Coordination of Hours within the Firm

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Abstract

Although coworkers are spending an increasing share of their working time interacting with one another, little is known about how the coordination of hours among heterogenous coworkers affects pay, productivity and labor supply. In this paper, we use linked employer-employee data on hours worked in Denmark to first document evidence of positive correlations between wages, productivity and the degree of hours coordination – measured as the dispersion of hours – within firms. We then estimate labor supply elasticities by exploiting changes made to the personal income tax schedule in 2010. We find that hours coordination is associated with attenuated labor supply elasticity and spillovers on coworkers not directly affected by the tax change. These spillovers lead to a 3.3% decrease in tax revenues from the 2010 tax reform, and if ignored, they induce substantial downward bias in estimates of the labor supply elasticity. We explain these findings in a framework in which differently productive firms choose whether to coordinate hours in exchange for productivity gains, leading more productive firms to select into coordinating hours and to pay compensating wage differentials.

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1 Introduction

In recent decades firms have become more collaborative, with coworkers spending a greater share of their working time interacting with one another (Delarue et al., 2008; Cross and Gray, 2013). One key aspect of the cooperation within firms is that it necessitates some degree of coordination of hours. Specifically, a greater need for interaction may require that coworkers work a more similar number of hours, despite possibly different labor supply preferences. While existing studies suggest that greater cooperation is associated with improved worker productivity (e.g., Hamilton et al., 2003; Chan, 2016), little is known about how hours coordination affects worker behavior or firm performance.

However, a better understanding of hours coordination is important for at least two reasons. First, coordination ties together the hours supplied by heterogeneous coworkers, and in doing so, it distorts the effects of policies that affect only the labor supply of a group of workers in a firm. In fact, coordination restrains the ability of the workers who are targeted by a policy to change their supply of hours. At the same time, it generates labor supply spillovers from changes in the hours of targeted workers to other coworkers. In the specific case of tax reforms, these distortions result in changes in tax revenues collected and provide a new explanation for the low elasticity of labor supply found in several other studies (e.g., Chetty, 2012). Second, to the extent that hours coordination improves productivity but requires that firms pay compensating wage differentials for offering a limited choice of hours, the study of coordination may help explain the observed link between productivity and wages in a firm (e.g., Card et al., 2018).

In this paper, we first document the features of coordinated firms. We use unique linked employer-employee data from Denmark to measure hours coordination and to shed light on how this correlates with other firm characteristics, including wages and productivity. Next, we explore how coordination distorts the effects of a policy intervention by studying the labor supply response to a Danish tax reform that predominantly affected high-income workers. The specific features of this reform, combined with the richness of the Danish data, provide a rare opportunity to quantify the effects of hours coordination on the labor supply and on tax revenues.

We conceptualize the link between firm profitability, hours coordination, wages and labor supply elasticities in a framework in which firms with different productivity employ workers with heterogeneous desired work hours. In this framework, firms can choose whether to coordinate hours. Coordination enhances productivity but entails fixed costs and requires the hours worked to be the same across heterogeneous coworkers. We derive four main predictions. (1) Firms that coordinate hours pay compensating wage differentials for imposing sub-optimal hours. (2) Firms that are ex ante more productive, which gain the most from coordination, choose to coordinate hours and thus incur higher labor costs. (3) Coordination attenuates the labor supply responses of workers targeted by a tax change. (4) In coordinated firms, a tax change that affects one type of workers has spillovers on the hours worked by other coworkers.

We investigate these predictions using linked employer-employee registers of the Danish population. Denmark is a particularly fitting setting for our study. The unique features of the Danish data allow us to link the number of hours worked to individual and firm characteristics. Additionally, in 2010, the government mandated a personal income tax reform that substantially lowered the marginal tax rates on high incomes while leaving almost unchanged the marginal tax rates of low-income workers. Furthermore, compared to other European countries, Denmark has a relatively flexible labor market in which employers have considerable discretion in setting wages and hours (Botero et al., 2004; Hummels et al., 2014). In particular, two institutional features allow for discretion in the provision of hours by salaried and hourly workers: overtime hours and the possibility to convert paid vacation into working time.

Due to the specific features of the tax reform that we analyze, which affected workers across the income and skills distribution differently, we focus most of the analysis on hours coordination across workers in different skill groups.[1] Accordingly, we measure coordination using the standard deviation of average hours worked across skill groups in a firm. In doing so, we assume – consistent with survey data on desired working hours in Denmark – that workers in different skill groups have different labor supply preferences. Thus, we interpret a lower dispersion of hours as implying a greater overlap of workers at the workplace and, therefore,

[1]However, at the end of the paper, we also discuss a few facts on hours coordination within skill groups and how it relates to coordination across skills.

higher coordination.[2] In line with this interpretation, we find that alternative measures of the interaction among coworkers from O*NET, the Survey of Adult Skills, and the Danish Time Use Survey strongly correlate with our measure of hours coordination.

With this measure of coordination in hand, we first document the features of coordinated firms. This analysis reveals that more-coordinated firms are more productive, larger in size, more likely to export and less likely to employ part-time, hourly and female workers. Next, we turn to a more systematic analysis of how the degree of coordination at a firm relates to the wage premium paid to workers. We estimate the premium as the firm fixed effect from a regression of hourly wages on individual, firm fixed effects and time-varying characteristics (Abowd et al., 1999). Then, we regress this premium on our measure of coordination. In line with the theory (Prediction 1), we find a strong and positive association between the firm component of wages and hours coordination across and within sectors. This correlation is robust to a number of firm characteristics that are known to affect wage inequality across firms.[3]

After controlling for measures of firm productivity, the correlation between wages and coordination is insignificant. In line with the theory (Predictions 1 and 2), this finding suggests that only highly productive firms can afford to pay higher wages to achieve greater coordination. Specifically, we estimate that coordination can explain between 6% and 9.5% of the wage inequality due to productivity across firms within the same sector. While descriptive, these findings suggest that a relevant part of the documented correlation between the firm component of wages and productivity may reflect wage premiums for greater coordination in more productive firms.

In the second part of the paper, we analyze the effects of a tax reform that abolished the middle bracket of a 3-bracket progressive tax schedule and lowered the top tax rates. This reform resulted in a sizable reduction in the marginal tax rates of workers who were formerly in the top and middle tax brackets prior to the reform (henceforth, high-income workers).

