal effects of union density and labor market concentration to differ by gender to examine if there are differential returns to union density for men and women across markets facing different levels of labor market concentration.

# 5 Results

In this section, we present novel evidence on the impact of unionization as a function of labor market concentration. In Section 5.1, we show results from our first stage analysis, examining the impact of changes in tax subsidies for union members in Norway on their willingness to unionize. In Section 5.2, we examine the union wage premium as a function of labor market concentration. In Section 5.3, we combine our primary labor market data with firm-level revenue data and explore the relative impact of product market power and labor market power on the union wage premium across markets that face different levels of labor demand concentration. In Section 5.4, we explore effect heterogeneity of the union earnings premium across differently concentrated labor markets with respect to worker type. Finally, in Section 5.5 we examine the effect of unions on overall labor market inequality as a function of market concentration.

## 5.1 First Stage Effects

Table 2 provides results on the impact of the Norwegian tax subsidies on workers' propensity to unionize. These results are obtained through estimation of Equations (2) and (3). In columns (1) and (2), we look at the relationship between subsidies and unionization without taking labor market concentration into account. While the regression underlying the results in column (1) includes occupation-by-industry, education, and age group fixed effects, the regression underlying the results in column (2) further includes individual-level fixed effects (such that the estimates are identified exclusively based on individuals who switch industry-occupation cells). In columns (3) and (4), we study the relationship between the subsidies

and unionization as a function of labor market concentration, using our preferred specification of 20 skill clusters. In columns (5) and (6), we perform a similar exercise but use 40 clusters as a means to examine robustness.

The results in columns (1) demonstrate that the subsidies had a strong impact on the probability that workers unionize. Specifically, raising the subsidy by 1,000 NOK increases the probability of being in a union by 22 percentage points. The coefficient on the subsidy in column (2) is approximately 50 percent smaller but remains highly economically meaningful and statistically significant at the 1 percent level despite being an incredibly restrictive specification. The result in column (2) thus reveals that the relationship between union subsidies and unionization probability is robust to including individual fixed effects (such that the estimates are identified exclusively based on individuals who switch industry or occupation).

In columns (3) and (4), we allow the impact of the subsidy to vary as a function of the labor market concentration in the market that the individual works. The results reveal that the price elasticity of unionization with respect to the union subsidy is considerably larger in markets that experience monopolistic competition. Specifically, going from a perfectly competitive market to a pure monopsonistic market increases the effect of the subsidy on unionization by almost 70 percent. This implies that individuals are considerably more willing to unionize in markets where labor demand is more concentrated. This is consistent with the notion that workers may be more concerned about employers trying to set their wages below marginal productivity in imperfect markets where there are limited outside options.

In columns (5) and (6), we re-estimate the regressions underlying the results in columns (3) and (4), but use 40 skill clusters rather than 20. Consistent with the main results, we find that the price elasticity of unionization with respect to the union subsidy is considerably larger in markets that experience monopsonistic competition. This implies that our results are not driven by the particular number of skill clusters used to identify market concentration.

## 5.2 Earnings Effects

Table 3 provides estimates on the effect of union density on log annual earnings at the firm level, using the changes in tax subsidies for union members as an instrument for firm-level union density. Panel A uses our full sample while Panel B restricts the sample to only the private sector. In column (1), we study the impact of union density on log annual earnings at the firm level without taking labor market concentration into account. In column (2), we study the impact of union density on log annual earnings at the firm level as a function of labor market concentration, using our preferred specification of 20 skill clusters. In columns (3), we perform a similar exercise to that in column (2), but use 40 clusters for robustness.

Focusing on our full sample in Panel A, the results in column (1) reveal that a 10 percentage point increase in firm-level union density is associated with an increase in annual earnings of approximately 6 percent. Although the coefficient on union density is slightly smaller than that in Barth et al. (2020), the implication of our finding is similar to theirs.[13] Specifically, there appears to be a non-negligible wage premium associated with unionization. This result is of great independent value, adding to the relatively scarce literature that has been able to isolate the union wage premium through the use of exogenous variation in unionization.

In column (2), we allow the impact of union density to vary as a function of the labor market concentration in the market that the firm is located. The results reveal that most of the union wage premium in column (1) is restricted to highly concentrated markets. Specifically, a 10 percentage point increase in firm-level union density is associated with an increase in annual earnings of approximately 3 percent in non-concentrated markets, and with an increase in annual earnings of approximately 8 percent in concentrated markets. In column (3), we re-estimate the regressions underlying the results in columns (2), but use 40 skill clusters rather than 20. The results are robust to this adjustment. This result is

[13]The difference in effect size is likely an implication of Barth et al. (2020) restricting their analysis to the manufacturing industry, while we consider all sectors and industries in the country. We also examine our estimates at the individual level rather than the firm level.

consistent with the theory that the greater the market imperfection, the greater is the amount of firm rent that unions can (re)extract. In addition, these results support the notion that unions may be able to correct market failures caused by firm concentration by driving up wages towards the competitive equilibrium.

To reiterate this point succinctly, Figure 1 shows that the negative correlation between earnings level and labor market concentration is strongly ameliorated by higher rates of predicted unionization from our instrument. At a low level of labor market concentration, moving from the bottom to the top quintile of predicted union density increases earnings by approximately 15 percent, while the same movement at an HHI of 0.1 would increase earnings by approximately 40 percent. These visual calculations closely mirror our estimates in Table 3.

The market imperfections generated by monopsonistic power, and the rents available to unions in concentrated markets, may be significantly larger in the private sector compared to the public sector. The reason underlying this hypothesis is that the public sector faces a different objective function which does not necessarily involve paying wages below workers' marginal revenue product, and it is not clear that there are substantial rents available in the public sector even in cases where labor concentration is high. To examine this hypothesis in detail, Panel B of Table 3 replicates Panel A but restricts the sample to only the private sector. Interestingly, the results suggest that the relationship between union density and earnings as a function of labor concentration is considerably stronger in the private sector. Specifically, in the private sector, there is no overall union wage premium in perfectly competitive markets, and the entire union wage premium loads on highly concentrated markets.

## 5.3 Source of Rents

In Table 4, we combine our primary labor market data with firm-level revenue data and explore the relative impact of product market power and labor market power on the union wage premium across markets that face different labor demand concentration. Prior literature has provided suggestive evidence of a strong correlation between labor and product

concentration at the firm level, and understanding to what extent unions are able to extract product rent and labor rent is of independent interest (e.g., Marinescu et al. (2019); Qiu and Sojourner (2019); Lipsius (2018)).

In column (1), we show the effect of union density on annual earnings for the sub-sample of our main analysis sample with available revenue data. In column (2), we show results from running horse-races between the labor HHI and product HHI based on our preferred 20 skill cluster categorization of concentration. In column (3), we repeat the exercise from column (2) but look at 40 skill clusters rather than 20.

The results in column (2) suggest that unions are considerably more effective in extracting labor rent relative to product rent. Specifically, the coefficient on the interaction between union density and labor HHI is four times larger than the coefficient on the interaction between union density and product HHI despite similar scales. In addition, only the coefficient on the interaction between union density and labor HHI is statistically significantly different from zero. That we are able to identify different effects across these two sources of market power highlight that they are substantively different, and that the correlations between the two are not as strong as previously thought. The results in column (3) of Table 4 demonstrate that this interpretation is robust to using 40 skill clusters rather than 20 skill clusters to define labor market concentration.

To illustrate this point in greater detail, Figure 4 shows the marginal effects of union density by product HHI as a function of labor HHI. The figure illustrates that there is little variation in the union wage premium as a function of product HHI for any given level of labor HHI. We believe that this is a novel finding with important policy implications, alluding to the fact that unions' ability to extract rent and reallocate this rent to their members depend not only on the extent of market imperfections but also whether these are driven by labor concentration or product concentration.

## 5.4 Heterogeneous Earnings Effects

In Table 5, we ask if the rent that unions are able to extract from firms are allocated differently to different types of workers. In Panel A, we examine heterogeneity with respect to worker productivity (proxied by whether the worker earns above or below median annual earnings *within occupation* at the firm). In Panel B, we explore heterogeneity with respect to white and blue-collar workers. In Panel C, we study effect heterogeneity across men and women. In all tables, we show results without taking labor market concentration into account (column (1)), using our preferred specification of 20 skill clusters to measure labor concentration (column (2)), and using 40 skill clusters to measure labor concentration (column (3)).

