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Abstract: In this article, we document and discuss salient features of collective bargaining systems in the OECD countries, with the goal of debunking some misconceptions and myths and revitalizing the general interest in wage setting and collective bargaining. We hope that such an interest may help close the gap between how economists tend to model wage setting and how wages are actually set. Canonical models of competitive labor markets, monopsony, and search and matching all assume a decentralized wage setting where individual firms and workers determine wages. In most advanced economies, however, it is common that firms or employer associations bargain with unions over wages, producing collective bargaining systems. We show that the characteristics of these systems vary in important ways across advanced economies, with regards to both the scope and the structure of collective bargaining.

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Introduction

In most OECD countries, employers negotiate wages with labor unions. Yet economic textbooks fantasize about decentralized wage setting where individual firms and workers determine the wages. In this article, we document and discuss salient features of collective bargaining systems in the OECD countries, with the goal of debunking some misconceptions and myths and revitalizing the general interest in wage setting and collective bargaining.

One myth is that collective bargaining is one unique way of wage determination. It is not. As we shall see, there are essential differences in collective wage bargaining systems among advanced countries. Countries with comparable levels of GDP per capita, competing on the same international markets, can be very different in terms of their bargaining systems and wage structures. Even economies with the same share of unionized workers (union density) or with the same share of workers whose terms of employment are covered by a collective agreement (bargaining coverage), can negotiate their wages rather differently.

Major differences stem from how unions coordinate with each other. Countries like Germany, Sweden, and Norway typically have export-led pattern-bargaining where unions in the metalworking sector and the chemical sector set the path for wage increases in private and public services. Other countries such as Israel, France, and Portugal have much less coordination across types of workers. Such differences in so-called horizontal coordination are important for how centralized the wage setting is and for how centralization works. Equally important is the level of so-called vertical coordination, reflecting whether wage bargaining takes place at the firm, the industry, or nation level. As we shall see, there is also a wide variation across otherwise comparable countries in terms of vertical coordination.

In general, unions tend to seek higher wages for their members, recognizing the tradeoffs in terms of possible job losses or higher consumer prices. The costs and benefits of internalizing such side effects depend critically on whether labor and output are

complements or substitutes in production and demand. We argue for the plausibility of a simple but forceful principle: Coordinating substitutes induces militancy, while coordinating complements induces acquiescence. We use this *Hawk-Dove* divide in union behavior to illustrate some likely implications of alternative structures of collective bargaining for wages, employment, investments, and work incentives.

Since the 1980s, most developed countries have experienced similar trends of decentralization in the wage setting. Despite wide initial differences, most countries now have lower union density and less horizontal and vertical coordination than forty years ago. Does this decentralization make theories of individually set wages more relevant? Not necessarily. It is a recent misconception that the outcome of decentralized but still collective bargaining resembles the case of individual wage determination.

Early students of labor relations, such as Beatrice and Sidney Webb (1897, p. 173), saw the difference clearly: “[T]he individual workman, applying for a job” is in a completely different position than “a group of workmen” that “sends representatives to conduct the bargaining on behalf of the whole body”. Their extensive discussion in *Industrial Democracy* can perhaps be summarized by a simple rule: When each worker operates alone, local conditions of the enterprise have little impact on his wage -- individual characteristics of the worker are decisive. When the work group bargains in concert, however, characteristics of each worker have little impact on individual wages -- local conditions of the enterprise are decisive.

What we call Webbs’ rule may also be relevant today. With collective bargaining at the firm level, equally strong unions may obtain different wages, depending on the profitability of their employer and the trade-offs they face between higher pay and lower employment. In addition, strong unions may exist in some corporations and in some plants, but not in others; some employers may have strong monopsony power, others may have none. Such differences may lead to unequal pay for equal work and a misallocation of labor across firms

and sectors, in contrast to what textbooks would predict. This assessment is important for understanding the implications of further centralization.

Are unions nothing but trouble? Clearly not. But with so many varieties of collective bargaining across countries and over time, there are some truths in both negative and positive assessments. Yet, the choice is not between uncritical blessings and overall condemnations. To insist that centralization of wage setting is generally bad for economic performance, that unions undermine important incentives, erode individualism, and demand more and more from capitalists until there is no capitalism left, misses important nuances. First, rather than excessive wage demands, wage restraint seems to be a salient feature of centralized wage setting. Second, two-tier bargaining - centrally set wages supplemented with local adjustments - can to some extent balance concerns for local incentives and flexibility in the wage setting.

Unfortunately, there is limited credible empirical evidence on the impacts of the centralization of the wage setting, and, more broadly, of the economic implications of alternative structures of collective bargaining. Indeed, much of what we know about the causes and consequences of different types of collective bargaining systems comes from theory and cross-country comparisons, subject to the usual criticism of omitted variables and endogeneity issues. Instead of performing yet another cross-country comparison, we therefore analyze, in the last part of this article, the wage setting in a particular country, Norway. Like many other European countries, the Norwegian collective bargaining system is based on a two-tier structure, with sectoral bargaining of wage floors or base wages followed by local bargaining at the firm level. By linking individual workers and firms to the relevant sectoral agreements, we can analyze this two-tier bargaining structure both theoretically and empirically with new register data. This analysis is centered around the question of how sectoral and local wage bargaining can be combined to trade off

internalization of externalities in the wage setting with flexibility and incentives at the firm level.

Wage Setting Practices

A taxonomy of wage setting practices across countries can be organized around two important dimensions: i) the level of union density and bargaining coverage and ii) the extent of vertical and horizontal coordination.

Union Density and Bargaining Coverage

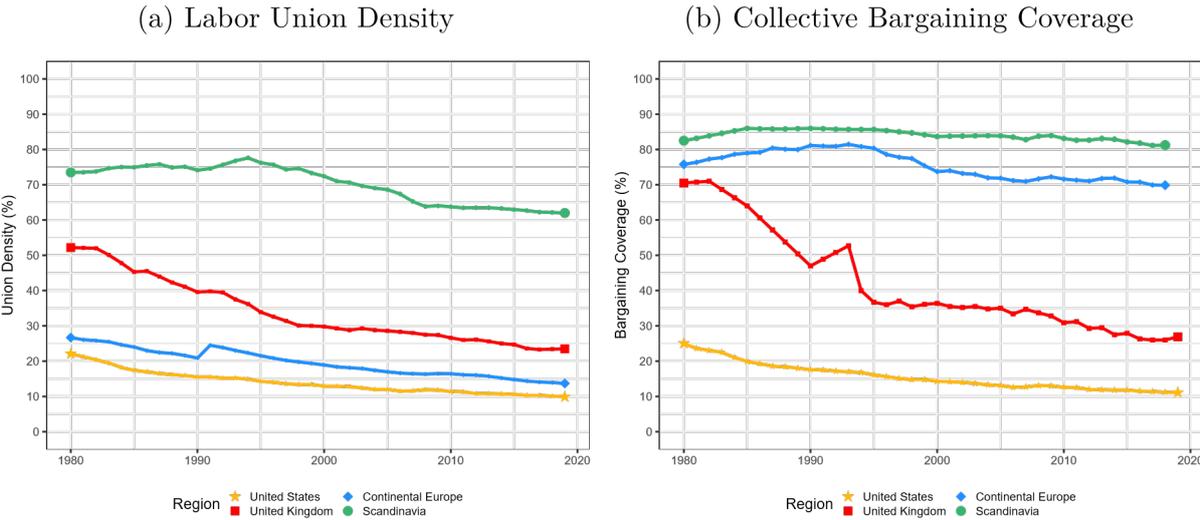
A fully decentralized and individualized process of wage setting, where individual firms and individual workers determine wages, is widespread in theory (either in the form of wage posting or single-worker firm bargaining) but rare in practice. Figure 1 presents the share of workers in an economy that are union members (panel a) and the share covered by collective bargaining agreements (panel b). We present trends over time in these measures for the United States, the United Kingdom, and for different regions of Europe.

Unionization varies widely across advanced economies, as shown in Panel (a) of Figure 1, with the highest density rates (in the Scandinavian countries) reaching several times the lowest density rates (in the United States). These differences expand from 1980 to 2018, as the share of US and UK workers that are union members has steadily declined over time. Indeed, Farber et al. (2021) show that the decline in US union density started in the 1950s. As Figure 1 shows, more than half of the UK workforce was unionized in 1980, while about one-fourth of American workers were members of a union. By 2018, the union density is below 20 percent in the United Kingdom and about 10 percent in the United States.

United States and the United Kingdom have the lowest degree of union influence. Still, in the United Kingdom, more than ten percent of the work force are members of one of the two largest unions; *Unite*, which organizes workers in construction, manufacturing, and

transport, and *Unison*, which organizes public service workers. A decline in union membership is also found in the four Continental European countries of France, Germany, Spain, and Portugal, and, since 1990, in the Scandinavian countries of Norway, Sweden, and Denmark.