[2]Ideally, we would measure coordination based on the degree to which coworkers with different labor supply preferences work at the same time of the day or interact with one another. Unfortunately, data of this type do not exist on such a large scale. We focus on full-time workers because Danish Time Use Survey data reveal that part-timers are more likely to start working later during the day or to work over weekends.

[3]For instance, we control for firm size (Mueller et al., 2015), exporter status (e.g., Helpman et al., 2016), the skill and gender composition of the workforce (Card et al., 2016, Song et al., 2016), the average number of hours, the unionization rate (e.g., Dickens, 1986), and overtime premiums (Cardoso et al., 2012).

To identify the attenuating effects of coordination, we estimate the elasticity of hours worked by high-income workers in high- versus low-coordination firms. In doing so, we use the tax reform as an instrument for the observed changes in after-tax earnings (Gruber and Saez, 2002). In line with the model (Prediction 3), we find an elasticity that is close to zero and insignificant in high-coordination firms and a significant elasticity of -0.1 in low-coordination firms.

Next, we test for the existence of labor supply spillovers by estimating the elasticity of hours worked by low-income workers to the tax-driven change in average hours worked by high-income coworkers. We find an elasticity of 0.88, which implies an increase of 0.85 hours worked by low-income workers for each additional hour provided by high-income coworkers. Consistent with our framework (Prediction 4) we find lower spillover effects among workers in low-coordination firms. Importantly, the effects of coordination are robust to an extensive set of other controls for observed and unobserved firm characteristics.

Our findings of attenuating and spillover effects of coordination have multiple implications. First, they show that the elasticity of labor supply captures only part of the costs associated with a tax change since it neglects the indirect effects on untargeted coworkers. By including spillovers, we estimate an additional 3.3% decrease in tax revenues from the 2010 Danish tax reform. Second, due to hours coordination, using workers who are not directly targeted by a tax change as a control group produces downward-biased estimates of the labor supply elasticity. We estimate that in our setting, the elasticity obtained using low-income workers as a control group would capture only 20% of the high-income response. More generally, our study suggests that hours coordination is important for policy evaluation, and it should be taken into account in the analysis of any intervention that affects the labor supply of one group of workers in a firm (e.g., older workers, parents).

This study relates to multiple strands of the literature. First, it relates to the literature on the effects of labor market frictions on labor supply responses to taxation (e.g. Kleven and Waseem, 2013). Within this literature, constraints on hours imposed at the firm level are usually viewed as a leading explanation for small labor supply responses to tax changes (Chetty et al., 2011; Best, 2014; Battisti et al., 2015). However, due to the lack of information on hours worked within firms, little is known about the source of these constraints or the magnitude of their effects. Using newly available data on hours and the quasi-experimental variation derived from a tax reform, we provide the first firm-level evidence quantifying the magnitude of a mechanism – coordination of hours – through which hours constraints attenuate the labor supply responses to taxation.[4]

Second, we contribute to the extensive literature on wage and productivity differentials across firms (e.g., Syverson, 2011; Card et al., 2018). Specifically, we offer a look inside firms by modeling, and empirically quantifying, the importance of coordination of hours as a rationale that leads more-productive firms to pay higher wages. In this respect, our results document a specific mechanism in line with the recent findings on compensating differentials as an important source of wage inequality across firms (Lavetti and Schmutte, 2016; Sorkin, 2018).[5] Relative to the literature on compensating differentials from less-desirable hours, our results emphasize the importance of considering hours worked relative to those of other workers in the firm as a way to measure dis-amenities from hours at the workplace (e.g., Rosen, 1986; Abowd and Ashenfelter, 1981; Card et al., 2016; Goldin and Katz, 2016; Mas and Pallais, 2017).

The remainder of the paper is organized as follows. Section 2 presents the conceptual framework. Section 3 describes the data and the institutional setting. Section 4 presents the empirical relationships between coordination, wages and firm productivity. Section 5 quantifies the effects of coordination on the elasticity of labor supply. Section 6 presents a few facts on hours coordination within skill groups. Finally, Section 7 concludes.

[4]Battisti et al. (2015) present evidence of reduced intertemporal elasticities from structural simulations of a policy that only affects a fraction of a firm's workforce. We complement their analysis by measuring coordination using firm-level data on hours and by analyzing an actual preference shock deriving from a tax reform. Our results also help to shed light on existing evidence and theory at more aggregate levels. Kahn and Lang (1991) finds the elasticity of actual hours to be lower than the elasticity of desired hours. Our findings suggest that this difference may be linked to firm-level coordination. Rogerson (2011) shows that if the work schedule is a collective choice, then it is invariant to purely idiosyncratic shocks but not to changes in aggregate factors. Our evidence of firm-level attenuating effects supports this model. Hamermesh et al. (2008) documents synchronization in working schedules across US states. Our results indicate that coordination among coworkers is associated with co-movement of hours.

[5]Siow (1987) found higher wages in industry-occupations with less volatile hours. Our research complements these findings with results from the linked employer-employee level. This allows us to measure the dispersion of hours between coworkers and examine how this relates to wage inequality across firms.

2 Conceptual framework

The standard labor supply model is based on the assumption that employers are indifferent to the hours supplied by their employees. However, hours worked vary across sectors and, most notably, across firms within a sector. Figure 1 plots the decomposition of the variance of total annual hours worked in Denmark into between- and within-sector variability first, and then into cross- and within-firm variability. The cross-firm variation explains more than 35% of the overall variance, whereas only 12% of the overall variation occurs between 3-digit sectors.[6]

This descriptive evidence suggests that employers may not be indifferent to their workers' supply of hours. Motivated by this evidence, in this section, we propose a model in which firms endogenously choose whether to restrict the range of hours available to their employees. Then, we examine how this affects wages and labor supply elasticities.

2.1 Workers

There are two types i of workers, N_H workers with high skill ($i = H$) and N_L workers with low skill ($i = L$). Workers have preferences over a continuum of consumption goods $\omega \in \Omega$ and leisure ℓ_i of the following type (Dixit and Stiglitz, 1977; Prescott, 2004):

$$U\left(Q_i, \ell_i\right) = \log\left[\int_{\omega\in\Omega} q_i(\omega)^{\frac{\sigma-1}{\sigma}}\, d\omega\right]^{\frac{\sigma}{\sigma-1}} + \eta\, v\left(\ell_i\right), \tag{1}$$

where $(Q_i)^{(\sigma-1)/\sigma} \equiv \int_{\omega\in\boldsymbol{\Omega}} q_i(\omega)^{(\sigma-1)/\sigma} \mathrm{d}\omega$ is the (exponentiated) consumption index for a worker of skill i, and $\sigma > 1$ is the elasticity of substitution between any two goods. We assume that the taste parameter η is positive and that the utility of leisure $v(\ell_i)$ is increasing and concave with $v'(\ell_i) > 0$ and $v''(\ell_i) < 0$.