Panels A and B reveal interesting patterns. First, the panels suggest that there exist modest union wage premiums in competitive markets among high-skilled and white-collar workers, but not among lower-skilled and blue-collar workers (column (1)). Second, the panels reveal that as markets become more concentrated, more of the additional rent that unions extract go to lower-productivity and blue-collar workers. This implies that unions have an inequality-enhancing effect on earnings within narrow sectors in competitive markets, while this is not the case in concentrated markets characterized by monopsonistic competition. This is a novel finding that has not been documented before.[14]

In understanding these results, we argue that unions are concerned with maximizing union dues. This objective function leads unions to prioritize higher-wage earners when allocating limited rents among members in competitive markets. First, higher-wage earners have more room to pay higher union dues. As we show in Figure 6, workers with above-median earnings in the occupation-firm cell pays approximately 750 NOK more in annual union dues than those below the median, even taking into account occupation, industry, education, and age. Second, in highly competitive markets, high-skilled and white-collar workers are less likely

[14]The finding that workers who are more highly paid benefit more from unionization and firm-level contracts is also a core finding in work done in Spain (Card and De La Rica, 2006).

to join unions, and the lack of significant firm rent means that unions have to prioritize which workers to push higher salaries on. Therefore, unions focus on satisfying and ensuring the continued membership renewal of high-skilled and white-collar workers who are more likely to leave the unions and pay more in dues. In addition, higher-productivity workers also may carry more weight as representative agents in negotiations. The threat of higher-productivity workers taking adverse action looms larger than if lower-productivity workers threaten the same action. These three characteristics make higher-productivity workers strong potential members. As the markets are becoming more concentrated, the reduction in outside options for high-skilled and white-collar workers combined with the improved rent extraction opportunities available to unions means that they can shift focus to bargaining for a more general wage increase across all worker types.[15]

With respect to effect heterogeneity across males and females, Figure 7 suggests that high levels of unionization may disproportionately increase the earnings of women in competitive markets on average. Specifically, the vertical distance between low- and high-density firms is larger for women when HHI is low. As HHI increases, the marginal benefit to women *increases* relative to men, suggesting that unionization reduces gender earnings gaps more in concentrated markets at the macro level. That women are unionized at far higher rates than men in Norway may reflect this understanding among male and female workers.[16]

However, men and women tend to sort into different types of occupations and industries, and prior work suggests that women in Norway, on average, experience higher levels of labor market concentration (Dodini et al., 2020). After controlling for these differences, Panel C

[15]These second stage effects are not reflective of differential propensities to join unions in response to the subsidies, as we show in Appendix Table A1. Above-median workers are, in fact, less responsive to the subsidies in competitive markets and more responsive to concentration, contrary to the pattern of returns. This emphasizes the need for unions to use wage returns to retain higher-skilled workers. white-collar workers are more likely to respond to the subsidies in competitive markets (and pay lower union dues and face higher labor market concentration, as we show in Appendix Table A2), but this difference goes to zero as concentration increases.

[16]Appendix Table A1 shows that female workers are more likely to join a union in response to the subsidies in competitive markets, so these differential first stage effects are not a matter of male workers being more responsive to subsidies in competitive markets. Women also tend to pay less in union dues, though they do experience higher labor market concentration (see Appendix Table A2).

of Table 5 shows that there is a modest union wage premium in competitive markets among men and that this premium is considerably larger than that among women (column 1). Panel C further shows that as markets become more concentrated, more of the additional rent that unions are able to extract goes to women. This implies that unions exacerbate the gender wage gap within narrow sub-sectors in competitive markets, while they serve to reduce the gender wage gap in markets defined by a high degree of monopsonistic competition. This finding has important policy implications, revealing a potential role for unions in reducing the persistent overall gender wage gap through targeted involvement in concentrated markets. However, unionization may exacerbate earnings gaps within firms in competitive markets.

## 5.5 Effects on Inequality

Existing economic research on labor unions has raised the question of how unions affect inequality both within sectors, i.e. earnings inequality within the set of all unionized workers, and across sectors, i.e. the gap between non-unionized and unionized workers. Given the heterogeneous treatment effects we have documented across labor market concentration in Section , we extend our analysis in an effort to advance the literature on unions and inequality as well. We do so by considering two types of inequality: (1) inequality within firms that are exposed to a common level of union density (within sector, within firms) and (2) inequality within local labor markets, which proxies for the net effect of within- and across-sector inequality.

To study (1), we regress four measures of inequality within the firm on our predicted union density measure and the interaction of union density and concentration, including firm and year fixed effects. To explore (2), we regress the same four measures of inequality at the LLM level on average measures of concentration in the LLM and average union density weighted by total firm employment at each firm in the LLM. Our 4 measures of inequality are the 90-10 ratio; the 90-50 ratio; the 50-10 ratio; and the interquartile range.

Table 6 shows the results of this exercise. In Panel A, we see that for firms in the least concentrated markets, the gap between the 90-50 ratio widens when union density increases

(column 1). This is consistent with our findings in Panel A of Table 5 that above-median workers in each occupation benefit the most from unionization in competitive markets. However, union density in concentrated markets has the opposite effect of reducing inequality both in the 90-10 ratio and in the 90-50 ratio (column 2). The 50-10 ratio rises with unionization in concentrated markets, though the coefficient is only marginally statistically significant. In column 4, the value of the raw interquartile range falls as unionization increases in competitive markets but falls by even more in concentrated markets. Overall, within-firm inequality in firms with greater market share thus falls when union density at the firm rises. In competitive markets, the results are more mixed depending on the measure of inequality, but the results uniformly suggest that unions reduce firm inequality in more concentrated markets.

In Panel B of Table 6, we show that a similar pattern arises at the local labor market level. When local labor markets are characterized by their *overall* market concentration across all firms and workers in the area, earnings inequality rises in more competitive labor markets and falls in markets characterized by more labor market concentration when union density increases. In column 1, we see this pattern appear when considering the 90-10 earnings ratio in the LLM. A one percentage point increase in local labor market unionization in competitive markets increases the 90-10 ratio by 0.028, or by about 1 percent relative to the mean value of 3.2. In concentrated markets, a one percentage point increase in unionization decreases this ratio by 0.042, or approximately by 1.6 percent relative to the mean. In column 2, the upper half of the distribution becomes more compressed in competitive and concentrated markets, though the effects are not statistically significant. The 50-10 ratio results in column 3 suggest that unions in competitive markets primarily raise the earnings of workers closer to the median, ostensibly leaving the least attached or least productive workers behind. In concentrated markets, the gains from unionization accrue to the 10th percentile as well. The LLM level IQR falls substantially in the most concentrated markets.[17]

[17]Barth et al. (2020) find a firm-wide increase in value added per worker when union density increases in manufacturing firms. One possible mechanism is that workers at the bottom of the distribution of ability

Taken together, these results suggest that the effect of union density on earnings inequality is strongly determined by the level of localized labor market concentration faced by the marginal union member. As we have shown above, the marginal union member is more likely to be working in concentrated labor markets, which matters when we consider comparisons of our results to other work. For example, Card et al. (2004) find that wage inequality in the United States falls both within and between sectors as unionization rises. Our work supports that result in the context of concentrated labor markets in the Norwegian context, but not in the context of highly competitive markets. Thus, our findings demonstrate that the impact of unions on inequality is more nuanced than that documented in previous work, and that variation in labor market concentration is an important factor that needs to be taken into account when considering the overall impact of unions.

# 6 Extension: The China Shock

In Section 5, we presented new evidence on the impact of unionization as a function of labor market concentration. We did this by exploiting an exogenous shift in unionization at the firm and interacting this with existing measures of labor market concentration. An alternative approach would be to utilize exogenous shifts in labor market concentration and interact this with existing levels of union density. In this section, we exploit the influx of imports from China to Norway in the early 2000s as an exogenous shifter of firm labor market concentration and use this to measure the effects of unionization on earnings when there are changes to the level of labor market concentration. This exercise provides a complementary approach to our main empirical strategy and helps establish the robustness of our results to relying either on exogenous variation in unionization or exogenous variation in labor market concentration.

or productivity at the firm may be substituted for more productive workers. When viewed in this lens, the effects we find on annual earnings at the bottom of the distribution may be mediated by falling work hours at this level of productivity.

## 6.1 Data and Method

To exploit the influx of imports from China to Norway as an exogenous shifter of firm labor market concentration, we rely on a shift-share measure of import exposure where we allocate the shock to local labor markets based on baseline labor shares.

In terms of data, we follow Balsvik et al. (2015) and exploit information on the amount of imports into Norway coming from China allocated across product types to specific industry codes. This enables us to capture the size of the import shock to particular national sectors. Rather than allocating our measure of exposure to Chinese imports to local labor markets along industry lines, we make use of the granularity of the Norwegian register data and use firm-specific baseline employment to allocate the size of the shock to local labor markets.

In terms of estimation method, we measure local labor market exposure to Chinese imports that is a per-worker measure of total firm-specific exposures in the local labor market. We define exposure at local labor market $l$ at time $t$ related to industry $i$ and firm $f$ as:

$$Exposure_{lt} = \frac{1}{L_0^l} \sum_f \frac{L_0^{fil}}{L_0^i} \Delta M_{it} \tag{7}$$

where $\Delta M$ represents the change in total imports from China related to industry $i$ from base year 2001 to the current year (the "shift"). The ratio $\frac{L_0^{fil}}{L_0^i}$ is the share of employment in the base year in industry $i$ working at firm $f$ in local labor market $l$ (the "share"). We sum these firm-specific exposures over all firms in the local labor market and normalize the shock by the total size of the local labor market at baseline.