Figure 1: Trends in Union Density and Bargaining Coverage in Europe and the United States



Notes: This figure shows the fraction of union members (left panel) and the fraction of workers covered by collective bargaining agreements (right panel) between 1980 and 2020 for the U.S. and selected European countries. “Continental Europe” includes France, Germany, Spain, and Portugal, and “Scandinavian Countries” includes Norway, Sweden, and Denmark. Source: The figure is based on the OECD/AIAS database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts (ICTWSS), as documented in Visser (2021).

The decline in union density may seem to suggest that advanced economies have become increasingly decentralized in wage setting. However, such a conclusion would ignore that the share of workers covered by the terms of collective bargaining agreements may greatly exceed union membership. This distinction matters little in the United States.

In contrast, in many Continental European countries and, to some extent in the Scandinavian countries, the share of workers covered by collective bargaining (including non-union jobs, firms, and sectors) can substantially exceed union membership. This distinction is rooted in statutes and practices for the extension of collective bargaining agreements to workers or employers who are not themselves member of unions or employer federations (for a

detailed discussion, see Flanagan 1999). The result of these extensions is that collective bargaining agreements directly influence the wage setting for a larger share of the workforce in these countries than the estimates of union density suggest.

Bargaining coverage in the Continental European countries has remained above 70 percent over the past four decades, despite a substantial decline in union density, as illustrated in panel (b) of Figure 1. In the Scandinavian countries, there is no indication of a decline in collective bargaining coverage, despite the decline in unionization since the early 1990s.

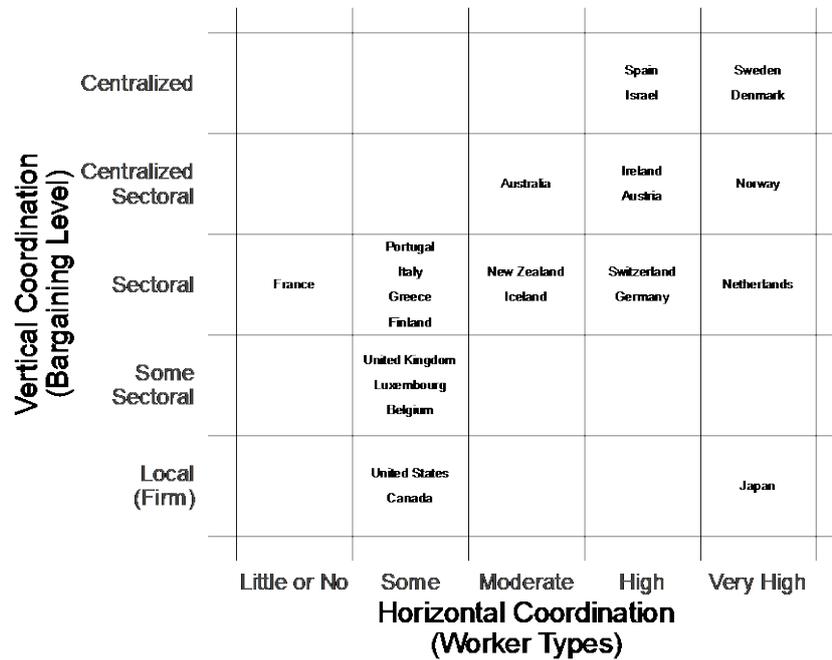
The large and increasing gap between union density and bargaining coverage in European countries is an important development that has received relatively little attention. It could be important for several reasons. For example, it might encourage non-union workers to free-ride on the collective bargaining efforts of union workers and thus reduce membership. If membership remains unaffected, however, extending the coverage of the union contract would raise the wage setting power of unions.

Union Coordination

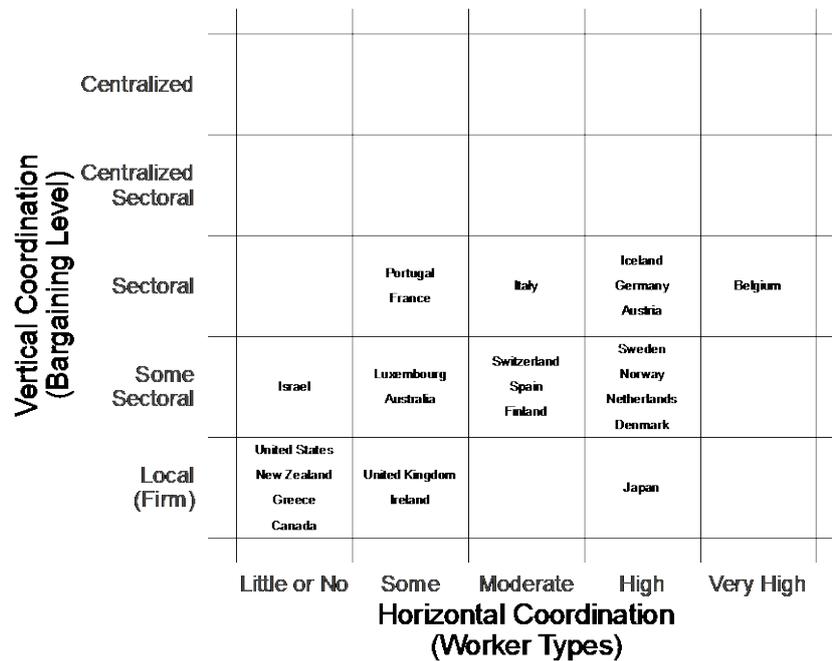
As discussed above, although a partial increase in either horizontal or vertical coordination both represent more centralization, horizontal and vertical coordination capture different features of the centralization of collective bargaining. An example of unions that are coordinated horizontally, but not necessarily vertically, is the traditional craft unions that organize workers of the same craft such as carpenters, typesetters, or shoemakers, who may well work in different firms. More coordination across unions of different crafts represents a higher level of horizontal coordination, and hence more centralization. In contrast, company unions organize many if not all types of workers within a given firm in the same union, as is common in the big corporations in Japan. The presence of company unions may imply a high level of horizontal coordination, even without coordination across unions.

Figure 2: Overview of Wage Setting Systems in Selected OECD Economies.

(a) 1980



(b) 2018



Notes: This figure provides an overview of wage setting systems in selected European countries, the U.S., Canada, Australia, New Zealand, Israel, and Japan as measured in 1980 (panel a) and 2018 (panel b). Each country is categorized according to the extent of vertical and horizontal coordination in wage setting. The prevalence of vertical coordination is shown along the y-axis, ranging between predominantly local bargaining (at the firm level), different degrees of sectoral bargaining, and predominantly centralized bargaining. The degree of horizontal coordination is shown along the x-axis, ranging between little or no, some, moderate, high, and very high coordination. Each

country is characterized by its predominant wage setting classification in the relevant year. Source: The figure is based on the OECD/AIAS database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts (ICTWSS); see Visser (2021).

Figure 2 characterizes the horizontal and vertical coordination in the collective bargaining systems of 24 advanced economies, again for 1980 (panel a) and 2018 (panel b). This characterization is based on institutional data from the OECD and the Amsterdam Institute for Advanced Labour Studies (AIAS), as documented in Visser (2021).¹

Most countries tend to be located along the diagonal in Figure 2. For instance, in 1980, the Scandinavian countries were at the one extreme with high degrees of both horizontal and vertical coordination. At another extreme, the United States and Canada had little coordination, especially horizontally.

Comparing wage setting systems in 1980 and 2018, we see a clear decentralization of the collective wage bargaining, with less coordination of either type. Notable examples are the Scandinavian countries that went from very high to moderate levels of vertical coordination.² Other examples are Greece and New Zealand, both of which shifted from moderate to low levels of both vertical and horizontal coordination.

Taken together, Figures 1 and 2 suggest that the fundamental change in how wages are set over the past few decades is a decentralization of collective wage bargaining, not a shift away from collective to individual wage setting. Below, we discuss causes, consequences, and controversies concerning this decentralization of collective wage bargaining. We also consider an important nuance ignored in Figure 2: Even countries with a highly centralized

¹ For in-depth discussions of how related indexes of centralization and coordination in the collective bargaining systems across countries were originally developed in the 1970s and 1980s, see Moene et al. (1993) and Calmfors and Driffill (1988). Since 1994, the OECD has carried out more systematic cross-country overviews of collective bargaining systems: for a recent example, see OECD (2019a). In a widely cited cross-country overview of labor market institutions, Nickell and Layard (1999) also relied on the characterizations provided by OECD (1994) and Calmfors and Driffill (1988). We use data from the recent OECD/AIAS database because it facilitates comparisons over time and is both publicly available and well-documented (Visser 2021).