[6] The variance of hours is decomposed into between- and within-group components as follows:

$$\frac{1}{N_t}\sum_i \left(h_{it} - \overline{h_t}\right)^2 = \frac{1}{N_t}\sum_g \sum_{i\in g}\left(h_{it} - \overline{h_{gt}}\right)^2 + \frac{1}{N_t}\sum_g N_{gt}\left(\overline{h_{gt}} - \overline{h_t}\right)^2$$

Where workers are indexed by i and years by t, g denotes groups (i.e., firms or sectors), while N_{gt} and N_t denote the number workers in each group and the total number of workers, respectively. h_{it}, $\overline{h_{gt}}$ and $\overline{h_t}$ are the worker hours, the average hours within each group and the average hours across all workers, respectively. The variance is decomposed for each year between 2003 and 2008. Figure 1 shows the average shares across all years. To the extent that hours are measured with errors, the within-firm component of the variance may be overestimated, which means that hours may vary between firms even more than our measure indicates.

Workers can take employment either in the non-coordinated or in the coordinated labor market. In the non-coordinated labor market, workers face equilibrium wages w_i^* and pick their optimal hours $h_i^* = 1 - \ell_i^*$, allowing for an optimal consumption level Q_i^* with individual product demand $q_i^*(\omega)$, and resulting in a utility level $U_i^* \equiv U(Q_i^*, h_i^*)$ (see details in the online Appendix A.1).

In contrast, workers employed in the coordinated labor market must work for a prescribed number of hours $\hat{h}$ regardless of their skill level. In the coordinated market, firms offer skill-specific hourly wages $\hat{\mathrm{w}}_H$ and $\hat{\mathrm{w}}_L$ that are discussed in the next subsection. Workers in this segment consume $\hat{Q}_i$ and $\hat{q}_i(\omega)$, resulting in utility $\hat{U}_i \equiv U(\hat{Q}_i, \hat{h}_i)$.

Workers face a skill-specific tax rate t_i that generates tax revenues distributed through a lump-sum transfer T that balances the government's budget. The overall labor market for each skill group clears such that $N_i^* + \hat{N}_i = N_i$ for equilibrium wages w_i^* and $\hat{\mathrm{w}}_i$.

2.2 The wage-hour function

We assume perfect worker mobility between firms in the non-coordinated and coordinated segments of the labor market. One implication of this assumption is that, in equilibrium, a coordinated labor market can co-exist with a non-coordinated labor market only if workers are indifferent between employment in the two market segments. The indifference condition for each type-i worker between coordinated and non-coordinated labor market segments is

$$U\left(\frac{\hat{\mathrm{w}}_{\mathrm{i}}}{P}\,\hat{h}\,(1-t_i) + \frac{T+\bar{\pi}}{P},\,\hat{h}\right) = U\left(\frac{\mathrm{w}_{\mathrm{i}}^*}{P}\,h_i^*\,(1-t_i) + \frac{T+\bar{\pi}}{P},\,h_i^*\right), \tag{2}$$

where $P^{\sigma-1} \equiv \int_{\omega\in\boldsymbol{\Omega}} p(\omega)^{-(\sigma-1)}\,\mathrm{d}\omega$ is the (exponentiated) price index, and $\bar{\pi} \equiv \int_{\omega\in\boldsymbol{\Omega}} \pi(\omega)\mathrm{d}\omega/(N_H + N_L)$ represents the equal distribution of firm profits as dividends. This condition implicitly defines the wage rates $\hat{\mathrm{w}}_i$ for each type-i worker as a function of the hours worked $\hat{h}$. We refer to this function $\hat{\mathrm{w}}_i(\hat{h})$, which has $\mathrm{w_i}^*$ as a parameter, as the *wage-hour function*.[7]

Regarding the properties of this function, under standard regularity conditions on the shape of the utility function, it can be shown that $\hat{\mathrm{w}}_i'(\hat{h}) < 0$ if $\hat{h} < h_i^*$. In this case, a marginal increase in $\hat{h}$ shortens the distance between $\hat{h}$ and h_i^*, thus requiring less extra compensation to make

[7]The concept of a wage-hour function of the type described here is not new in the literature; see, for instance, Abowd and Ashenfelter (1981); Altonji and Paxson (1988).

the worker indifferent between working $\hat{h}$ and working h_i^*. Similarly, $\hat{\mathrm{w}}_i'(\hat{h}) > 0$ if $\hat{h} > h_i^*$, whereas if $\hat{h} = h_i^*$, no extra compensation is needed, and thus, $\hat{\mathrm{w}}_i'(\hat{h}) = 0$. Additionally, it can be shown that $\hat{\mathrm{w}}''(\hat{h}) > 0$ (online Appendix A.2). Therefore, the resulting wage-hour function is U-shaped with its minimum at the equilibrium wage w_i^*, where hours $\hat{h} = h_i^*$.[8]

The economic insight behind this function is that firms in the coordinated market need to offer higher wages to both skill groups when the coordinated hours differ from optimal hours.

2.3 Firms

There is a continuum of firms in which each firm produces a different variety ω of consumption goods under monopolistic competition. Every firm produces with a constant-returns-to-scale technology $q(\omega) = \gamma\,\phi\,G(n_H h_H, n_L h_L)$, where ϕ is a productivity parameter that differs from firm to firm under some probability distribution (similar to Melitz, 2003), γ is a Hicks neutral productivity shifter that varies with hours coordination, and $G(\cdot,\cdot)$ is the production function. The firm employs n_H high-skilled and n_L low-skilled workers. In what follows, we denote by $G_H(\cdot,\cdot)$ the first derivative of $G(\cdot,\cdot)$ with respect to its argument $(n_H h_H)$ and by $G_L(\cdot,\cdot)$ the first derivative with respect to $(n_L h_L)$. For simplicity, we do not allow for market entry (Chaney, 2008). However, firms can choose whether to operate in the non-coordinated or in the coordinated labor market. In the non-coordinated labor market, $\gamma = 1$, such that firms produce with productivity ϕ. In the coordinated labor market, $\gamma = \hat{\gamma} > 1$, meaning that firms can raise their productivity to $\hat{\gamma}\phi$ but must pay a fixed cost $\hat{F}$ to achieve hours coordination.[9]