A firm that is not directly exposed to import competition may nonetheless be influenced at the local level by aggregate shocks to import competition through a reshuffling of labor demand across industries and occupations in the local labor market. This is, in fact, the margin at which Balsvik et al. (2015) find that Norwegian firms respond to Chinese import competition: through changes to the employment level rather than wages. We, therefore, estimate a moving value of firm-specific labor market concentration as a function

of employment-weighted firm exposure to Chinese imports across all its local labor markets and include firm and year fixed effects:

$$HHI_{ft} = \alpha_0 + \alpha_1 Exposure_{lt} + \tau_t + \phi_f + \nu_{ft} \tag{8}$$

We use predicted HHI from this equation in a second stage estimate of individual-level log earnings:

$$\begin{aligned} Log(Earnings)_{iocft} =& \alpha_0 + \alpha_1 UD_{ft} + \alpha_2 UD_{ft} * \widehat{HHI}_{ft} + \alpha_3 \widehat{HHI}_{ft} \\ &+ \delta_{Ed} + \pi_{Age} + \gamma_{oc} + \tau_t + \phi_f + \eta_{iocft} \end{aligned} \tag{9}$$

In this equation, we use a raw value of calculated union density $UD_{ft}$ and interact this with predicted labor market concentration based on exogenous shifts in labor market concentration driven by the influx of imports from China to Norway in the early 2000s. Because the import data are limited in their time coverage, we measure these effects from our baseline in 2001 to 2007. As an alternative to using the raw union density, we also use the average predicted union density and obtain nearly identical results. In this alternative approach, we predict the probability of unionization using our various fixed effects for occupation by industry, year, age groups, and education cells and then take the firm-level mean of this predicted value. This gives us a composition-constant predicted union density for the firm that is robust to any composition changes at the firm arising from import competition. These results are provided in Appendix Table A3.[18]

[18]We also estimate the effect of import exposure on the likelihood of being in a union. When controlling for individual fixed effects, exposure to Chinese imports has no effect on the probability that an individual worker is a member of a union. While there may be compositional changes that affect firm union density, the results in Appendix Table A3 indicate they do not affect our conclusions.

## 6.2 Results

Table 7 shows results from estimating the impact of exposure to Chinese imports on the labor market concentration of Norwegian firms. In column (1), we show results for our preferred measure of 20 clusters. For robustness, in column (2), we show the effects on HHI calculated for 40 skill clusters.

The results in Table 7 suggest that exposure to Chinese exports has a small but highly statistically significant impact on the labor market concentration experienced by firms. Specifically, an increase in exposure to Chinese imports per worker of 100,000 NOK (approximately 12,000 USD) reduces the HHI of the firm by approximately 0.34 percent of a standard deviation. For firms at the top of the exposure distribution, with an exposure of approximately 2 million NOK per worker, the predicted effects would be nearly seven percent of a standard deviation. The F-statistics associated with the regressions underlying the results are 116 and 50, respectively. These statistics are significantly greater than the conventional rule-of-thumb values required for pursuing a two-stage least squares approach.

In Table 8, we use a raw value of calculated firm-level union density $UD_{ft}$ and interact this with the predicted labor market concentration based on the first stage results in Table 7. Looking across the table, the results suggest a strong negative association between labor market concentration and wages. Specifically, a standard deviation change in labor market concentration is associated with a wage reduction of 15-20 percent. This is consistent with the notion that firms can leverage their labor market power to suppress wages below the competitive equilibrium.

The results in Table 8 also demonstrate that the negative impact of labor market concentration is considerably smaller in highly unionized firms. A one percentage point increase in union density increases wages by approximately 4.5 percent in the most concentrated labor markets. These estimates across definitions of HHI are remarkably consistent: according to the estimates, the negative earnings effect of labor market concentration is effectively eliminated upon reaching a union density of approximately 62-63 percent at the firm. This set

of results highlights that unions may serve to limit the wage-setting power of monopsonistic employers and that unions may play an important role in limiting market failures generated by monopsonistic power. This result is consistent with the notion that the greater the market imperfection, the greater is the amount of firm rent that unions are able to extract. The findings from this exercise thus provide a complementary view to our main results and help provide a better understanding of the dynamic interplay between unions and monopsonistic employers in the economy.

# 7 Discussion

In this paper, we bring together the literatures on monopsony power and unionization in labor markets by empirically examining the effects of unionization on the dynamics of worker earnings across differently concentrated markets. Existing empirical evidence has focused either on market power (e.g., Dodini et al. (2020); Schubert et al. (2020); Azar et al. (2020b)) or union power (e.g., Card et al. (2004); DiNardo and Lee (2004); Lee and Mas (2012)), without considering the potential interaction effects of the two. While these two strands of literature provide extremely important insights into the workings of labor markets, the lack of understanding of how these two forces interact—unions and monopolistic employers—severely limits our understanding of the dynamics of labor markets.

Exploiting tax reforms to union due deductions as an exogenous shock to unionization, we demonstrate that the price elasticity of unionization has an extremely steep gradient over labor market concentration. We then show that there is an equally strong gradient in the union earnings premium and that the union wage premium loads almost exclusively on the highly concentrated markets. This result is consistent with the notion that the greater the market imperfection, the greater is the amount of firm rent that unions can extract. It also suggests a potentially important role of unions as limiting the market failures generated by monopsonistic competition.

Running horse-races on product market power and labor market power on the union wage premium across differently-concentrated markets suggest that unions are considerably more

effective in extracting labor rent relative to product rent. Specifically, the coefficient on the interaction between union density and labor HHI is four times larger than the coefficient on the interaction between union density and product HHI. In addition, only the coefficient on the interaction between union density and labor HHI is statistically significantly different from zero. That we identify different effects across these two sources of market power highlights that they are substantively different components and that the correlations between the two are not as strong as previously thought.

We document important heterogeneity with respect to the type of worker that benefits from union membership as a function of labor market concentration. Specifically, we show that the modest union wage premiums that exist in competitive markets are loading on high-skilled and white-collar workers. As the degree of market concentration increases, more and more of the additional rent that unions are able to extract go to low-ability and blue-collar workers. This implies that unions may have an inequality-enhancing effect on wages in some subsectors of competitive markets, while this is not the case in concentrated markets characterized by monopsonistic competition. While speculative, we suggest that this pattern of results is consistent with unions trying to maximize union dues.

Related to this point, Card et al. (2004) discuss the concepts of "between-sector" versus "within-sector" wage inequality, defined as inequality measured between union and non-union workers and inequality among unionized workers, respectively.[19] Our results suggest that there is a notable, positive effect on inequality within small *sub-sectors* of the unionized sector when labor markets are competitive. In other words, when comparing unionized workers to each other within the same firm, inequality increases when outside options for the most productive workers are more feasible to enter. This does not appear through a redistribution of resources per se, but rather through unequal benefits to unionization. That we find such an effect suggests that prior work that has identified reductions in within-sector inequality as a function of unionization, may be operating within concentrated markets. However, we

[19]Discussions of these effects date back to the 1950s (Friedman, 1956; Rees, 1989).

also note there are differences in the definition of "sector" measured by our estimates.

We find a similar result pattern when exploring effect heterogeneity between men and women, suggesting that unions exacerbate the gender earnings gap in occupation-firm subsectors within competitive labor markets, while they serve to reduce the gender earnings gap on the whole, particularly in concentrated markets. This finding has potentially important policy implications, revealing a role for unions in reducing the persistent macro gender wage gap through involvement in concentrated markets. This is particularly important as other work has found that women, on average, face more concentrated markets in their occupations (Dodini et al., 2020; Ransom and Oaxaca, 2010).[20]

Finally, we use the China shock as a shift-share instrument for exogenous variation in labor market concentration to provide a complementary view of our main results and help establish the robustness of our results to relying either on exogenous variation in unionization or exogenous variation in labor market concentration. We find a small negative association between exposure to the China shock and a firm's labor share, and that this is associated with a reduction in the union wage premium. According to the estimates, the negative earnings effect of labor market concentration is effectively eliminated upon reaching a union density of approximately 62-63 percent at the firm. This empirical exercise helps clarify the relationship between unions and monopolistic employers and provides a better understanding of the dynamic interplay between these forces in the economy.