² See Dahl *et al.* (2013) for a discussion of the decentralization of Danish collective bargaining system that happened in the early 1990s.

bargaining system can have an important decentralized component in their wage setting. For example, collective bargaining in Scandinavia is not as centralized as the figure suggests, because the high level of coordination is combined with supplementary local wage bargaining within a two-tier framework. The Scandinavian countries are not unique in this regard. Many other developed countries, including Austria, Belgium, Italy, the Netherlands, and more recently, Portugal and Spain (Boeri, 2015), also have some version of a two-tier bargaining system.

Employer Associations and Government Involvement

Historically, unions can be considered a countervailing power against tacit collusion of employers. “We rarely hear”, said Adam Smith (1776, I:VIII, p. 75), “of the combinations of masters, though frequently of those of workmen. But whoever imagines, upon this account, that masters rarely combine, is as ignorant of the world as of the subject.” In economic analysis of unionism, however, it is too often assumed that individual firms bargain against unions with monopoly power. In practice, however, both employer associations and the government often play important roles in determining both the structure and the outcomes of the collective wage bargaining.

A possible reason for the one-sided focus on unions in the literature is that data on the employer side is scarce. Official statistical agencies rarely survey employers about their participation in collective bargaining, their membership in employer associations, or the extent to which pay and other employment practices are determined by collective bargaining negotiations in which they do not participate (Flanagan 1999). Of course, this lack of information does not mean that employers’ organizations are irrelevant.³

Government may also play an important role in the bargaining between unions and employer associations. In some cases, the government role may be relatively passive: it can

³ For an in-depth discussion of the role of employers, see Swenson (1989).

include the provision of economic forecasts to bargaining parties, recommendations of wage-setting guidelines or norms, and appointments of mediators facilitating legal discussions and conflict resolution. In other settings, the government can play a more active role by setting minimum wages, extending collective agreements, imposing national wage schedules, imposing peace clauses on supplementary local bargaining, or ordering conflict resolutions through compulsory arbitrations.

Implications of the Structure of Collective Bargaining

The literature on collective bargaining covers a range of theoretical and empirical issues.⁴

Our discussion in this section is selective and incomplete, centered around coordination and externalities in the wage setting. While this discussion will be verbal, it draws heavily on the formal results and models discussed in existing work such as Moene et al. (1993).

What Do Unions Care About?

There is controversy over what unions maximize. Most unions are democratic, with union members voting to influence the policies and behaviors of their organization. Theories about democratic voting have demonstrated that outcomes of elections rarely are equivalent to the maximization of some aggregate objective function, especially when heterogeneous voters are facing choices along more than one dimension. But while union members care about many issues, they are likely to have strong common interests on the topics of wages and jobs. For a private firm, economists are often willing to start with an objective function of maximizing total profits, given the belief that shareholders in big corporations are likely to have strong common interests on this subject, even though they might disagree on other subjects. Likewise, a union is typically assumed to maximize some variant of the objective

⁴ For an extensive review of the literature on unions and collective bargaining, OECD (2019b) offers a useful starting point and cites many of the earlier studies since the 1980s. Freeman and Medoff (1984) is a classic work in this area. See also Elster (1989).

function $u = u(w, L)$, with real wages w and quantity of labor L , subject to some reasonable constraint such as non-negative profits.⁵

We focus on union wage aspirations—that is, the preferred wage levels chosen by union leaders who then (at least tacitly) accept employers' right to manage employment levels after the wage is set. Given these preferences, we consider a variety of the vertical and horizontal coordination that exists in various OECD countries.

Substitutes and Complements – the Hawk-Dove Divide

More than hundred years ago, when United Mine Workers of America teamed up with the National Progressive Unions of Miners and Mine Laborers, basically every organized miner in the US became a member of the same union organization. With all substitute workers organized under the same union leadership, the leadership could safely be more militant in their wage demands.

When the American Railway Union almost at the same time became an industrial union, organizing all the crafts that worked within the US railroad system, it expanded by organizing workers who were each other's complements. Consequently, the leadership of the union had to be more careful in its wage demands, as lower activities caused by higher wages to some workers would threaten the employment and wages of many other members of the same industrial union.

⁵ As a concrete algebraic example, say that the unions maximize $u = (w - r)^\gamma L^\beta$, where w denotes the wage and L the employment level, γ and β are positive constants and r is the outside option wage of the members of the given union. If $\gamma = \beta = 1$ and $r = 0$, the union can be considered a bureaucratic budget maximizer, maximizing the total wage bill as a foundation to extract rents to the leadership. The case with $\beta = 1$ and $r = 0$ can be interpreted as a utilitarian union with $u = w^\gamma L$, maximizing the sum of union members' utility w^γ . In the unlikely special case with $\beta = 0$, the union maximizes union rents $(w-r)$ with no consideration of employment level L (again, subject to some reasonable constraint such as non-negative profits).

These two examples illustrate a simple and forceful principle – what we call the Hawk-Dove divide: Coordinating substitutes induces militancy, coordinating complements induces acquiescence.

This Hawk-Dove divide can arise for two distinct reasons. Firstly, it can arise from workers being substitutes or complements in production, as illustrated by the miners' union versus the railroad union. More generally, consider a group of workers in a specific firm, say steel workers. Other metal workers in similar firms are often substitutes to these steel workers. Construction workers supplying inputs to metal production tend to be complements, as do shipbuilding workers who use metals as inputs.

Secondly, the divide can arise when two groups of workers produce final outputs which are either substitutes or complements in demand. Firms within the same industry are again likely to produce outputs that tend to be substitutes in demand, implying that an increase in production by any of the firms will reduce the output price and employment for each of them. Firms in different industries, in contrast, produce outputs that are more likely to be complements in demand.

In collective wage bargaining, unions are likely to be aware of whether labor and output are complements or substitutes, and incorporate this in their wage policies and industrial actions.⁶ The Hawk-Dove divide has implications also for the likelihood of conflicts between employers and unions, as the willingness to be aggressive is affected by whether unions incorporate the interests of their substitutes or their complements. The frequency of industrial actions, as measured by working days lost in wage conflict relative to the workforce, should therefore be highest when the union association primarily organizes substitutes.

⁶Horn and Wolinsky (1988) provide an insightful discussion of how the pattern of unionization depends on worker substitutability.

Meanwhile, high levels of centralization may likely lead to low levels of industrial action, since centralization beyond a certain level (vertically or horizontally) involves coordination across complements. A negative association between conflicts and centralization is consistent with data both across countries and over time, as was first demonstrated by Hibbs (1978). For example, between World Wars I and II, Sweden and Norway had little coordination in the wage setting and record-high numbers of strikes and lockouts. After World War II, however, wage setting became increasingly centralized, extending cooperation to complementary workers and sectors in both countries, and there were remarkably few strikes and lockouts in accordance with a more acquiescent union attitude.

That coordination can produce acquiescence can also be seen from the impact of wage increases on prices. At the industry level, a higher wage raises the relevant producer price more than the consumer price index (which by construction reflects all prices). This imbalance can induce aggressive wage aspirations at the industry level since the costs of job losses becomes lower from every improvement in the consumer real wage. Further coordination, however, leads to acquiescence, since the impacts on producer and consumer prices become more in line as the agreements incorporate more unions and sectors.

The Salience of Union Wage Restraints

As argued above, wage restraint can be an important outcome of comprehensive coordination of wage aspirations. Increasing cooperation by incorporating different types of workers or different types of industries motivates wage moderation, to prevent either too high price effects or direct job-losses among members in collaborating unions. Only when coordination shifts from the firm-level to the industry-level – when unions demand a common wage for workers who are each other's substitutes – does centralization imply militancy, with higher wages and lower employment. This observation is often missed in the discussion of collective bargaining, where it is frequently claimed that more centralized

union power necessarily leads to higher wages and lower employment (see for example, Baird 1984; Lindbeck and Snower 1989).

When price externalities dominate and unions coordinate vertically, both completely decentralized and centralized systems of wage bargaining can give a similar level of union wage aspirations with price-taking firms. The trade-off between real pay and jobs becomes similar in the two cases. When wages are set at the industry level, in comparison, a wage rise is less costly to the union, and it has reason to aspire for higher nominal wages. Hence, centralization can affect real wages and employment in a non-monotonic manner.

A similar result from vertical coordination also applies when employment externalities dominate. At the industry level, coordination leads to aggressive wage demands as all substitutes receive the same wage. Further coordination across branches of industries involves more coordination across complements and hence more acquiescence.

The empirical literature that aims to test whether the relationship between centralization of collective bargaining and aggregate employment or real wages is hump-shaped or monotonic has mostly relied on cross-country comparisons. In early examples, Calmfors and Driffill (1988) and Freeman (1988) found some evidence in favor of a hump-shape, while later studies have concluded differently. To date, the evidence remains mixed (for an overview of evidence, see Calmfors 2001, Table III and Moene et al. 1993).