2.3.1 Non-coordinated labor market

In the non-coordinated labor market, firms take equilibrium wages w_i^* and workers' preferred hours h_i^* as given. Thus, they choose the number of high- and low-skilled workers that minimize costs:

$$C^*(\omega) \equiv \min_{n_H, n_L} \mathrm{w}_\mathrm{H}^* n_H h_H^* + \mathrm{w}_\mathrm{L}^* n_L h_L^* \qquad \text{s.t.} \quad G\left(n_H h_H^*, n_L h_L^*\right) \geq q^*(\omega)/\phi. \tag{3}$$

[8] As we show in the online Appendix A.2, there are conditions on the curvature of the leisure preferences or economy-wide productivity that ensure that $\hat{\mathrm{w}}''(\hat{h})$ is positive.

[9] The fixed costs of coordination can be thought of as the infrastructure needed to sustain coordinated production such as office space, conference rooms, scheduling software, and the like.

The first-order conditions imply that

$$\frac{G_H(n_H^* h_H^*, n_L^* h_L^*)}{G_L(n_H^* h_H^*, n_L^* h_L^*)} = \frac{\mathrm{w}_{\mathrm{H}}^*}{\mathrm{w}_{\mathrm{L}}^*}.$$

We assume that $G_H(\cdot,\cdot) > G_L(\cdot,\cdot)$, such that $\mathrm{w}_{\mathrm{H}}^* > \mathrm{w}_{\mathrm{L}}^*$ and $h_L^* \neq h_H^*$, with $h_L^* < h_H^*$ if the substitution effect prevails and the opposite if the income effect prevails.

2.3.2 Coordinated labor market

Firms in the coordinated labor market offer contracts for a single number of hours $\hat{h}$ that workers of all skill levels must accept but offer skill-specific wages along the wage-hours function $\hat{\mathrm{w}}_i(\hat{h})$ such that each type-i worker is indifferent between employment in the coordinated or non-coordinated labor market. This scenario results in the following cost minimization problem:

$$\hat{C}(\omega) \equiv \min_{n_H, n_L, h} \hat{\mathrm{w}}_{\mathrm{H}}\, n_H\, h + \hat{\mathrm{w}}_{\mathrm{L}}\, n_L\, h \qquad \text{s.t.} \quad h\, G(n_H, n_L) \geq q^*(\omega)/(\hat{\gamma}\phi)$$

$$\text{and} \quad U\left(h \frac{\hat{\mathrm{w}}_i}{P}(1-t_i) + \frac{T+\bar{\pi}}{P}, h\right) = U(Q_i^*, h_i^*)$$

$$\text{for } i = H, L.$$

From which the first-order condition that implicitly defines $\hat{h}$ is (see online Appendix A.3)

$$\hat{n}_H\, \hat{\mathrm{w}}_{\mathrm{H}}'(\hat{h}) = -\hat{n}_L\, \hat{\mathrm{w}}_{\mathrm{L}}'(\hat{h}). \tag{4}$$

Condition (4) has several implications. First, it implies that optimal hours $\hat{h}$ are between h_L^* and h_H^*. In fact, since $h_H^* \neq h_L^*$, $\hat{h}$ cannot be equal to either h_L^* or h_H^*. Furthermore, if $\hat{h}$ is greater than h_L^* and h_H^*, then $\hat{\mathrm{w}}_H' > 0$ and $\hat{\mathrm{w}}_L' > 0$, and thus, (4) cannot be satisfied. For a similar reason, $\hat{h}$ cannot be smaller than h_L^* or h_H^* to satisfy (4). Second, (4) establishes that optimal hours are such that the marginal costs of increasing hours in coordinated firms equal the marginal benefits. To understand this point, let us consider the case in which high-skilled workers desire to work more than low-skilled workers ($h_H^* > h_L^*$). For any choice of coordinated hours $h_L^* < \hat{h} < h_H^*$, a marginal increase in $\hat{h}$ moves them closer to h_H^*. Therefore, this situation results in lower wage premiums paid to high-skilled workers and, thus, in wage bill savings in the amount of $\hat{n}_H\, \hat{\mathrm{w}}_{\mathrm{H}}'$. However, the same increase in hours moves $\hat{h}$ further away from h_L^*, resulting in higher wages paid to low-skilled workers and therefore in a higher wage bill in the amount of $\hat{n}_L\, \hat{\mathrm{w}}_{\mathrm{L}}'$. At the optimum, the savings from marginally higher hours equal the costs.

Finally, (4) implies that $\hat{h}$ is set closer to the desired hours of the larger group of workers in the firm.[10]

Based on (4), both high- and low-skilled workers in coordinated firms work suboptimal hours and are therefore compensated with wage premiums. We therefore have the following:

Prediction 1 *Firms that coordinate work time at a common number of hours for both skill groups pay higher hourly wages than non-coordinated firms, which take the supply of work hours as given.*

2.3.3 Endogenous market segmentation

We now establish the conditions for the existence of the coordinated labor market segment in equilibrium. A firm producing variety ω maximizes its profits by setting the variety-specific price $p(\omega)$ given total demand. Maximized profits in the two segments are (online Appendix A.4):

$$\begin{aligned} \pi^*(\phi) &= \left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1}\left(\frac{P}{\mu^*}\right)^{\sigma-1}\frac{E}{\sigma}\,\phi^{\sigma-1}, \\ \hat{\pi}(\phi) &= \left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1}\left(\frac{\hat{\gamma}P}{\hat{\mu}}\right)^{\sigma-1}\frac{E}{\sigma}\,\phi^{\sigma-1}-\hat{F}, \end{aligned}$$

where $E = PQ$ are economy-wide expenditures, and μ^*, $\hat{\mu}$ are minimized marginal production costs in the uncoordinated and coordinated segments, respectively. Based on these conditions, a firm with productivity ϕ will choose to enter the coordinated labor market if and only if

$$\hat{\pi}(\phi) > \pi^*(\phi).$$

If $\hat{\gamma} > \hat{\mu}/\mu^*$, this inequality can be rewritten in terms of a firm's productivity ϕ:

$$\phi > \frac{\sigma}{\sigma-1}\frac{\hat{F}^{1/(\sigma-1)}}{E^{1/(\sigma-1)}P}\frac{\hat{\mu}}{\hat{\gamma}-\hat{\mu}/\mu^*} \equiv \hat{\phi}, \tag{5}$$

where $\hat{\phi}$ is the productivity threshold above which firms select into the coordinated segment. Intuitively, as the fixed cost $\hat{F}$ of coordinating or the marginal cost $\hat{\mu}$ of producing in the coordinated market increases, the entry threshold elevates. Conversely, a less competitive market with a high overall price level P and a larger aggregate economy with higher E facilitates