We are the first to provide causal estimates of the union wage premium in an entire country and the first to bring together the modern literatures on monopsony power and unionization in labor markets. Examining the intersection of unionization and labor market concentration allows us to substantially advance our understanding of the role of unions and their impact on the dynamics of labor markets. Our main contribution is to provide a method for identifying the union wage premium as a function of employer concentration,

[20]Women in our sample are also disproportionately likely to be in the "below-median" earner class within occupation-firm cells, with 59 percent of women falling within the "below median" earner group. Unions appear to reward workers with either high levels of productivity or attachment to the labor market or firm, which may explain part of the gender gap in returns within firms.

systematically grouping together occupations using the skill content of different jobs, and pairing this measure with a credible empirical strategy for identifying the causal effect of unionization on wages across markets with differently concentrated labor demand.

We believe that the results from this paper have important policy implications. Specifically, the lack of a substantial union wage premium in perfectly competitive markets suggests that the possible distortionary effect of unions may be small in a market facing relatively few imperfections. That there is a sizable union wage premium in highly concentrated markets, on the other hand, may point to unions as being able to ameliorate a market failure generated by employer power. Given that our estimates are identified based on a simple policy change—modest tax subsidies for union dues —and that the workers who disproportionately benefit from unionization are those more likely to be in concentrated markets, this policy lever is one that may serve to decrease overall earnings inequality. It is also a policy lever that, while general in scope, is well-targeted in effect. While speculative, the high unionization rates in Norway may therefore be one reason for its relatively compressed pre-tax labor earnings structure relative to countries such as the United States.

Given our prediction that a union density of 63% is sufficient to reverse the negative effects of labor market concentration at the firm, we perform a back-of-the-envelope calculation to identify what the total subsidy cost would be to incentivize workers at every firm in the Norwegian economy to reach this threshold. At the end of our sample period, approximately 39% of all workers were at firms with a predicted union density from our first stage equation below this 63% threshold, representing 48% of firms. On average, firms below the tipping point have predicted densities approximately 3.7 percentage points away from 63%. Generating a 3.7 percentage point change in unionization, according to our first stage estimates, would require an increase in the base tax subsidy of approximately 168 NOK, or raising the deduction by approximately 622 NOK. This would induce approximately 26,500 new workers to join a union at a cost of 4.44 million NOK. Holding constant the union membership status of those in firms already above 63%, a universal tax subsidy increase of

168 crowns per member would also result in additional payments to approximately 730,000 full-time workers totaling 123 million NOK, for a total new base subsidy value of approximately 128 million NOK (approximately $16.6 million). Given the size of the workforce in our sample (approximately 1.86 million workers at the end of the sample) this amounts to a transfer of approximately 69 NOK per worker per year for the base subsidy.

The results from this analysis also have implications for regulatory policy. According to the Horizontal Merger Guidelines used as the basis for antitrust enforcement by the US Department of Justice (DOJ), an HHI above 0.25 is considered "highly concentrated," and the US Congress has recently proposed giving the DOJ a mandate to regulate mergers and acquisitions with labor concentration in mind. However, our estimates emphasize that *unionization rates* ought to be considered as well, and that certain mergers and acquisitions may not be distortionary – and could even be beneficial – in already concentrated markets as long as there is a sufficient union presence.

We see our paper as opening up a new avenue of research, exploring the dynamics of how the balance of power between employers and unions may impact not only wages, but also other types of non-pecuniary benefits, employment levels, and social goods.

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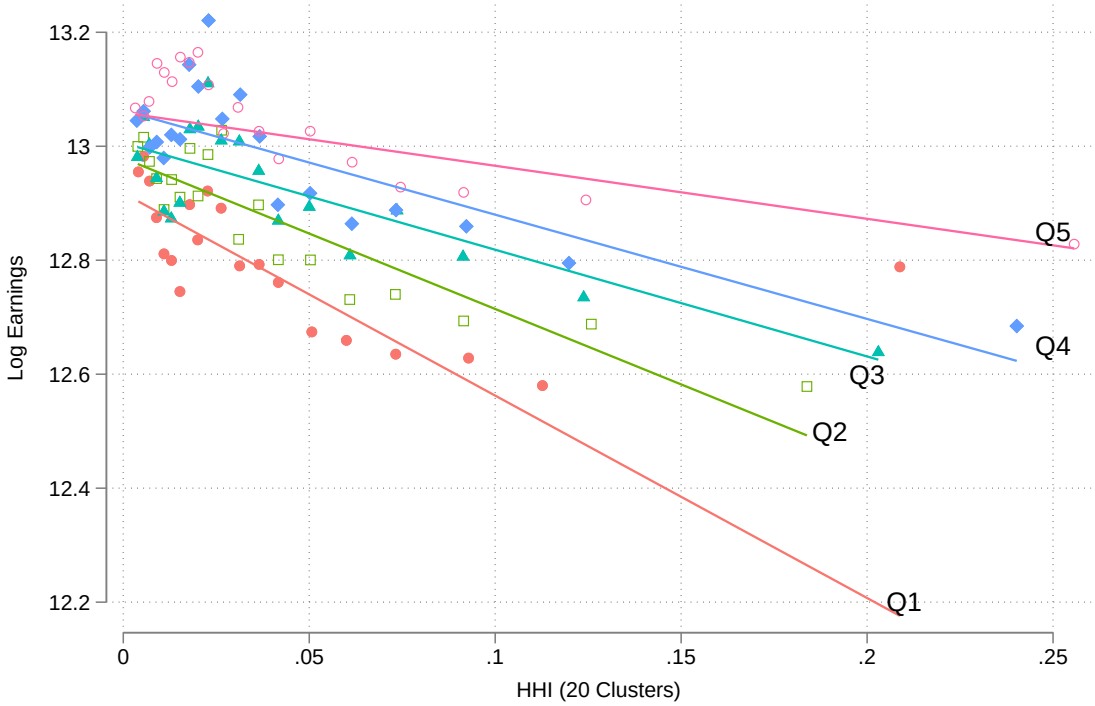
# Figures

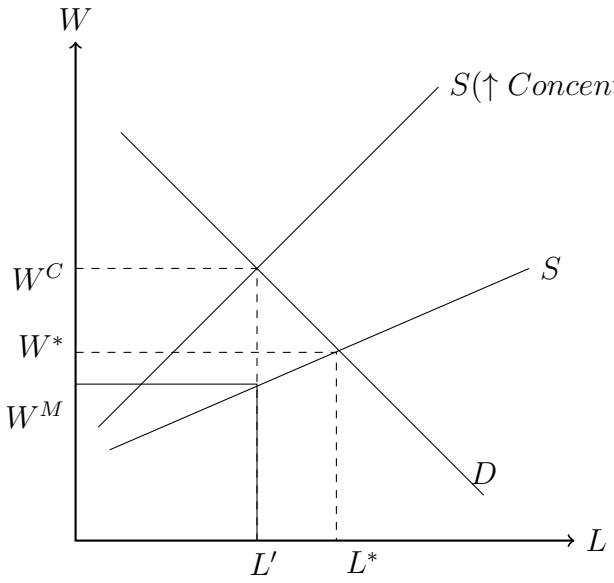
Figure 1: Log Annual Earnings (NOK) and Labor Market HHI by Quintiles of Predicted Firm Union Density



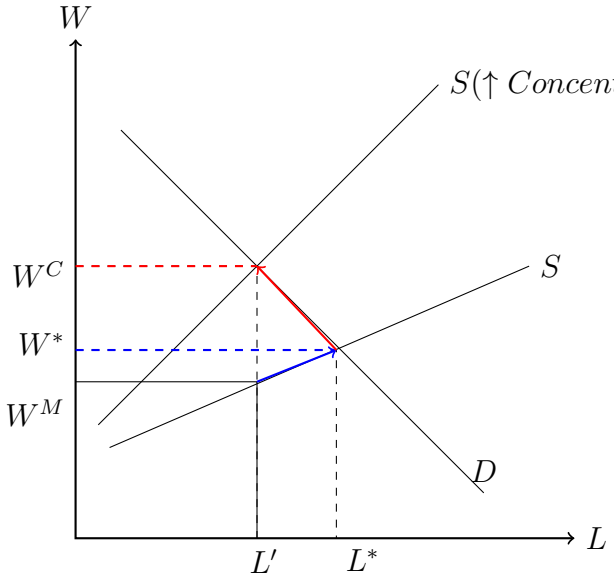

Source: Authors' calculations of Norwegian registry data.
Notes: Predicted union densities are based on average predicted unionization rates at each firm from Equation 3 as described in the text.