Key challenges in such empirical analyses are how to define a metric of centralization, how to classify each country according to this metric, and how to rule out correlated factors. For instance, Switzerland is sometimes ranked highly centralized and sometimes highly decentralized, as employers do not officially coordinate their wage offers but may do so tacitly. Japan's system of enterprise bargaining is sometimes classified as highly decentralized, while others put more weight on the coordinated wage setting across types of

workers at the level of the enterprise and classify the system as centralized. The small number of observations implies that the classification of a few countries determines the overall pattern of performance – and thus whether there is a hump-shape or not.

It should also be noted that theory may predict a less pronounced hump-shape, or no hump at all, if the output market is characterized by monopolistic competition. In that case, completely centralized and decentralized wage bargaining no longer produce the same outcome. When wages are set at the firm level, a higher wage has some impact on the output price of the firm, leading to more aggressive nominal wage setting also in the decentralized case. In this context, it is also important to recall that horizontal coordination normally yields monotone wage moderation as wages are coordinated across different types of workers who are complements in either production or in demand.

Given the weak empirical and theoretical basis for a hump-shape, we argue that wage restraint is the most salient implication of the theory of coordinated wage aspirations. This insight is also in line with experiences from small open economies in Europe, where collective wage coordination is most prevalent.

Effort, Flexibility, and Investment with Central versus Local Wage Bargaining

An important cost of centralization stems from the weak flexibility and work incentives that result when wages are set independently of local performance. Conversely, an obvious advantage of decentralized collective wage bargaining is how local bargaining works as revenue sharing that can provide powerful incentives. Local bargaining can reward local initiatives including work effort, flexibility, and skill upgrading. However, while local bargaining in the form of revenue sharing can reward current work effort and flexibility, it is likely to perform less well when it comes to the use of inputs that are sunk cost at the time of wage setting.

To illustrate these differences between local and central wage bargaining, it is useful to consider a simplified representation of the process of creative destruction. Consider therefore the stylized case where the newest technology, embodied in the newest vintages of equipment, displaces older technologies in older vintages (for an in-depth analysis of wage coordination and creative destruction, a useful starting point is Moene and Wallerstein 1997).

Once investments are made, they are sunk costs and the equipment stays in use till it becomes economically obsolete. At any point in time, there is a distribution of plants from the newest ones with the best technology to the oldest ones which just cover variable costs. As new technologies emerge, changes take place by entry of new plants and exit of old ones.

In such a setting, local bargaining means that wages are determined as a share of value added at the local plant. Even wages for homogeneous labor will thus differ across plants, with the highest wages in the most productive new plants and the lowest wages in the least productive old plants. Compared to the case with industry bargaining, which gives a uniform wage to all homogeneous workers tied to the average productivity in the industry, local bargaining works as a kind of low-wage subsidy to old inefficient plants and as a high-wage tax on the new productive plants. Therefore, firms may under-invest in new technologies and keep old equipment longer than socially optimal. Industry bargaining, in contrast, works as a tax on the least productive units and as a subsidy on the most productive. In this case, firms have incentives to invest more in modern technologies and in scrapping the old ones at an earlier stage.

Both cases may lead to a steady state with the same average growth in wages, determined by the rate of technological improvements. Yet, there are clear differences. Collective industry bargaining is expected to lead to a modernized industry with high average productivity and an egalitarian wage distribution across firms. Local bargaining should lead

to a less modernized industry with a somewhat lower average productivity and with a more inegalitarian wage distribution.

Thus, the bargaining system that is best for local work effort can in some respect be worst for local investments. Similarly, the flexibility entailed in local wage bargaining may work well in the case of temporary changes that require local temporary adjustments, while it may work less well with permanent shocks that require permanent adjustments. Local wage adjustments to local conditions can postpone necessary adjustments to permanent changes, delaying necessary restructuring of enterprises and industries. Advancement in one dimension can be an impediment in another. Can the two extremes be combined? This is the question of interest in the next section.

Export Led Two-Tier Bargaining in a Small Open Economy

The wage setting practices in many small open economies in Europe, such as Norway and Sweden, are canonical examples of two-tier bargaining. In these countries, the collective bargaining system is designed to raise the competitiveness of the national economies by pursuing union wage moderation in the sectors most exposed to international competition.

Export-led Cooperation

In Norway and Sweden, the coordinated wage-setting system came as a response to the world crisis in the 1930s. It started with a conflict over wage cuts within the union movement between sheltered and exposed unions – who were complements in both production and demand. Export-producing metalworkers stood against equally militant construction workers who to some extent were sheltered from direct foreign competition in output markets. Yet, the construction workers did produce inputs to exporting industries. During the 1930s, the metalworkers had to accept large wage cuts to stem the decline in employment. To convince construction workers to take wage cuts (to prevent high input prices for exporting industries), employers provided a helping hand: The national association

of employers intervened with threats of lock-out if the construction workers did not follow the wage moderation of the metalworkers.

This was the initial step in a process of centralization of authority within the union movement in both Norway and Sweden, a process that was encouraged and supported by employers. Thus, the political coalition that prevailed in these countries after World War II—and established the so-called “centralized solidarity bargaining” system—was comprised of export-oriented workers and employers. It is unlikely that the export-oriented unions and the leadership of the union confederation would have been able to force the other high-wage unions to accept an egalitarian wage policy without the backing of employers and the threat of lockouts by employers against recalcitrant unions.

This export-led pattern-bargaining, in which unions in the export sector set the pattern for the development of wages in the rest of the economy, is controversial both in theory and in practice. Theoretically, the term “pattern bargaining” has changed over time. In the early use (Webb and Webb 1897), “pattern bargaining” referred to a strategy where the most profitable industries and enterprises went first to set a pattern, to raise the wages of all workers. However, export-led pattern-bargaining is a strategy where the industries and enterprises most exposed to international competition go first to set a pattern that lowers wages, or restrains the wage increases to all workers.

There is also no consensus about just how unions of export firms can persuade unions in other firms to restrain the wage increases of their members. Is it a first mover advantage or a repeated game argument that explains it? A form of collective rationality? Our best interpretation is simply that the role of employers remains important for maintaining the system. If some unions or industries break out from the pattern, the employers are likely to respond with threats of lock-out. Another potentially important mechanism is the role of government authorities who can take non-cooperating industries and enterprises to a

“compulsory pay board” if their wage demand exceeds the export-led pattern by too much. In fact, some Norwegian unions have brought complaints to the Administrative Tribunal of the International Labour Organization (ILO) that an overuse of the “pay board,” in an attempt to coordinate wage setting, violates the freedom of labor organization. Workers in the non-export industries, whose wage increases are implicitly set or constrained by the exporting industries, often complain that they are lagging behind in the rise of real wages.

Nevertheless, export-led pattern-bargaining is frequent. Not just in the Scandinavian countries; other small open economies in Europe have also established a similar coordinated arrangement. The practice points to the possibility that unionized interests can raise the overall competitiveness of the economy.

A recent test of how export-led pattern bargaining works is performed by Barth et al. (forthcoming), showing how union associations in countries with a high level of wage coordination have prevented local unions, sheltered from international competition, from reaping market power gains and raising their wages relative to workers in more exposed industries. They exploit within-country variation in exposure to trade with China in 13 European countries and find a clear pattern: In countries with wage coordination, local regions exposed to import competition from China experience no fall in employment, while in countries with uncoordinated wage setting, local regions that are exposed to import competition experience a clear fall in employment, mainly due to a reduction in manufacturing employment.

Local Supplementary Bargaining

In Scandinavian countries, the introduction of centralized systems of wage setting was later supplemented by local adjustments. The union locals wanted a say. This supplementary bargaining increased worker autonomy and the extended workplace democracy. Extreme centralization of wage setting therefore went hand in hand with decentralized work

involvement and influence at the local level, where union leaders became substitutes for foremen and leaders at the intermediate level.

Our preferred interpretation of the details of Scandinavian two-tier bargaining is that central wage setting – the determination of the base wage q – is captured by the union wage aspirations as discussed above, while the supplementary bargaining at the local level provides wage drift d , implying that the local wage is $w = q + d$.⁷

The wage drift is best understood as a form of negotiated revenue-sharing at the level of the firm or the plant. At this local level, however, there are restrictions on the degree and type of industrial conflict. Norway and Sweden have a “peace clause” in the main agreements between the peak associations of labor and capital, which forbids strikes and lock-outs between the time when a central agreement is reached and the start of the negotiations for a new agreement. The implicit threats that can be used at the local level are therefore restricted to “work-to-rule” actions, in which workers slow production via strict observation of the letter of the rules, without reducing production by so much that the firm responds by laying off workers. This approach will plausibly yield the local unions a lower revenue share than they would have obtained with viable strike threats.