[10] A greater $\hat{n}_i$ in (4) raises the marginal costs of increasing $\hat{h}$ if $\hat{h} > h_i^*$ or decreases the marginal benefits of increasing $\hat{h}$ if $\hat{h} < h_i^*$, which implies that $\hat{h}$ moves closer to h_i^* as $\hat{n}_i$ increases.

entry and therefore reduces the entry threshold. The inequality would be reversed if $\hat{\gamma} < \hat{\mu}/\mu^*$, and a coordinated labor market would not exist. Therefore, we can state the following:

Prediction 2 *If a firm's productivity premium resulting from coordinating work hours is sufficiently large, $\hat{\gamma} > \hat{\mu}/\mu^*$, a coordinated labor market co-exists with a non-coordinated labor market. Firms with productivity above a unique threshold $\hat{\phi}$ coordinate work time, whereas firms with productivity weakly below that threshold remain non-coordinated.*

Assuming that $\hat{\gamma} > \hat{\mu}/\mu^*$, we indicate with $\hat{M}$ and M^* the total mass of non-coordinated and coordinated firms in equilibrium, respectively. It follows that the total number of each type-i worker in the two labor market segments is $\hat{N}_i = \hat{M} \cdot \hat{n}_i$ and $N_i^* = M^* \cdot n_i^*$.

2.4 The effect of a tax rate change on hours worked

In this section, we explore the consequences of a change in the tax rate faced by high-skilled workers t_H on optimal hours in the coordinated sector of the economy. Based on (4), one can derive the following expression (see online Appendix A.3):

$$\frac{d\hat{h}}{dt_H} = -\left[\hat{\mathrm{w}}_{\mathrm{H}}\frac{U_{cc,H}U_{\ell,H}}{U_{c,H}^2\,(1-t_H)} + \frac{P\,U_{\ell,H}}{U_{c,H}\hat{h}\,(1-t_H)^2}\right] \times \left[\hat{\mathrm{w}}_H''(\hat{h}) + \alpha\,\hat{\mathrm{w}}_L''(\hat{h})\right]^{-1}, \tag{6}$$

where $U_{cc,H}(< 0)$, $U_{c,H}(> 0)$ and $U_{\ell,H}(> 0)$ are the second derivatives of the utility function relative to consumption, the marginal utility of consumption and the marginal utility of leisure for high-skilled workers, respectively, whereas $\alpha = \hat{n}_L/\hat{n}_H$.[11]

Since $\hat{\mathrm{w}}_i''(\hat{h}) > 0$ (Section 2.2), the sign in (6) depends on the first term in brackets, which consists of two terms. Starting from the left, the first term captures the income effect, while the second term is the substitution effect. If the income effect prevails over the substitution effect, the derivative is positive. In that case, the desired hours of high-skilled workers increase when t_H increases, as do the hours worked in the coordinated sector. Conversely, the derivative is negative if the substitution effect prevails over the income effects.

Hours worked by high-skilled workers in coordinated firms, however, are less elastic to the tax change than high-skilled workers' hours in uncoordinated firms. To visualize this, in Figure

[11]Here, we consider the case of a generic additively separable utility function of which (1) is an example. Since firms simultaneously optimize hours worked and the number of workers of each type, the envelope theorem implies that $\alpha = \hat{n}_L/\hat{n}_H$ is not affected by changes in t_H.

2, we plot the case, consistent with our empirical findings, in which high-skilled workers desire to work more hours than low-skilled workers, the tax rate on high-skilled workers declines, and the income effect from the tax change prevails. In this case, as t_H declines, desired hours decrease from h^*_{0H} to h^*_{1H}, and thus, optimal hours in coordinated firms shift down from $\hat{h}_0$ to $\hat{h}_1$. If hours in the coordinated sector were to decline by as much as desired hours ($\mid \hat{h}_1 - \hat{h}_0 \mid = \mid h^*_{1H} - h^*_{0H} \mid$), the benefits for coordinated firms from marginally increasing hours would remain unchanged relative to the pre-tax-change period. However, the marginal costs from increasing hours would be lower because coordinated hours after the tax change are closer to the desired hours of low-skilled workers. Therefore, due to the convexity of the wage-hours function, a marginal increase in hours would imply a smaller increase in the wage premiums paid to low-skilled workers than prior to the tax change. As a result, marginal benefits would exceed marginal costs, and hours would optimally increase, which implies that $\mid \hat{h}_1 - \hat{h}_0 \mid < \mid h^*_{1H} - h^*_{0H} \mid$.

Based on the discussion in the paragraph above, we can state the following two predictions:

Prediction 3 *(Attenuation): High-skilled workers in coordinated firms are less responsive to tax rate changes than are high-skilled workers in uncoordinated firms.*

Prediction 4 *(Spillovers) In firms that coordinate work hours, changes in tax rates that affect only high-skilled workers have spillover effects on the hours worked by low-skilled coworkers. Hours worked by high- and low-skilled workers move together.*

In the empirical analysis that follows, Prediction 1 and 2 are discussed in Section 4, while the empirical analysis of Predictions 3 and 4 is presented in Section 5.[12]

[12] The algebra behind Prediction 4 remains difficult to treat, even when assuming specific functional forms for the utility function. Therefore, we propose only a graphical examination of this prediction. While our main analysis focuses on hours worked, a tax change that moves coordinated hours also affects wage rates. These effects are discussed in the online Appendix A.5. In the model in this section, we abstract from the sorting of workers across firms based on hours preferences. In reality, workers with preferences for longer hours may sort into hours-intensive firms, and vice versa. However, to the extent that there exists a continuum of workers' preferences and only a limited number of firms, perfect sorting can be ruled out and the predictions of the model would also be valid in this setting.

3 Institutional framework and data sources

We base the empirical part of the study on a panel of Danish workers. In this section, we describe the main features of the Danish labor market and the main sources of our data.