Figure 2: Wage Floors in a Monopsony Framework

Panel A: Monopsony Model of the Labor Market by Labor Market Concentration

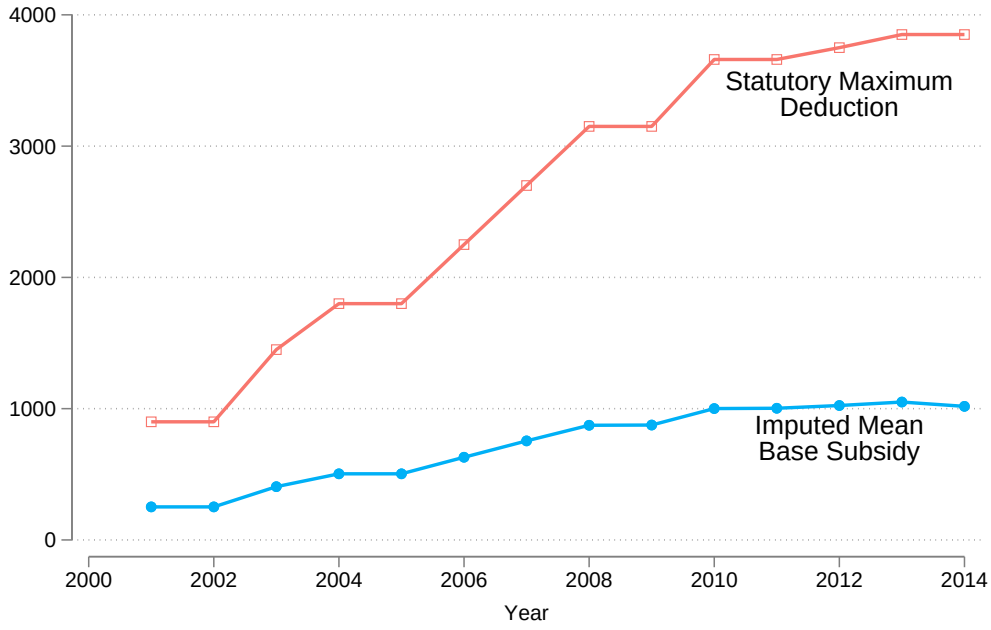



Panel B: Wage Floor at W* (Blue) or above W* (Red)



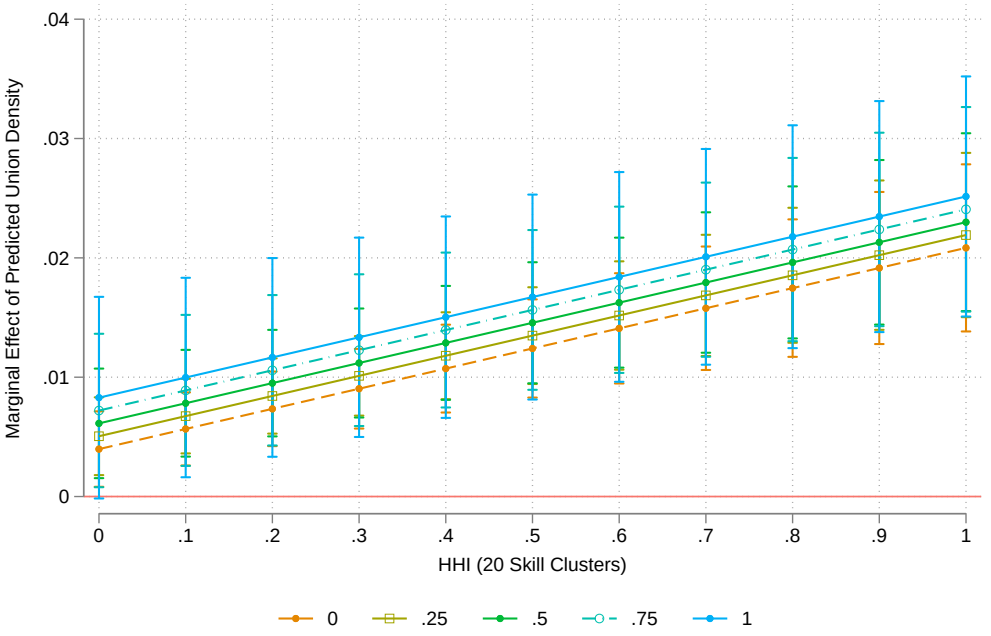

Notes: Similar to a minimum wage in a monopsonistic framework, wages set at $W^*$ from $W^M$ will increase economic efficiency by moving to the competitive wage level $W^*$ and competitive employment level $L^*$, moving along the blue arrow. Wages set above $W^*$ will increase inefficiency. Unions function in a similar fashion but allow for negotiation of wages or minimum wages across worker types.

Figure 3: Statutory Maximum Deduction and Imputed Mean Subsidy for Union Dues (NOK)



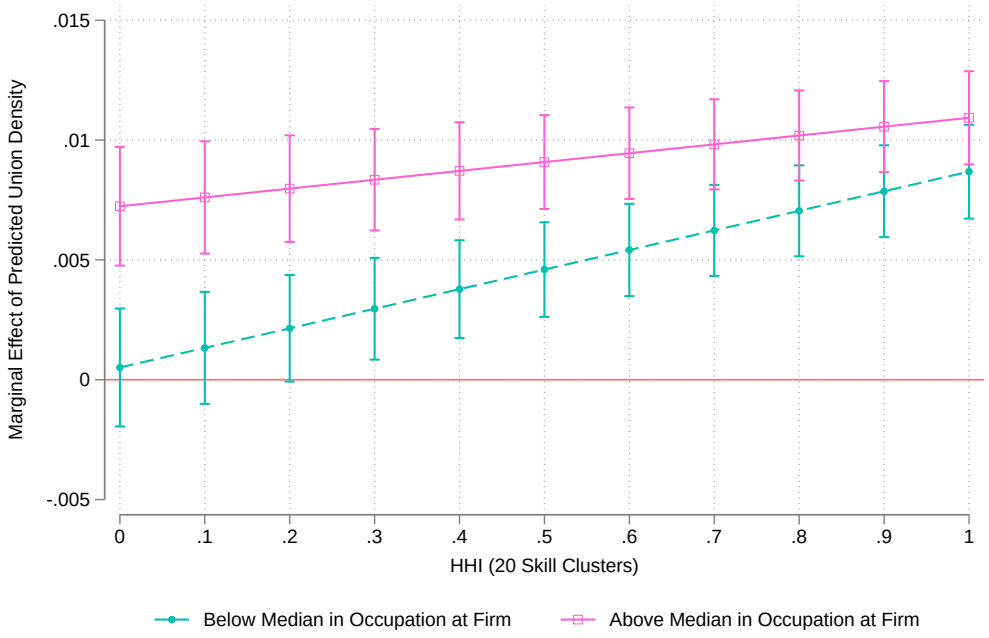

Source: Authors' calculations of Norwegian registry data.
Notes: Imputed base subsidies are calculated as the base tax rate times the lesser of imputed union dues at the occupation-by-industry cell or the statutory maximum deduction.

Figure 4: Marginal Effects of Union Density by Industry Revenue HHI



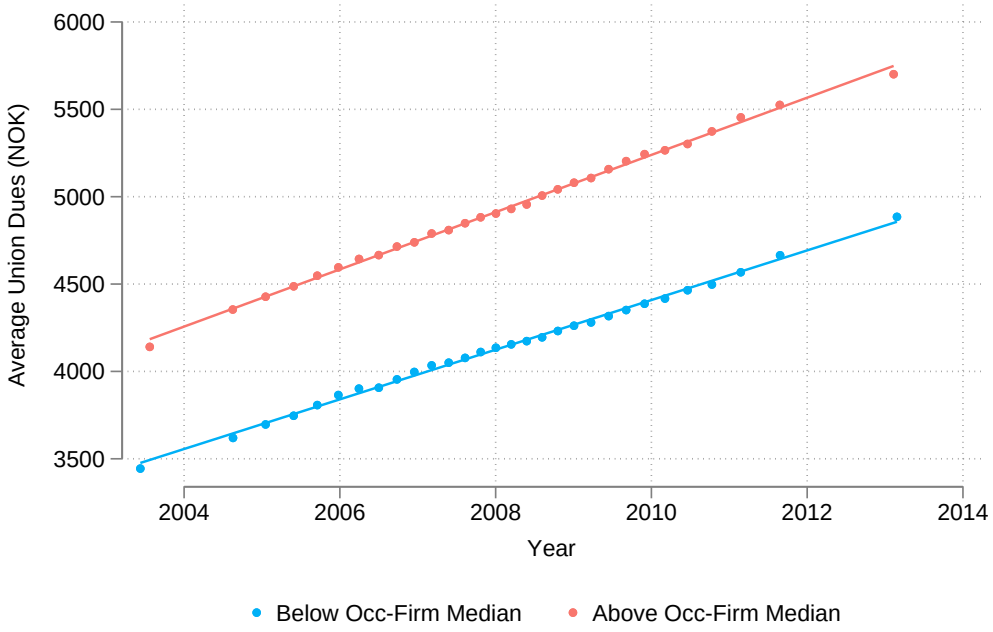

Source: Authors' calculations of Norwegian registry data as described in the text.
Notes: Standard errors are clustered at the firm level and calculated at each margin using the delta method.