The restriction on the local use of industrial conflicts in a two-tier system has two major implications. First, it ties wages to local productivity, but with a lower elasticity than in the pure local bargaining case in which strikes are permitted, as the share of the revenues that the union obtains is lower. Nevertheless, a linkage from local wages to firm profits can create some incentives for good work performance and involvement at the firm level. Second, pure local bargaining runs a risk of subsidizing old and inefficient firms with lower

⁷ The definition of the term “wage drift” varies across papers. It is sometimes defined as the difference and other times as the change in the wage actually paid to a worker as compared to her base wage. Throughout the paper, we let wage drift denote the difference (not the change) in the wage actually paid to a worker as compared to a base wage.

wages, while imposing an implicit tax in the form of higher wages on firms that make productive new investments. Two-tier bargaining can therefore strike a balance between the concerns for work incentives and investment incentives.

Does the flexibility of two-tier bargaining lead to the same outcomes as decentralized collective bargaining? Particularly when the drift is high relative to total changes in wages, it might seem as though the answer is ‘yes’. But on the contrary, we argue that the two-tier system functions as a centralized system of wage setting irrespective of whether the supplementary wage increases are higher than the centrally negotiated base wage increases or not. At the central level, the negotiators can foresee (or make a qualified guess on) the average wage drift that will come on top of the centrally negotiated base wage, and they can incorporate this drift in their wage aspirations. Obviously, they can only incorporate the typical or average drift, implying that workers in the most productive enterprises obtain a higher wage than what lies in the implicit bargaining goal, while workers in less efficient firms obtain less than the bargaining goal. Nevertheless, the structure and level of wages are determined by the union aspirations at the central level. Holden (1998) offers an in-depth theoretical and empirical discussion of both wage drift and downward wage rigidity under centralized bargaining in the Nordic countries.

Empirical Illustrations in the Case of Norway

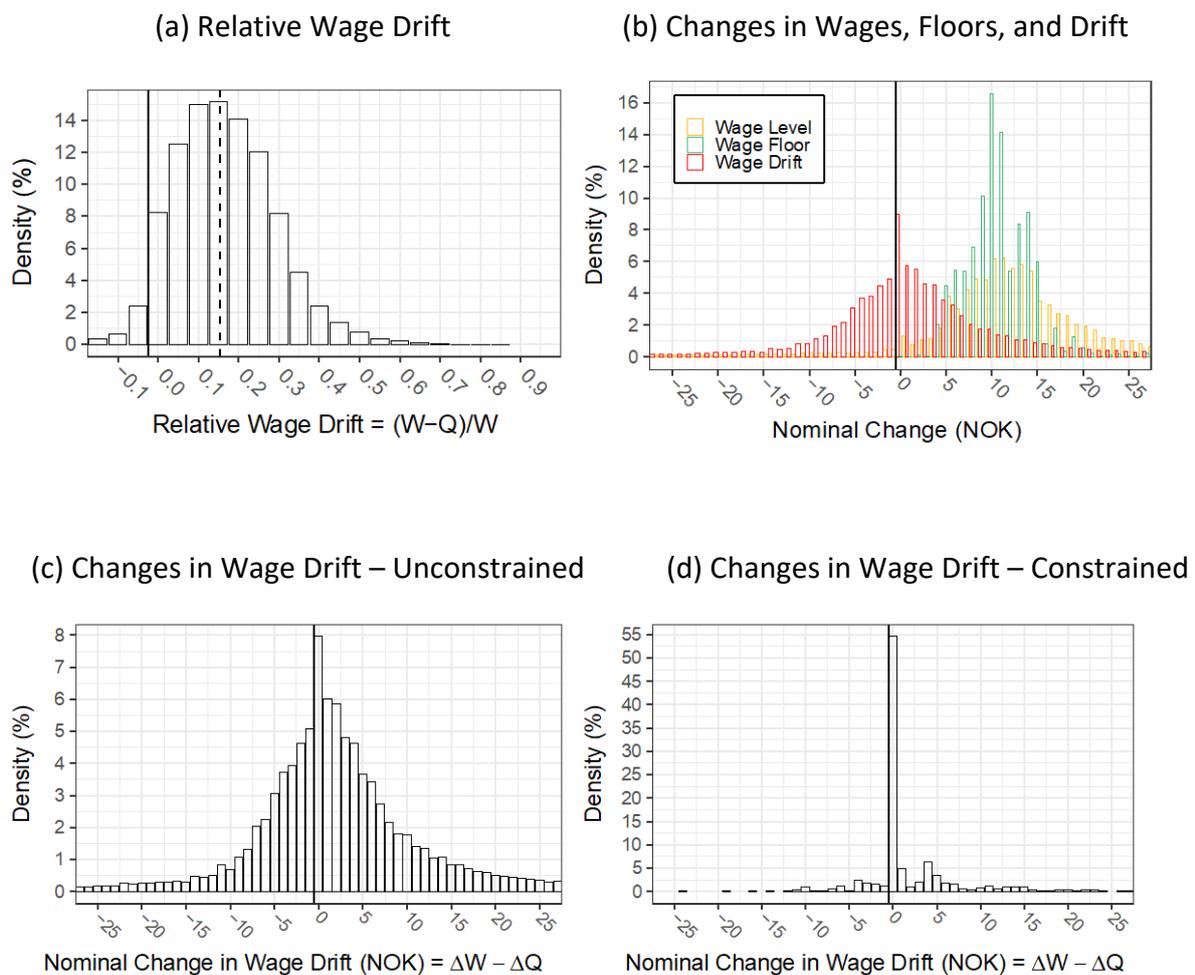
We now draw on high-quality micro data to illustrate the “anatomy” of the wage setting in Norway, a small open economy with a two-tier bargaining system.⁸ We present empirical evidence on (i) composition of wages and changes in wages, (ii) wage inequality within and between industries, and (iii) pattern bargaining. The goal is to tie the theory of collective bargaining discussed above to the wage structure we observe in an actual economy.

⁸ Details about data sources, variables, and the procedure for linking of individual workers to job-specific wage floors are provided in the Appendix. See also Card and Cardoso (2021), who are using similar data to analyze the collective bargaining system in Portugal.

Wage Floors and Drift with Two-tier Bargaining

Above we emphasized how the base wage q acts as a wage floor, and that wage drift d (equal to $w - q$) is non-negative but not the same for all workers. Figure 3 confirms this pattern empirically: It shows distributions of relative wage drifts and nominal changes in wages, floors, and drifts for workers covered by a collective bargaining agreement.

Figure 3: Distributions of Wage Drift and Changes in Wages, Floors, and Drift.



Source: Our calculations based on Norwegian administrative records.

Notes: This figure shows distributions of relative wage drifts and changes in nominal wages, floors, and drifts for workers covered by a collective bargaining agreement. In panel (a), wage drifts are measured for each even year in the period 2010–2018. For each of these years, the sample includes full-time workers who did not change jobs in the same year. The figure shows wage drift measured as a fraction of total wages. The changes in panels (b)–(d) are calculated based on observed changes in nominal wages, drifts, and floors between two consecutive even years for full-time workers who did not change jobs between the two years, and reported in Norwegian Kroners (NOK). For panels (c) and (d), “unconstrained workers” are defined as workers earning wages strictly above the wage floor associated with their job in year $t-2$, while the “constrained workers” are those earning wages equal to the associated wage floor in year $t-2$. Observations of hourly wages above 2,000 Norwegian kroner, below 50 kroner, or below 20 percent of the associated wage floor are excluded.

Panel (a) of Figure 3 shows estimates of relative wage drift in Norway, using data for even years from 2010 through 2018 for workers covered by a collective bargaining agreement. The reason for looking at even years is that the main negotiations between unions and employer federations happen every even year (that is, not every year). The graph reveals that although about 10 percent of workers are paid wages equal to or close to the base wage that apply to their jobs, most workers receive substantial wage premiums above this floor. For a typical worker, this wage drift corresponds to about 15 percent of the wage.

There seems to be two types of rigidities in the Norwegian wage structure. One is about the *level* of the wage drift d , which is almost never negative (see panel (a) of Figure 3). The other is about the *changes* in wages. Nominal wages and wage floors are (almost) never adjusted downwards, likely reflecting downward rigidity in nominal wages.⁹ Panel (b) of Figure 3 shows distributions of changes in nominal wages, changes in wage floors, and changes in wage drift between two consecutive even years for a sample of job stayers. Changes in wage floors are never negative, while only about 8 percent of all workers received a nominal wage cut during a two-year period. By contrast, the distribution of changes in wage drift resembles a bell shape, albeit with a clear spike at zero and a somewhat smaller left tail than right tail.