3.1 The Danish labor market

Denmark is a particularly fitting setting for our study. In fact, a soft employment protection legislation combined with a generous social safety net makes the Danish labor market one of the most flexible in the world (Botero et al., 2004). In the past, wages and working time were set at the industry level through collective bargaining, but over time, the system has undergone a decentralization process that has made negotiations much more firm-level based.

As an effect of this process and despite the fact that approximately 70% of the workers in the private sector are unionized, the wages of approximately 85% of them are negotiated directly at the worker-firm level (Hummels et al., 2014). The wage premium for workers who work overtime is usually equivalent to 50% of the normal wage for the first 3 hours in a week and 100% of the normal wage for each hour of overtime that exceeds the first 3 hours.

Regarding working time regulation, sectoral agreements usually define the normal week as 37 hours on average with no more than 8 hours of overtime work. Firms, however, have made increasing use of "opening clauses", which allow the union representatives at the company to develop local regulations that can deviate from sector-level agreements. In 2008, approximately 60% of full-time workers in the private sector were estimated to be covered by this type of local regulation (Dansk-Arbejdsgiverforening, 2012).

Further discretion in the choice of working hours comes from overtime work. Approximately 20% of the salaried workers and 60% of the hourly workers in our sample report at least one hour of paid overtime work. Finally, flexibility in the supply of hours derives from the possibility to convert hours of vacation into working hours at the contractual wage (see details in online Appendix B.1). According to a survey of Danish private firms, 73% of HR managers report having employees who do not make full use of their vacation time (Bluegarden, 2014). In line with this, a decomposition of the variance of annual vacation hours into between- and within-firm variability reveals substantial variation in vacation time between firms, particularly among salaried workers (online Appendix Figure D.1). The relative flexibility that Danish firms have in setting hours is consistent with the substantial variation in hours worked across firms that we observe in the data (Figure 1).

3.2 The data

The empirical analysis is based on data from multiple sources (online Appendix Table D.2). We use data on individual socio-economic characteristics such as tax returns, earnings and education from the Integrated Database for Labor Market Research (IDA), which collects annual data on the entire Danish population. Data on annual hours of regular and overtime work are extracted from *Lønstatistikken* (LON), which are reported by employers whose contributions to employees' pensions are based on hours worked and therefore have incentives to accurately report them (see details in Appendix B.2). Unfortunately, not all workers in IDA can be matched to LON. For our study, however, it is particularly important to observe the hours of as many workers as possible within a firm. For this reason, we consider only firms in which the number of hours worked in a year are available for at least 95% of their workforce. Hourly wages are obtained as annual earnings over the sum of regular and overtime hours.

We use firm-level data from the Firm Statistics Register (Firmstat) and the Danish Foreign Trade Statistics Register, which provide information on firm characteristics, such as the number of employees, industry affiliation, accounting and trade data. These registers cover the totality of private firms with more than 50 full-time equivalent employees and a representative sample of smaller private firms. We match each employee to the highest paying employer using the Firm-Integrated Database for Labor Market Research (FIDA), which links workers to firms in the employment spell of week 48 of each year only. For workers whose spell in week 48 lasted less than 1 entire year, we use annualized hours and earnings.

We focus on full-time employees who were 15 to 65 years old in the 2003–2011 period, for which data are available from all sources. Following the official definition in place during that period, we define full-timers as those working more than an average of 26 weekly hours over a one-year period, which represent approximately 90% of the workers in the sample. We exclude part-timers because they are more likely to work at unusual hours or fewer days in a week, which can be problematic for measuring coordination (section 4.3). However, we also show the results obtained while considering all workers as a robustness check.

The final sample that we use includes more than 400,000 employees and approximately 8,300 firms. Table 1 reports descriptive statistics for the entire population (column 1), for the sample of the population that can be linked to data on firms and hours (column 2), and for our final sample that comprises firms for which data on hours are reported for 95% or more of the workforce (column 3). A comparison of columns 2 and 3 suggests that our final sample, while providing better information on hours worked, does not substantially distort the composition of the population for which records on individuals and firms are available.

4 Coordination and wage differentials across firms

4.1 The empirical model

In this section, we study the relationship between employer-specific wage premiums and the coordination of hours. To do so, we use an empirical model that relates the average wage premium paid by each firm j to all its workers over the time period of the study ($\widehat{\psi_{j(i,t)}}$) with a measure of the average coordination of hours over the same period (σ_j) and a vector of average firm controls ($\bar{Z}_j$). The equation to be estimated is as follows:

$$\widehat{\psi_{j(i,t)}} = \delta_0 + \delta_1 \sigma_j + \delta_2 \bar{Z}_j + v_j \tag{7}$$

We begin by measuring $\widehat{\psi_{j(i,t)}}$ as the average wage in a firm. Then, to account for the fact that workforce characteristics might correlate with coordination and firm wages, we also measure $\widehat{\psi_{j(i,t)}}$ using the firm fixed effect from a firm-worker fixed effect model of the type described in Abowd, Kramatz and Margolis (1999) (henceforth, AKM), which we discuss in Section 4.2. The term σ_j measures the average dispersion of hours worked across skill groups in a firm. Higher dispersion is interpreted as lower coordination. In Section 4.3, we discuss the details behind this variable. Based on Prediction 1 from the stylized model, we expect $\hat{\delta}_1$ to be negative.

Existing studies have shown that wage differentials across firms correlate with a number of other firm characteristics, some of which may confound the estimated correlation between the coordination of hours and wages. For this reason, in our empirical specifications, we include in $\bar{Z}_j$ an extensive set of controls intended to reduce these concerns. Among the controls, we include detailed geographic and industry fixed effects, controls for the composition of the workforce of a firm in terms of both gender and ability, as well as other firm characteristics, such as a firm's size, exporter status or unionization rate, all of which have been found to correlate with wage differentials across firms.

Furthermore, one may worry that a negative correlation might be driven by institutional factors. In particular, workers in high-paying firms may work longer hours, and in doing so, they may bunch at 37 hours, which is the upper limit imposed on the average number of hours by most of the collective labor agreements. For a similar reason, if workers in high-paying firms are more likely to work overtime, higher wages may reflect statutory overtime premiums rather than compensating wage differentials. To take these factors into account, first, in all the specifications, we control for the average number of hours worked. Then, in a set of robustness checks, we explicitly explore these potential concerns by excluding firms that bunch at 37 hours and by considering only the earnings from regular hours.