Figure 5: Marginal Effects of Union Density by Firm-Occupation Median



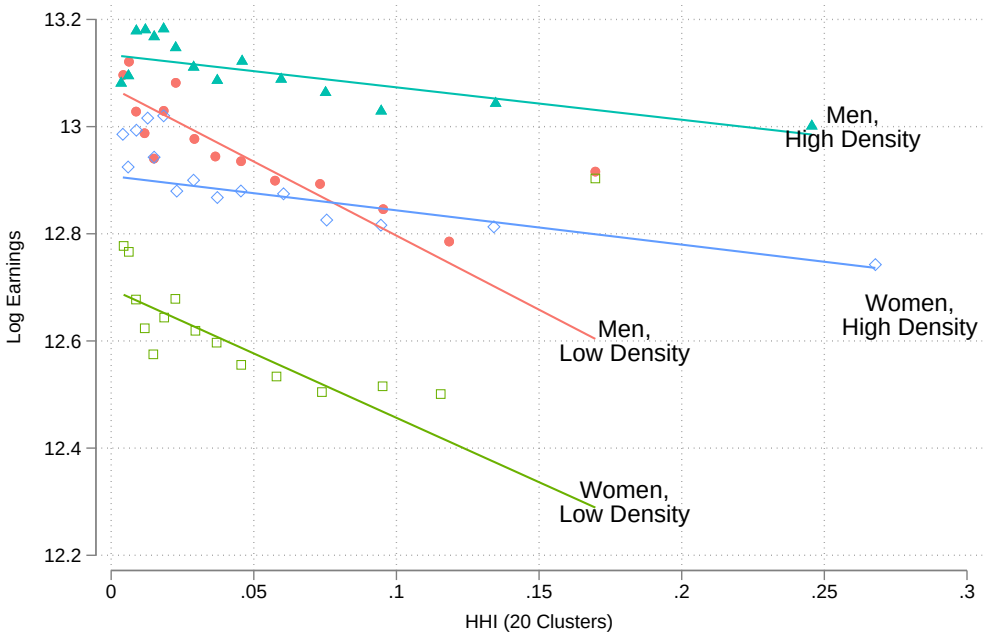

Source: Authors' calculations of Norwegian registry data as described in the text.
Notes: Standard errors are clustered at the firm level and calculated at each margin using the delta method.

Figure 6: Annual Union Dues by Above or Below Median Occupation-Firm Earnings




Source: Authors' calculations of Norwegian registry data.
Notes: Above vs below median earnings are calculated in each occupation-firm-year cell in the data. The estimated means take into account fixed effects for occupation by industry, education, and age group cells.

Figure 7: Log Annual Earnings (NOK) and Labor Market HHI by Gender and Top vs Bottom Quintiles of Predicted Firm Union Density




Source: Authors' calculations of Norwegian registry data.
Notes: Predicted union densities are based on average predicted unionization rates at each firm from Equation 3 as described in the text.

# Tables

Table 1: Key Sample Summary Statistics

| VARIABLES | (1) Mean | (2) SD |
|---|---|---|
| Pr(Union) | 0.5792 | 0.4937 |
| Firm Union Density | 0.5771 | 0.2766 |
| Real Annual Earnings (2015 NOK) | 465,224 | 277,711 |
| Age | 41.70 | 11.66 |
| Imputed Tax Subsidy (1,000s NOK) | 0.7615 | 0.2847 |
| Imputed Net Union Due (1,000s NOK) | 3.1685 | 0.5856 |
| Labor HHI (20 Clusters) | 0.0452 | 0.0588 |
| Labor HHI (40 Clusters) | 0.0560 | 0.0678 |
| Product HHI (National Industry) | 0.0455 | 0.0868 |
| Public Sector Industry Worker | 0.3071 | 0.4613 |
| N | 17,464,604 | |

Source: Norwegian registry data as described in the text.
Notes: The sample is limited to full-time workers at firms with at least ten workers. We take a 70% random sample of the full set of individuals to ease computational constraints.

Table 2: The Effect of Tax Subsidies on Propensity to Unionize

| VARIABLES | (1) No HHI | (2) No HHI | (3) 20 Clusters | (4) 20 Clusters | (5) 40 Clusters | (6) 40 Clusters |
|---|---|---|---|---|---|---|
| Subsidy (1,000 NOK) | 0.219*** | 0.0943*** | 0.198*** | 0.0930*** | 0.200*** | 0.0931*** |
| | (0.0566) | (0.0165) | (0.0564) | (0.0164) | (0.0564) | (0.0165) |
| HHI x Subsidy | | | 0.140*** | 0.0755*** | 0.0868*** | 0.0357** |
| | | | (0.0371) | (0.021) | (0.0320) | (0.0179) |
| Observations | 17,464,077 | 17,279,227 | 17,464,077 | 17,279,227 | 17,464,077 | 17,279,227 |
| R-squared | 0.244 | 0.739 | 0.246 | 0.739 | 0.246 | 0.739 |
| Occupation x Industry FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Education FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Age Group FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | | Yes | | Yes | | Yes |
| Avg Pr(Union) | 0.575 | 0.575 | 0.575 | 0.575 | 0.575 | 0.575 |
| Mean Subsidy 2001 (1,000 NOK) | 0.252 | 0.252 | 0.252 | 0.252 | 0.252 | 0.252 |
| Mean Subsidy 2014 (1,000 NOK) | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 |

Source: Authors' estimates as described in the text.
Notes: Standard errors are in parentheses and are clustered at the firm level.
* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 3: Effect of Union Density on Log Annual Earnings by Labor Market Concentration

| | Panel A: Full Sample | | |
|---|---|---|---|
| VARIABLES | (1) No HHI | (2) 20 Clusters | (3) 40 Clusters |
| Predicted Firm Union Density | 0.00671*** | 0.00351*** | 0.00417*** |
| | (0.00136) | (0.00130) | (0.00134) |
| Predicted Firm Union Density * HHI | | 0.00523*** | 0.00572*** |
| | | (0.00105) | (0.000952) |
| Observations | 17,464,066 | 17,464,066 | 17,464,066 |
| R-squared | 0.584 | 0.584 | 0.584 |
| | Panel B: Private Sector Only | | |
| VARIABLES | (1) No HHI | (2) 20 Clusters | (3) 40 Clusters |
| Predicted Firm Union Density | 0.00382** | 0.000209 | 0.000851 |
| | (0.00155) | (0.00154) | (0.00157) |
| Predicted Firm Union Density * HHI | | 0.0218*** | 0.0137*** |
| | | (0.00249) | (0.00224) |
| Observations | 12,100,943 | 12,100,943 | 12,100,943 |
| R-squared | 0.596 | 0.596 | 0.596 |
| Occupation x Industry FE | Yes | Yes | Yes |
| Education FE | Yes | Yes | Yes |
| Age Group FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |

Source: Authors' estimates as described in the text.
Notes: Standard errors are in parentheses and are clustered at the firm level.
* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 4: The Effect of Union Density on Log Annual Earnings by Labor and Product Market Concentration

| VARIABLES | (1)<br>No Labor HHI | (2)<br>20 Clusters | (3)<br>40 Clusters |
|---|---|---|---|
| Predicted Firm Union Density | 0.00474*** | 0.00398** | 0.00392** |
| | (0.00152) | (0.00161) | (0.00158) |
| Predicted Firm Union Density * Labor HHI | | 0.0169*** | 0.00953*** |
| | | (0.00362) | (0.00282) |
| Predicted Firm Union Density * Industry Revenue HHI | | 0.00431 | 0.00356 |
| | | (0.00452) | (0.00435) |
| Change in ME with 10 ppt Change in Labor HHI | | 0.0017 | 0.0010 |
| Change in ME with 10 ppt Change in Industry Revenue HHI | | 0.0004 | 0.0004 |
| Observations | 8,627,535 | 8,627,535 | 8,627,535 |
| R-squared | 0.612 | 0.612 | 0.612 |
| Occupation x Industry FE | Yes | Yes | Yes |
| Education FE | Yes | Yes | Yes |
| Age Group FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |

Source: Authors' estimates as described in the text.
Notes: Standard errors are in parentheses and are clustered at the firm level.
* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 5: Heterogeneous Effects of Union Density on Log Annual Earnings

| | Panel A: Above vs Below Firm-Occupation Median | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| VARIABLES | No HHI | 20 Clusters | 40 Clusters |
| Predicted Firm Union Density | 0.00353*** | 0.000332 | 0.000917 |
| | (0.00131) | (0.00126) | (0.00130) |
| Predicted Firm Union Density * HHI | | 0.00807*** | 0.00876*** |
| | | (0.00104) | (0.000939) |
| Union Density * Above Firm-Occ Median | 0.00650*** | 0.00673*** | 0.00681*** |
| | (4.02e-05) | (4.89e-05) | (4.95e-05) |
| Union Density * HHI * Above Firm-Occ Median | | -0.00453*** | -0.00509*** |
| | | (0.000289) | (0.000277) |
| R-squared | 0.717 | 0.717 | 0.717 |
| | Panel B: White Collar vs Other Occupations | | |
| | (1) | (2) | (3) |
| VARIABLES | No HHI | 20 Clusters | 40 Clusters |
| Predicted Firm Union Density | 0.00573*** | 0.00251* | -0.000722 |
| | (0.00135) | (0.00129) | (0.00108) |
| Predicted Firm Union Density * HHI | | 0.00572*** | 0.00413*** |
| | | (0.00103) | (0.000644) |
| Union Density * White Collar | 0.00180*** | 0.00180*** | 0.00194*** |
| | (0.000250) | (0.000279) | (0.000312) |
| Union Density * HHI * White Collar | | -0.00126*** | -0.000737*** |
| | | (0.000465) | (0.000262) |
| R-squared | 0.584 | 0.584 | 0.584 |
| | Panel C: By Gender | | |
| | (1) | (2) | (3) |
| VARIABLES | No HHI | 20 Clusters | 40 Clusters |
| Predicted Firm Union Density | 0.00733*** | 0.00641*** | 0.00637*** |
| | (0.00133) | (0.00128) | (0.00131) |
| Predicted Firm Union Density * HHI | | 0.00357*** | 0.00464*** |
| | | (0.00107) | (0.000968) |
| Union Density * Female | -0.00265*** | -0.00282*** | -0.00282*** |
| | (3.50e-05) | (4.22e-05) | (4.29e-05) |
| Union Density * HHI * Female | | 0.00339*** | 0.00272*** |
| | | (0.000278) | (0.000232) |
| R-squared | 0.596 | 0.596 | 0.596 |
| Observations | 17,464,066 | 17,464,066 | 17,464,066 |
| Occupation x Industry FE | Yes | Yes | Yes |
| Education FE | Yes | Yes | Yes |
| Age Group FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |

Source: Authors' estimates as described in the text.

Notes: Standard errors are in parentheses and are clustered at the firm level.

* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 6: Effect of Union Density on Inequality in Firms and Local Labor Markets

| | Panel A: Firm Level Inequality | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| VARIABLES | Firm 90/10 | Firm 90/50 | Firm 50/10 | Firm IQR (NOK) |
| Predicted Union Density | 0.00386 | 0.00808*** | -0.00514 | -1,485** |
| | (0.00641) | (0.00194) | (0.00330) | (712.2) |
| Predicted Union Density x HHI | -0.0181** | -0.0158*** | 0.00620* | -2,240*** |
| | (0.00714) | (0.00215) | (0.00365) | (735.0) |
| Dep Variable Mean | 2.61 | 1.52 | 1.71 | 186,853 |
| Pct Effect Union Density | 0.15 % | 0.53 % | -0.30 % | -0.79 % |
| Pct Effect Union Density x HHI | -0.69 % | -1.04 % | 0.36 % | -1.20 % |
| Observations | 340,470 | 340,470 | 340,470 | 340,470 |
| R-squared | 0.605 | 0.605 | 0.583 | 0.817 |
| Firm FE | Yes | Yes | Yes | Yes |

| | Panel B: Local Labor Market Level Inequality | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| VARIABLES | LLM 90/10 | LLM 90/50 | LLM 50/10 | LLM IQR (NOK) |
| Predicted Union Density | 0.0276** | -0.00960 | 0.0269*** | 5,177* |
| | (0.0124) | (0.00585) | (0.00726) | (3,000) |
| Predicted Union Density x HHI | -0.0419*** | -6.73e-05 | -0.0240*** | -8,145*** |
| | (0.00880) | (0.00264) | (0.00587) | (1,176) |
| Dep Variable Mean | 3.22 | 1.68 | 1.91 | 218,315 |
| Pct Effect Union Density | 1.06 % | -0.63 % | 1.57 % | 2.77 % |
| Pct Effect Union Density x HHI | -1.61 % | 0.00 % | -1.40 % | -4.36 % |
| Observations | 2,396 | 2,396 | 2,396 | 2,396 |
| R-squared | 0.975 | 0.983 | 0.890 | 0.970 |
| LLM FE | Yes | Yes | Yes | Yes |

Source: Authors' estimates as described in the text.

Notes: Standard errors are in parentheses and are clustered at the firm level in Panel A and the local labor market level in Panel B.

* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 7: The Effect of Exposure to Chinese Imports on Labor Concentration

| VARIABLES | (1)<br>20 Clusters | (2)<br>40 Clusters |
|---|---|---|
| Exposure to Chinese Imports per Worker (1,000s NOK) | -2.00e-06***<br>(1.85e-07) | -1.64e-06***<br>(2.31e-07) |
| SD of HHI (full sample): | 0.0588 | 0.0678 |
| SD effect of 1 million NOK | -0.0340 | -0.0242 |
| Observations | 145,032 | 145,032 |
| R-squared | 0.826 | 0.811 |
| Limiting to Export Industries | No | No |
| Firm Fixed Effects | Yes | Yes |

Source: Authors' estimates as described in the text.
Notes: Standard errors are in parentheses and are clustered at the firm level.
* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 8: The Effect of Predicted Labor Concentration on Union Premium

| VARIABLES | (1)<br>20 Clusters | (2)<br>40 Clusters |
|---|---|---|
| Union Density | -0.000748* | -0.00158*** |
| | (0.000403) | (0.000614) |
| Union Density x Predicted HHI | 0.0448*** | 0.0546*** |
| | (0.0115) | (0.0140) |
| Predicted HHI | -2.730*** | -3.328*** |
| | (0.667) | (0.813) |
| Observations | 10,351,840 | 10,351,840 |
| R-squared | 0.557 | 0.557 |
| Occupation x Industry FE | Yes | Yes |
| Education FE | Yes | Yes |
| Age Group | Yes | Yes |
| Firm FE | Yes | Yes |

Source: Authors' estimates as described in the text.
Notes: Standard errors are in parentheses and are clustered at the firm level.
* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

# A Appendix

Table A1: Heterogeneous First Stage Effects by Subgroup

| VARIABLES | (1) Women | (2) Above Occ-Firm Median | (3) White Collar |
|---|---|---|---|
| Subsidy (1,000 NOK) [Base] | 0.185*** | 0.204*** | 0.135** |
| | (0.0566) | (0.0563) | (0.0561) |
| Subsidy (1,000 NOK) * HHI (20 Clusters) [Base] | 0.0401 | 0.0760* | 0.271*** |
| | (0.0616) | (0.0396) | (0.101) |
| HHI [Base] | 0.719*** | 0.841*** | 0.155 |
| | (0.186) | (0.174) | (0.292) |
| Subsidy * Group Interaction | 0.0158*** | -0.0171*** | 0.0585*** |
| | (0.00456) | (0.00463) | (0.0102) |
| Subsidy * Group Interaction * HHI | 0.140*** | 0.135*** | -0.147 |
| | (0.0541) | (0.0369) | (0.0999) |
| Group * HHI | 0.945*** | 0.722*** | 1.315*** |
| | (0.145) | (0.120) | (0.308) |
| Constant | 0.224*** | 0.226*** | 0.228*** |
| | (0.0445) | (0.0444) | (0.0449) |
| Observations | 17,464,077 | 17,464,077 | 17,464,077 |
| R-squared | 0.248 | 0.248 | 0.246 |
| Occupation x Industry FE | Yes | Yes | Yes |
| Education FE | Yes | Yes | Yes |
| Age Group | Yes | Yes | Yes |

Source: Authors' estimates of first stage interacting subsidy and net-of-subsidy union dues with group indicators.
Notes: Standard errors are in parentheses and are clustered at the firm level.
* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table A2: Summary Statistics - Means by Subgroup

| VARIABLES | (1) Union Dues Paid (NOK) | (2) Subsidy (1,000 NOK) | (3) Net-of-Subsidy Dues (1,000 NOK) | (3) HHI (20 Clusters) |
|---|---|---|---|---|
| Men | 4783 | 0.7602 | 3.2049 | 0.0338 |
| Women | 4335 | 0.7650 | 3.1310 | 0.0560 |
| Below Occ-Firm Median | 4062 | 0.7596 | 3.1645 | 0.0445 |
| Above Occ-Firm Median | 5004 | 0.7660 | 3.1717 | 0.0455 |
| Not White Collar | 5167 | 0.7609 | 3.4357 | 0.0306 |
| White Collar | 4369 | 0.7630 | 3.0946 | 0.0489 |

Source: Authors' estimates using Norwegian register data.