Panels (c) and (d) show the distributions of changes in wage drifts for two separate groups of job-stayers. The “unconstrained workers” in panel (c) are workers earning wages strictly above the wage floor associated with their job, while the “constrained workers” in panel (d) are those earning wages approximately equal to the associated wage floor. Less than 5 percent of workers are constrained in this manner, which reflects the importance of wage drift in our data. The distribution in panel (c) resembles the distribution for the full sample of job stayers in panel (b), with a spike at zero showing that only 8 percent of the

⁹ Nominal wage rigidities are also evident in many other countries and wage settings. For more discussion and evidence on downward nominal wage rigidity, see, e.g., Dickens *et al.* (2007) in this journal and Grigsby *et al.* (2021).

unconstrained workers received a nominal wage increase exactly equal to the increase in their wage floor. By contrast, more than 50 percent of the workers who earned wages equal to their wage floors in the previous period earn wages equal to their wage floors also in the present one. Most constrained workers thus also remain constrained two years ahead.

Wage Inequality with Two-Tier Bargaining

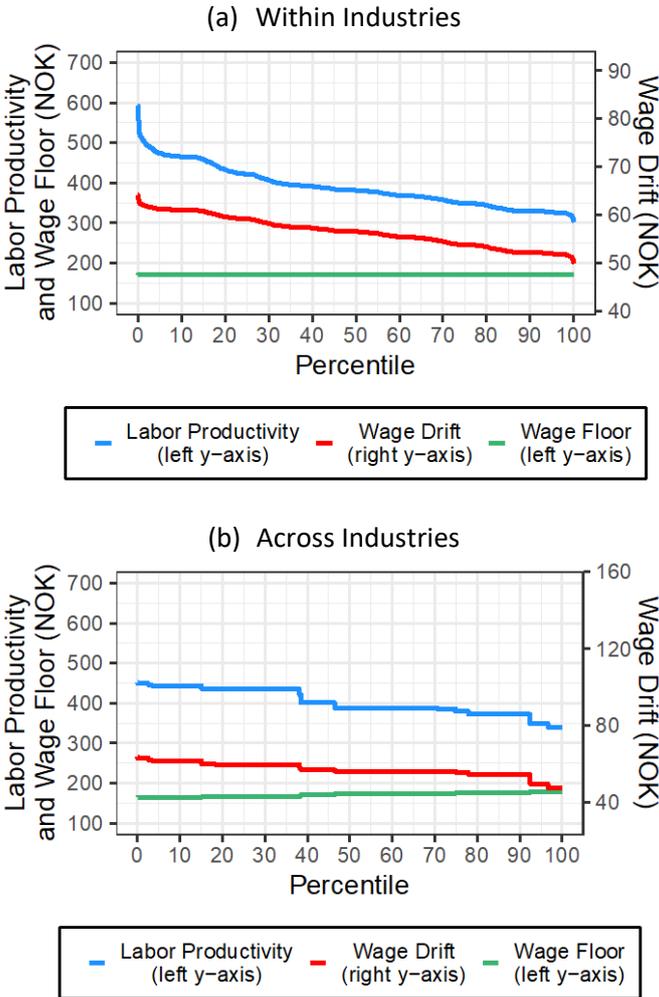
Centralized collective bargaining is likely to affect the extent of wage dispersion, both across and within industries. With Norway's strong horizontal coordination in wage setting across industries, one would expect inter-industry wage differentials for observationally similar workers to be limited. When negotiators internalize price and employment externalities across types of workers, we obtain base wages that tend towards equal pay for observationally similar workers. However, inter-industry wage differentials may persist, primarily due to systematically different quantities of wage drift in industries with different labor productivity. Indeed, a decomposition of the variance of wages between and within industries reveals that about 40 percent of the variation in wages in Norway can be attributed to differences in wages across industry-wide collective bargaining agreements.

The structure of collective bargaining should also matter for intra-industry wage differentials. Norway's strong vertical coordination should imply limited dispersion in wages across firms within the same industry. However, the two-tier bargaining structure allows for local wage supplements, which could also lead to persistent differences in wages across firms within the same industry, depending on firm-specific productivity.

Figure 4 explores the relationship between wages and labor productivity within and across industries. We define firm average labor productivity as firm revenues minus input costs and changes in the value of stock of produced goods. Wage floors and drifts are measured net of observable worker characteristics and workers are sorted by labor productivity, with workers employed in the most productive firms to the left and workers employed in the

least productive firms to the right. Panel (a) shows intra-industry differences in labor productivity, wage floors, and wage drift for all collective bargaining agreements covered by our sample (net of average differences across agreements). Note that both labor productivity (blue line) and wage floor (green line) are indexed in Norwegian Kroners (NOK) along the left y-axis, while wage drift (red line) is shown along the right y-axis.

Figure 4: Labor Productivity, Wage Floors, and Wage Drift.



Source: Our calculations based on Norwegian administrative records.

Notes: This figure shows average labor productivity, wage floors, and wage drift by percentiles in the worker-weighted distribution of labor productivity, ranked in descending order, with wage floors and drifts measured net of observable worker characteristics. The lines are estimates from kernel (local constant) regressions of labor productivity, wage floors, and wage drift, respectively, on percentile group indicators. Panel (a) shows firm/worker level measures (net of differences across collective bargaining agreements) for firms and workers covered by any of the 18 collective bargaining agreements in our sample. Panel (b) shows agreement level average labor productivity, wage floors, and wage drifts. Labor productivity, wage floors, and wage drifts are measured for each even year in the period 2010–2018 (net of differences across years), and for each of these years, the sample includes firms with at least 5 workers in the relevant year and positive

value added in the surrounding 5-year period. The sample of firms is truncated at the 5th and 95th percentile in the distribution of labor productivity. Wage floors and drifts are measured for all full-time workers between the ages of 25 and 60 who did not change jobs in the relevant year, and wages are winsorized at the 2.5th and 97.5th percentiles.

This figure illustrates two key features of a collective wage setting system with two-tier bargaining. First, the centrally negotiated base wage establishes a common wage floor in each industry. Second, the locally negotiated wage drifts produce significant differences in wages across workers within the same industry, depending on the productivity of the firm they are employed in. As the theory predicts, the least productive firms pay wages that are approximately equal to their labor productivity, while the most productive firms pay wages that are much lower than labor productivity, earning positive (quasi)rents on the workers. This evidence is consistent with how two-tier bargaining can reflect a compromise between work and investment incentives, as discussed above.

Panel (b) of Figure 4 shows the relationship between average wages and average labor productivity *across* industries. Consistent with the theory of how wage coordination across workers who are complements (in production or in demand) leads to wage restraint, there is little evidence of a systematic relationship between the wage floors and the average productivity of the industries. If anything, moving from high- to low-productivity industries, we see a decline in average wage drifts and a slight increase in wage floors. This pattern is consistent with a wage-setting system in which the base wage is set slightly higher in industries where one expects a lower average drift. Overall, the relatively small differences in wage floors across high- and low-productivity industries can be interpreted as evidence of strong horizontal coordination across industries in Norway's collective bargaining system.

A concern with Figure 4 is that it only uses cross-sectional data, which means that the wage differentials may reflect unobserved differences in the quality of workers. Interestingly, if we instead use the panel data available to us in this setting to study the relationship between wages and changes in productivity within and across industries, we find similar patterns.

Positive productivity shocks are associated with higher wages, regardless of whether the shocks are common to all industries, specific to certain industries, or specific to certain firms within an industry. And while common productivity shocks tend to raise wages primarily through adjustments of wage floors, industry- and firm-specific shocks are transmitted to wages in the form of changes in the locally negotiated wage drift.