While we control for a large number of confounding factors, in the absence of an exogenous change in coordination, the results of this analysis remain of a correlational nature. However, due to the limited evidence that exists on hours coordination among coworkers, we regard this analysis as an important first step towards understanding a relevant economic phenomenon.

A growing number of studies have found evidence of a positive correlation between wage and productivity differentials across firms (e.g., Card et al., 2018). In the setting of our study, the coordination of hours can be regarded as a factor by which higher productivity in a firm translates into higher wages through compensating wage differentials. To measure the share of the correlation between wages and productivity in a firm that can be predicted by coordination, we first estimate equation (7) while omitting σ_j and including total factor productivity (TFP) and value added per employee as measures of firm productivity. From this alternative specification of equation (7), we obtain the partial R-squared associated with value added and TFP. Then, we measure the predictive power of hours coordination as the ratio of the partial

R-squared associated with σ_j from equation (7) and the partial R-squared associated with value added and TFP. Henceforth, we refer to this ratio as the *coordination share*.

4.2 The firm component of wages

We estimate the average wage premium paid by a firm to all workers as the firm fixed effect in the following regression model:

$$ln\, \mathrm{w}_{\mathrm{ijt}} = \alpha_i + \psi_{j(i,t)} + \beta_1 X_{ijt} + r_{ijt} \tag{8}$$

where $\mathrm{w}_{\mathrm{ijt}}$ is the gross hourly wage earned by individual i in firm j in year t. X_{ijt} is a vector of time-varying controls, while α_i controls for individual fixed effects. The variable of primary interest to us is the firm fixed effect $\psi_{j(i,t)}$, which measures the fixed component of the wage that is specific to firm j once we control for individual fixed and time-varying characteristics.

Equation (8) is similar to the model used in AKM and several other studies. However, unlike most other studies, we use hourly wages rather than annual or monthly earnings as a dependent variable to better fit the theoretical model that refers to wage rates. Furthermore, we consider both male and female workers since coordination of hours involves all coworkers in a firm, regardless of their gender.

The AKM wage decomposition rests on the assumption of exogenous worker mobility conditional on observables. Following Card et al. (2013), in online Appendix C.1, we present a number of tests performed with the aim of investigating the plausibility of this assumption. The results of these tests suggest that endogenous mobility is unlikely to be an issue in our setting.

4.3 Coordination of hours: measures and facts

Ideally, we would measure coordination based on the degree to which coworkers with different labor supply preferences work at the same time of the day or interact with one another. Unfortunately, data of this type do not exist on a large scale. In what follows, we introduce an alternative measure of coordination based on the number of hours worked. Then, we use survey data to validate it, and finally, we discuss how this measure correlates with other firm characteristics.

Our measure of coordination is the standard deviation of hours worked across skill groups:

$$\sigma_{jt} = \left[\frac{1}{S_{jt}}\sum_{s=1}^{S_{jt}}\left(\tilde{h}_{sjt} - \mu_{jt}\right)^2\right]^{1/2}, \tilde{h}_{sjt} = \frac{1}{N_{sjt}}\sum_{i=1}^{N_{sjt}} h_{isjt} \tag{9}$$

where h_{isjt} is the number of annual hours (regular and overtime) worked by employee i in skill group s in firm j at time t, $\tilde{h}_{sjt}$ is the average of h_{isjt} across workers in sjt, and μ_{jt} is the average of $\tilde{h}_{sjt}$ across skill groups in firm-year jt. Finally, N_{sjt} and S_{jt} are the number of workers in sjt and the number of skill groups in jt, respectively. We interpret a low value of this standard deviation as implying greater overlap of workers at the workplace and thus greater coordination. σ_j in equation (7) is the average of σ_{jt} over the years 2003–2011.

In measuring coordination, we use skill groups to proxy for differences in desired hours. Labor force survey data on desired hours support this assumption and indicate that desired hours increase with skills (online Appendix Table D.3). We use two alternative definitions of skill groups. First, starting from the estimated coefficients from equation (8), we measure skills as the sum of the fixed and the time-varying individual components of the hourly wages: $\widehat{s_{ijt}} = X_{ijt}\hat{\beta}_1 + \hat{\alpha}_i$ (Iranzo et al., 2008 and Irarrazabal et al., 2014). We thus assign workers in each year to one of 10 skill groups, defined as deciles of the distribution of $\widehat{s_{ijt}}$. We also construct a measure of skills as the intersection of education (i.e., primary, secondary and tertiary education) and occupation categories (i.e., manager, middle manager and blue collar). The results obtained from the two alternative definitions of skills do not differ in a meaningful way. Thus, to keep the exposition shorter, we present in the main paper the results obtained under the former definition and in the online Appendix E those obtained under the latter definition.

Since we do not observe the days and times when workers provided hours, our measure of coordination may be misleading if coworkers work a similar number of hours at different times of the day, on different days of the week or in different periods of the same year. For the latter case, since the vast majority of the workers in our sample work for the entire year, this issue is unlikely to play a major role.[13] Furthermore, by focusing on full-time workers in

[13] More than 75% of the workers in our sample have yearly employment spells that last more than 360 days.

private firms, we reduce concerns regarding whether they work on different days of the week or at different times of the working day. In fact, descriptive evidence from time use survey (TUS) data indicates that approximately 70% of full-time workers in Denmark begin working between 7am and 9am. Of the remaining 30%, the vast majority are employed in either the manufacturing sector or the health-care sector. However, the former sector emerges as one of the least coordinated from our analysis (Section 4.3.2), while most of the health-care sector is public and thus excluded from the analysis. Similarly, approximately 60% of full-time workers in the TUS do not work on weekends, and those that do work are mostly concentrated in the health-care sector (for further details, see online Appendix C.2).

While focusing on full-time workers reduces the concerns mentioned above, it may come at the cost of ignoring some of the variation that may be of interest for us. For this reason, we present a set of robustness checks in which we replicate our main results using a measure of hours coordination that includes the hours of part-timers.

4.3.1 Validation exercises

In this section, we use O*NET data to validate our measures of firm-level coordination. O*NET is a survey that provides information on 277 occupation-specific descriptors such as work style, work content, interests and experience for 965 occupations. It is based on an ongoing survey of workers in the United States. We use the US survey because a similar survey is not available in Denmark. For each descriptor, O*NET provides a measure of its importance in each of the occupations surveyed. We match this information to Danish registers based on occupation. We select the 3 descriptors in O*NET that capture aspects of a job that involve coordination of hours across skills. Similar descriptors are used in other studies to capture skill complementarity (Bombardini et al., 2012). The descriptors are as follows: *Contact*: "How much does this job require the worker to be in contact with others (face-to-face, by telephone, or otherwise) in order to perform it?"; *Teamwork*: "How important is it to work with others in a group or team in this job?"; and *Communication*: "How important is communicating with supervisors, peers, or subordinates to the performance of your current job?".