Table A3: The Effect of Predicted Labor Concentration on Union Premium

| VARIABLES | (1)<br>20 Clusters | (2)<br>40 Clusters |
|---|---|---|
| Average Union Density x Predicted HHI | 0.0517*** | 0.0630*** |
| | (0.0193) | (0.0236) |
| Predicted HHI | -3.157*** | -3.848*** |
| | (1.058) | (1.289) |
| Observations | 10,351,840 | 10,351,840 |
| R-squared | 0.557 | 0.557 |
| Occupation x Industry FE | Yes | Yes |
| Education FE | Yes | Yes |
| Age Group | Yes | Yes |
| Firm FE | Yes | Yes |

Source: Authors' estimates as described in the text.
Notes: Standard errors are in parentheses and are clustered at the firm level. * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table A4: The Effect of Tax Subsidies on Propensity to Unionize, Occupation-Specific HHI

| VARIABLES | (1) 2-Digit Occupation | (2) 2-Digit Occupation | (3) 3-Digit Occupation | (4) 3-Digit Occupation |
|---|---|---|---|---|
| Subsidy (1,000 NOK) | 0.181*** | 0.0802*** | 0.182*** | 0.0886*** |
| | (0.0569) | (0.0162) | (0.0571) | (0.0162) |
| HHI x Subsidy | 0.102*** | 0.127*** | 0.0573** | 0.0586*** |
| | (0.0292) | (0.0190) | (0.0227) | (0.0132) |
| Observations | 17,464,077 | 17,279,227 | 17,464,077 | 17,279,227 |
| R-squared | 0.246 | 0.739 | 0.247 | 0.739 |
| Occupation x Industry FE | Yes | Yes | Yes | Yes |
| Education FE | Yes | Yes | Yes | Yes |
| Age Group FE | Yes | Yes | Yes | Yes |
| Individual FE | | Yes | | Yes |
| Avg Pr(Union) | 0.575 | 0.575 | 0.575 | 0.575 |
| Mean Subsidy 2001 (1,000 NOK) | 0.252 | 0.252 | 0.252 | 0.252 |
| Mean Subsidy 2014 (1,000 NOK) | 1.018 | 1.018 | 1.018 | 1.018 |

Source: Authors' estimates as described in the text.
Notes: Standard errors are in parentheses and are clustered at the firm level.
* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table A5: Effect of Union Density on Log Annual Earnings by Labor Market Concentration, Occupation-Specific HHI

| VARIABLES | (1)<br>No HHI | (2)<br>2-Digit Occupation | (3)<br>3-Digit Occupation |
|---|---|---|---|
| Predicted Firm Union Density | 0.00671*** | -0.00127 | 0.000415 |
| | (0.00136) | (0.00106) | (0.00108) |
| Predicted Firm Union Density * HHI | | 0.00665*** | 0.00356*** |
| | | (0.000843) | (0.000631) |
| Observations | 17,464,066 | 17,464,066 | 17,464,066 |
| R-squared | 0.584 | 0.584 | 0.584 |
| Occupation x Industry FE | Yes | Yes | Yes |
| Education FE | Yes | Yes | Yes |
| Age Group FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |

Source: Authors' estimates as described in the text.
Notes: Standard errors are in parentheses and are clustered at the firm level.
* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table A6: Effect of Union Density on Log Annual Earnings by Labor Market Concentration - Private Sector Only, Occupation-Specific HHI

| VARIABLES | (1) No HHI | (2) 2-Digit Occupation | (3) 3-Digit Occupation |
|---|---|---|---|
| Predicted Firm Union Density | 0.00382** | -0.00293** | -0.00217 |
| | (0.00155) | (0.00137) | (0.00139) |
| Predicted Firm Union Density * HHI | | 0.0109*** | 0.00673*** |
| | | (0.00191) | (0.00113) |
| Observations | 12,100,943 | 12,100,943 | 12,100,943 |
| R-squared | 0.596 | 0.596 | 0.596 |
| Occupation x Industry FE | Yes | Yes | Yes |
| Education FE | Yes | Yes | Yes |
| Age Group FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |

Source: Authors' estimates as described in the text.
Notes: Standard errors are in parentheses and are clustered at the firm level.
* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table A7: The Effect of Union Density on Log Annual Earnings by Labor and Product Market Concentration, Occupation-Specific HHI

| VARIABLES | (1) No Labor HHI | (2) 2-Digit Occupation | (3) 3-Digit Occupation |
|---|---|---|---|
| Predicted Firm Union Density | 0.00474*** | 0.00332** | 0.00258* |
| | (0.00152) | (0.00152) | (0.00148) |
| Predicted Firm Union Density * Labor HHI | | 0.00544** | 0.00439*** |
| | | (0.00257) | (0.00138) |
| Predicted Firm Union Density * Industry Revenue HHI | | 0.00426 | 0.00324 |
| | | (0.00463) | (0.00485) |
| Change in ME with 10 ppt Change in Labor HHI | | 0.0005 | 0.0004 |
| Change in ME with 10 ppt Change in Industry Revenue HHI | | 0.0004 | 0.0003 |
| Observations | 8,627,535 | 8,627,535 | 8,627,535 |
| R-squared | 0.612 | 0.612 | 0.612 |
| Occupation x Industry FE | Yes | Yes | Yes |
| Education FE | Yes | Yes | Yes |
| Age Group FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |

Source: Authors' estimates as described in the text.
Notes: Standard errors are in parentheses and are clustered at the firm level.
* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table A8: Effect of Union Density on Log Annual Earnings by Labor Market Concentration and Firm-Occupation Median, Occupation-Specific HHI

| VARIABLES | (1) No HHI | (2) 2-Digit Occupation | (3) 3-Digit Occupation |
|---|---|---|---|
| Predicted Firm Union Density | 0.00353*** | -0.00420*** | -0.00244** |
| | (0.00131) | (0.00103) | (0.00104) |
| Predicted Firm Union Density * HHI | | 0.00864*** | 0.00561*** |
| | | (0.000832) | (0.000641) |
| Union Density * Above Firm-Occ Median | 0.00650*** | 0.00688*** | 0.00707*** |
| | (4.02e-05) | (5.29e-05) | (5.40e-05) |
| Union Density * HHI * Above Firm-Occ Median | | -0.00461*** | -0.00454*** |
| | | (0.000263) | (0.000186) |
| Observations | 17,464,066 | 17,464,066 | 17,464,066 |
| R-squared | 0.717 | 0.717 | 0.717 |
| Occupation x Industry FE | Yes | Yes | Yes |
| Education FE | Yes | Yes | Yes |
| Age Group FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |

Source: Authors' estimates as described in the text.
Notes: Standard errors are in parentheses and are clustered at the firm level.
* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1 level.

Table A9: Effect of Union Density on Log Annual Earnings by Labor Market Concentration and White Collar Occupation Status, Occupation-Specific HHI

| VARIABLES | (1) No HHI | (2) 2-Digit Occupation | (3) 3-Digit Occupation |
|---|---|---|---|
| Predicted Firm Union Density | 0.00573*** | -0.00215** | -0.000722 |
| | (0.00135) | (0.00107) | (0.00108) |
| Predicted Firm Union Density * HHI | | 0.00652*** | 0.00413*** |
| | | (0.000841) | (0.000644) |
| Union Density * White Collar | 0.00180*** | 0.00154*** | 0.00194*** |
| | (0.000250) | (0.000307) | (0.000312) |
| Union Density * HHI * White Collar | | -0.000132 | -0.000737*** |
| | | (0.000360) | (0.000262) |
| Observations | 17,464,066 | 17,464,066 | 17,464,066 |
| R-squared | 0.584 | 0.584 | 0.584 |
| Occupation x Industry FE | Yes | Yes | Yes |
| Education FE | Yes | Yes | Yes |
| Age Group FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |

Source: Authors' estimates as described in the text.
Notes: Standard errors are in parentheses and are clustered at the firm level.
* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table A10: Effect of Union Density on Log Annual Earnings by Labor Market Concentration and Gender, Occupation-Specific HHI

| VARIABLES | (1)<br>No HHI | (2)<br>2-Digit Occupation | (3)<br>3-Digit Occupation |
|---|---|---|---|
| Predicted Firm Union Density | 0.00733*** | 0.00333*** | 0.00348*** |
| | (0.00133) | (0.00108) | (0.00110) |
| Predicted Firm Union Density * HHI | | 0.00395*** | 0.00226*** |
| | | (0.000827) | (0.000612) |
| Union Density * Female | -0.00265*** | -0.00288*** | -0.00290*** |
| | (3.50e-05) | (4.34e-05) | (4.25e-05) |
| Union Density * HHI * Female | | 0.00274*** | 0.00194*** |
| | | (0.000208) | (0.000145) |
| Observations | 17,464,066 | 17,464,066 | 17,464,066 |
| R-squared | 0.596 | 0.596 | 0.596 |
| Occupation x Industry FE | Yes | Yes | Yes |
| Education FE | Yes | Yes | Yes |
| Age Group FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |

Source: Authors' estimates as described in the text.
Notes: Standard errors are in parentheses and are clustered at the firm level.
* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.