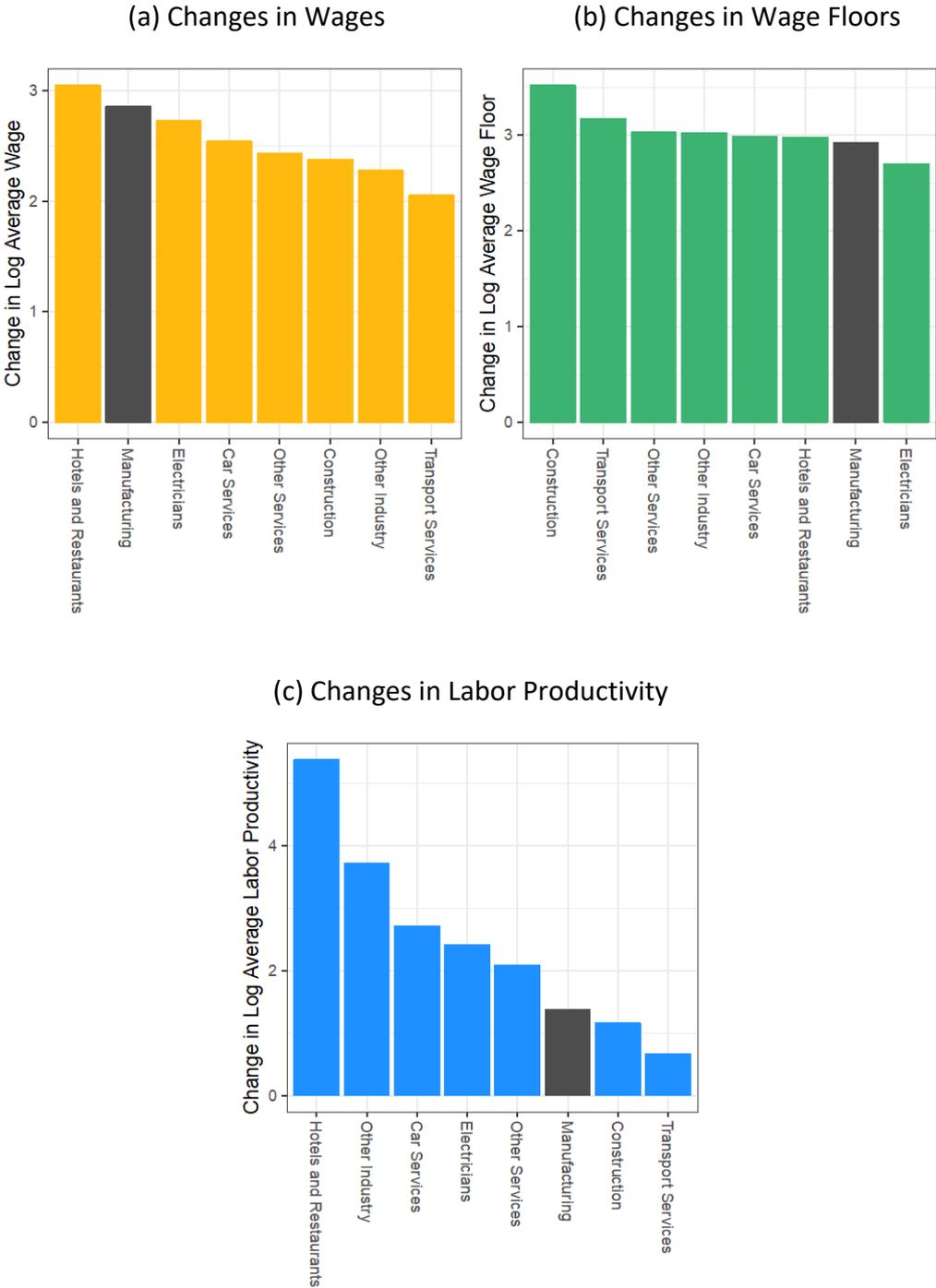
The Salience of Pattern Bargaining

Our discussion about export-led coordination has highlighted how this type of pattern bargaining can allow the industries and enterprises most exposed to foreign competition to set a pattern of wage increases that applies to the rest of the economy. In the Norwegian context, export-oriented manufacturing has traditionally functioned as the “front runner” in the centralized collective bargaining system, so that the wage settlements in the manufacturing agreement set norms for wage settlements that take place in the other collective bargaining agreements (for a historical overview of this “front runner” system, see Nymoene 2017, Section 2.5).

In Figure 5, we focus on eight major industries, where each industry can have multiple collective bargaining agreements. Panel (a) shows annual growth rates in mean wages, averaged between years 2010 and 2018, for each industry. Consistent with manufacturing being the “front runner,” we find the second highest average wage growth in this industry. By comparison, panel (b) suggests limited differences in the growth rates of negotiated wage floors across industries. The ‘wage growth premium’ in favor of the manufacturing industry becomes even more striking when we consider industry differences in the growth of mean labor productivity in panel (c), where manufacturing has had among the lowest growth rates. Despite the low growth in manufacturing productivity, Norwegian manufacturing has been able to retain a high growth in mean wages. We interpret this as empirical support of a strong influence of export-led pattern bargaining in the Norwegian system of collective bargaining. The sustainability and economic consequences (e.g., in terms of (mis)allocation

of labor, aggregate productivity, wage inequality) of this system are important but largely unresolved questions.

Figure 5: Annual Changes in Average Wages, Wage Floors, and Labor Productivity.



Source: Our calculations based on Norwegian administrative records.
 Notes: This figure shows annual changes in the log of collective bargaining agreement-level average wages, wage floors, and labor productivity for different groups of agreements. Average wages, wage floors, and labor productivity are measured for each even year in the

period 2010–2018, and changes in the log of these averages are calculated for each pair of successive even years. The annual changes shown in the figure are obtained by dividing the two-year changes by two and multiplying by 100. For each even year in the period 2010–2018, the sample includes firms with at least five workers and positive value added in the relevant year. The sample of firms is truncated at the 5th and 95th percentile in the distribution of labor productivity. Wage floors and drifts are measured for all full-time workers between the ages of 25 and 60 who did not change jobs in the relevant year, and wages are winsorized at the 2.5th and 97.5th percentiles. The collective bargaining agreement groups are defined as follows: Manufacturing – Manufacturing, Textile and Confection, Technology and Data; Other Industry – Cartonage, Meatpacking Industry, Construction Materials Industry; Construction – Construction Trades, Private Construction Contractors; Electricians – Electricians Trade; Car Services – Car Services; Transport Services – Bus Industry, Freight Forwarding, Transport Firms; Hotels and Restaurants – The National Agreement (for hotel and restaurant workers); Other Services – Cleaning, Private Security.

Concluding Remarks

In this article, we documented and discussed salient features of collective bargaining systems in the OECD countries, with the goal of debunking some misconceptions and myths and revitalizing the general interest in wage setting and collective bargaining. We hope that such an interest may help close the gap between how economists tend to model wage setting and how wages are actually set. The textbook models of competitive labor markets, monopsony, and search and matching, all assume a decentralized wage setting where individual firms and workers determine wages. In most advanced economies, however, it is common that firms or employer associations bargain with unions over wages, producing collective bargaining systems. The characteristics of these systems vary substantially across advanced economies, with regards to both the scope and the structure of the collective bargaining.

Understanding the causes and consequences of different wage setting practices and work organization has a long history in labor economics. However, these questions have, over time, become less fashionable. Instead, many labor economists have shifted attention to understanding the relative importance of individual determinants of wages given the wage-setting practice in the economy of study.

For example, in the context of the lightly unionized US economy, numerous studies have sought to identify a causal effect of the union wage premium—that is, how much more an

otherwise identical American worker is paid as a result of union membership. Much effort has gone into improving the research design of such studies.¹⁰ While these improvements have been important, the results of these kinds of quasi-experimental studies are only informative about how a marginal increase in union membership, given the wage-setting practices in the American economy, would benefit the workers entering a union.

More generally, a study focused on changing an individual determinant of wages, while holding the overall system of wage setting fixed, cannot tell us about the systemic effects of broader changes in the wage setting system. We suspect that real progress in the study of wage setting institutions broadly understood will require a shift in research towards careful modeling of the actual institutional setting and tighter connections between data and theory.

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¹⁰ Ashenfelter (1978) constructs control groups for union members based on industry, race, and worker type (like craftsmen, operatives, laborers); Freeman (1984) compares wage rates for the same individual who changes unionization status over time; Lemieux (1998) compares wage rates for the same individual who holds two jobs, one of which is unionized, and the other is not; Krashinsky (2004) compares wage rates of identical twins, one who is unionized and one who is not; DiNardo and Lee (2004) use a regression discontinuity design that takes advantage of the fact that new unionizations often occur as a result of a secret ballot election.

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Appendix

We provide here an overview of data sources, sample selection and variables used in our analysis, and describe the procedure for assigning job-specific wage floors to workers.

Data and Sample Selection

The Norwegian register data allow us to construct a long population panel dataset containing information on industry, occupation, labor earnings, contracted hours, and the number of days worked for each job spell. We also observe each establishment's membership in employer associations and its collective bargaining coverage, and we have information from firm-level income statements and balance sheets, including revenue and cost of inputs. On top of this, we have collected and digitized detailed information from collective bargaining agreements. This enables us to link individual workers to the collective bargaining agreements and wage floors that apply to their jobs.

Microdata on workers' earnings and employment histories is drawn from Norwegian administrative registers (Statistisk sentralbyrå, 2010; 2020a; 2020b), while hourly wage measures were constructed based on Statistics Norway's Wage Statistics Surveys (Statistisk sentralbyrå, 2011). We have collected information on establishments' membership in employer associations and their collective bargaining coverage directly from employer associations (NHO, 2022), while firm-level income statements and balance sheets are obtained from the Register of Company Accounts (Statistisk sentralbyrå, 2020c). Finally, we have collected a large number of agreement documents from the historical archives of the Confederation of Norwegian Enterprise (NHO), the Norwegian Labor Movement Archives and Library (Arbark), and the Fafo Institute for Labour and Social Research.

In our empirical analysis, we focus on the period from 2010 to 2018, where we can study firms and workers covered by one of the 18 major private sector collective bargaining

agreements in Norway. While these agreements do not represent the universe of private sector collective bargaining agreements, they do represent heterogeneous workplaces and workers, with covered industries including the manufacturing and construction industries as well as service-oriented industries such as transportation and hotels and restaurants. Each agreement contains a set of wage floors for workers in different occupations, and adjustments of these wage floors is one of the key outcomes of the sectoral negotiations. We observe wage floor adjustments after the sectoral negotiations in every even year, when the collective bargaining agreements are subject to major revisions (*"Hovedoppgjør"*).

Table A.1 provides an overview of the steps we take to construct the samples used in our empirical analysis. Our initial data extracts consist of full-population employment records drawn from Norwegian registers for even years between 2010 and 2018 (Statistisk sentralbyrå, 2000a). We then restrict attention to private sector jobs that can be linked to Statistics Norway's Wage Statistics Survey (Statistisk sentralbyrå, 2011). This survey provides data on monthly earnings and hours of work that we use to construct measures of hourly wages. Restricting further to each worker's main job spell, workers with non-missing occupation, full-year and full-time workers, and ages 25–60, we retain about half of the linked employer-employee-wage survey sample.

Next, we restrict our sample to private establishments that are covered by at least one collective bargaining agreement. For this purpose, we use restricted-access data on whether an establishment was a member of an employer association, and, if so, which agreement(s) it was covered by in each year from 2010 to 2018. Further, we exclude managers and white-collar workers who are typically covered by firm-level agreements or sectoral agreements without wage floors (*lederavtaler, funksjonæravtaler*, and similar agreements). In the remaining sample of (predominantly blue-collar) workers, around 15% are covered by one of the 18 private sector collective bargaining agreements.

Table A.1: Sample Selection.

	Sample Size:		
	Observations	Workers	Firms
Initial Data Extracts: Private Sector Job Spells ¹	8,452,183	2,452,406	257,535
Matched to Wage Statistics Survey	4,459,513	1,907,305	164,087
Additional Sample Restrictions:			
Main Job Spell ²	4,058,574	1,817,436	153,650
Non-missing Occupation	4,025,432	1,811,759	153,541
Full-time Workers ³	2,792,828	1,303,117	128,027
Full-year Workers ⁴	2,204,261	1,054,376	97,130
Workers Aged 25 to 60	1,966,733	944,485	92,899
Establishments Covered by Collective Bargaining	1,125,972	517,031	12,124
Excluding Managers and White-Collar Workers ⁵	807,247	393,157	11,288
Workers Assigned Job-Specific Wage Floors ⁶	117,123	66,283	2,538
Matched to Firm Balance Sheets	115,289	65,401	2,490

Notes:

The initial sample consists of administrative employment records for even years between 2010 and 2018.

1 Each job spell is uniquely identified by a combination of person ID, establishment ID, and calendar year.

2 Main job is defined as the job spell with the highest annual earnings.

3 Full-time is defined as working more than 35 hours per week.

4 Full-year is defined as having the same job throughout the year.

5 Workers with an occupational code (ISCO-08) that starts with either 1 or 2.

6 Workers covered by one of the 18 agreements that were transcribed and linked to our microdata as part of this project.

Table A.2: Overview of Variables.

Variable Name	Notation	Definition	Data Source	Used in the Paper
Contracted Hourly Wage	$W_{i,t}$		Wage Statistics	Figure 3:(b)–(d)
Total Hourly Wage [†]	$\tilde{W}_{i,t}$		Wage Statistics	
Contracted Wage, Log	$W_{i,t}$	$\ln(W_{i,t})$		Figures 5:(a)
Total Hourly Wage, Log	$\tilde{W}_{i,t}$	$\ln(\tilde{W}_{i,t})$		
Wage Floor	$Q_{i,t}$		Transcribed agreements	Figures 3:(b)–(d),4:(a)–(b)
Wage Floor, Log	$q_{i,t}$	$\ln(Q_{i,t})$		Figures 5:(b)
Wage Drift, Absolute	$D_{i,t}$	$W_{i,t} - Q_{i,t}$		Figure 3:(b)–(d)
Total Wage Drift, Absolute	$\tilde{D}_{i,t}$	$\tilde{W}_{i,t} - Q_{i,t}$		Figure 4:(a)–(b)
Wage Drift Relative to Contracted Wage	$d_{i,t}$	$D_{i,t}/W_{i,t}$		Figure 3:(a)
Total Wage Drift, Relative to Wage Floor	$\tilde{d}_{i,t}$	$\tilde{W}_{i,t} - q_{i,t}$		
Firm Revenues	$R_{i,t}$		FirmAccounts	
Firm Input Costs	$C_{i,t}$		FirmAccounts	
Firm Change in Stock of Produced Goods	$\Delta G_{i,t}$		FirmAccounts	
Firm Wage Bill	$B_{i,t}$		FirmAccounts	
Value Added	$Y_{i,t}$	$R_{i,t} - C_{i,t} - \Delta G_{i,t}$		
Firm Mean Wage	$\overline{W}_{i,t}$	$E[\tilde{W}_{i,t} i \in I_{i,t}]$		
Firm Labor Hours	$L_{i,t}$	$B_{i,t}/W_{i,t}$		
Value Added per Hour	$P_{i,t}$	$Y_{i,t}/L_{i,t}$		Figure 4:(a)–(b)
Value Added per Hour, Log	$p_{i,t}$	$\ln(P_{i,t})$		Figures 5:(c)

Note: [†]Total hourly wage and total wage drift include bonuses/commissions and irregular individual wage supplements (*uregel/messigetillegg*).

With these restrictions, our final sample consists of about 66,000 workers and 2,500 firms. We attach a job-specific wage floor to each worker, using information on occupation and the establishment's collective bargaining agreement coverage, as described below. Further, we can link the information on wages and wage floors to firm-level measures of value added for almost all of these workers.

Table A.2 gives an overview of the variables used in our analysis, providing information on how each variable is defined, its data source and where in the main part of the paper the variable is used. Using data from the Wage Statistics Survey, we can distinguish between contracted hourly wages and total hourly wages, where the latter includes bonuses or commissions as well as irregular individual wage supplements. Using information on hourly wage rates together with the job-specific wage floor assigned to each worker, we construct measures of wage drift. We obtain measures of each firm's value added and total wage bill from company accounts, and use these measures together with each firm's mean wage to construct a measure of value added per hour.

Assigning Job-Specific Wage Floors to Workers

In the following, we describe the procedure used to assign job-specific wage floors to workers. Due to data availability, we focused on the 18 major private sector collective bargaining agreements in Norway. These were negotiated between employer associations organized in the largest employer federation, the Confederation of Norwegian Enterprise (NHO), and labor unions organized in the largest labor union confederation, the Norwegian Confederation of Trade Unions (LO). We hand-collected the collective bargaining agreements from historical archives, where each agreement is available as a separate document for all even years between 2010 and 2018.

Most collective bargaining agreements prescribe a series of wage floors, differentiating between workers by occupation, tenure, and vocational certification (Statistisk sentralbyrå,

2000b; 2001). The first step in assigning wage floors to workers involved transcribing information on the negotiated wage floors and associated agreement coverage features. The latter includes textual information describing the prerequisites for being covered by a wage floor, such as occupational categories, tenure categories, and requirements on whether or not the worker has a vocational certificate. This textual information was categorized in a systematic manner so that each of the wage floors prescribed in the collective bargaining agreements could be associated to a set of 7-digit occupation codes. The 7-digit occupation codes are from the Norwegian Occupational Catalogue (STYRK-98), which is more detailed than the 4-digit International Standard Classification of Occupations (ISCO-08). This procedure produced a data set of wage floors associated with occupation codes, detailed tenure categories, and vocational certification requirements.

The next step required linking wage floors to microdata on workers and establishments. To implement this step, we used information on whether an establishment was a member of an employer association, and, if so, which collective bargaining agreement(s) it was covered by in each year between 2010 and 2018. Notably, whenever an establishment in Norway is covered by a collective bargaining agreement, this agreement must apply to all its regular workers irrespective of their trade union membership. Managers and white-collar workers are typically covered by other agreements or have considerably more wage flexibility. As discussed in the sample selection, we remove these workers from our analysis. By combining the information on agreement coverage with data on workers' occupation, tenure, and vocational certification, we were thus able to assign job-specific wage floors to workers.

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