The measure of the importance of these 3 descriptors ranges between 1 and 100. We take the median score across coworkers each year as a measure of the importance of each factor in a specific firm in that year. In Figure 3, we plot the standard deviation of hours versus the importance of the 3 descriptors across firm-year observations. A negative and statistically significant correlation emerges between each of the above descriptors and the standard deviation of hours across skill groups. That is, in firms where coordination of hours is low, the importance of aspects that involve coordination is also low.

In the online Appendix C, we discuss an additional set of validation exercises based on the Survey of Adult Skills and the Danish Time Use Survey. The evidence emerging from these surveys is consistent with the evidence we found using O*NET.

4.3.2 Coordination and firm characteristics

In this section, we document new facts that emerge when we examine the correlations between our measures of coordination and other firm characteristics across and within sectors.

Table 2 reports the standardized coefficients obtained from a set of regressions of coordination on a number of firm characteristics.[14] A few interesting facts emerge from the table. First, firms that coordinate are more productive: they have higher value added per employee and TFP.[15] This evidence supports our theoretical framework in which more productive firms select into coordination. Moreover, firms that coordinate are larger in size and are more likely to be exporters and to employ a greater share of tertiary educated workers. Second, less coordinated firms employ relatively more hourly, part-time and female workers, which suggests that greater flexibility in these firms is achieved through the hiring of these workers.

Existing studies document that managerial ability in a firm strongly correlates with the use of more advanced management practices and higher productivity (Ichniowski et al., 1997, Bloom et al., 2015). In a recent study by Bender et al. (2018), managerial ability is measured as the average individual fixed effect ($\hat{\alpha}_i$) from an AKM model among the workers in the top quartile of the distribution of $\hat{\alpha}_i$ in each firm. In Table 2, we examine the correlation between this measure of managerial ability and hours coordination and find a strong positive association

[14] Figure 4 presents the distribution of our measure of hours coordination across skill groups showing substantial variation across firms.

[15] For more details on the construction of the value added and TFP variables, see the online Appendix section B.3.

between the two, which suggests that hours are more coordinated in better-managed firms.

Deming (2017) highlights the importance of social skills in reducing the costs of coordination among workers. To examine how hours coordination correlates with social skills at the firm level, we construct 4 measures of social skill intensity within firms. These are based on the same O*NET descriptors used in Deming (2017) to measure the intensity of social skills at the occupational level (i.e.,*Coordination*, *Negotiation*, *Persuasion* and *Social Perceptiveness*). Consistent with Deming (2017), we find that hours coordination is stronger in firms where the social skill intensity is greater. In this respect, our empirical findings support the theoretical work that links the synchronization of working schedules to the potential for better communication and cooperation (Lewis, 1969; Weiss, 1996).

If hours coordination is thought to decrease the costs of communication, then greater coordination may lead to more problems being solved at the top of the firm hierarchy and, thus, to a decrease in wage inequality among blue-collar workers and an increase in wage inequality among managers (Garicano and Rossi-Hansberg, 2006). In line with this hypothesis, we find that high coordination in a firm is associated with a lower 90th–10th wage ratio among blue-collar workers and a greater 90th–10th ratio among top managers.

The degree of hours coordination may depend on the type of product or service that a firm offers. In line with this argument, we observe differences in coordination across sectors, with firms in the service industry coordinating more on average than those operating in the agriculture, manufacturing or construction sectors (online Appendix Table D.4).[16] However, when we decompose the variance of hours coordination in a within- and a between-sectors component, we find that more than 80% of the variation is within sectors (Appendix Figure D.2), which indicates that there is substantial heterogeneity in the degree of hours coordination among firms that produce similar products. Consistent with this, all the correlations discussed in this section hold within narrowly defined sectors, suggesting that they are driven by differences across firms within sectors (see columns 2 and 3 in Table 2).

When we measure skills as the intersection of educational groups and occupational categories

[16]Reassuringly, when we use time use survey data to measure coordination based on the overlap of differently skilled workers at the workplace across hours of the day, we obtain a similar ranking of the sectors to that based on our measure of coordination (online Appendix C.2.2)

(section 4.3), we find almost identical results (Table D.27 in the online Appendix).

4.4 Results

In this section, we discuss the correlation between firm wages and hours coordination. We begin by estimating this correlation across all firms and checking for the importance of other confounding factors. Then, we study how wages and hours coordination correlate across firms within sectors, and finally, we assess the importance of coordination in linking productivity to wages in a firm.

Column 1 in Table 3 shows the standardized correlation between coordination and the average firm wage estimated from equation (7). In line with Prediction 1 from the theory, higher coordination in a firm is associated with higher wages. Column 2 shows the coefficients obtained while using the firm component of wages from the AKM decomposition as dependent variable. In this specification, the coefficient on hours coordination has the same sign and significance as in column 1, while the magnitude of the correlation decreases. This finding is consistent with the fact that part of the correlation in column 1 may depend on workforce characteristics that are better controlled for when using the AKM-based measure of average firm wages. Based on this, in the specifications that follow, we use the firm component of wages as a dependent variable to the extent that it results in more conservative estimates of the correlation between firm wages and hours coordination.

From the discussion in the previous section, one may be concerned that this correlation may be driven by other firm characteristics. Thus, in column 3, we control for firm size and exporter status to account for the fact that large firms and exporters pay higher wages (e.g., Mueller et al., 2015, Helpman et al., 2016, Macis and Schivardi, 2016). We also include region fixed effects to control for geographic differences in pay, and we control for the share of female workers in the firm because females are more likely to sort into low-paying firms or to bargain for lower wages (Card et al., 2016). Additionally, we control for the share of unionized workers as a way to capture rents from unions (Dickens, 1986) and for the average number of hours worked to control for compensating differentials due to long hours (e.g., Goldin and Katz, 2016).

In column 3, we also add further controls for the skill composition of a firm's workforce.

In fact, recent studies show that the sorting of more able workers into better-paying firms is important in determining wage inequality between firms (Card et al., 2013, Song et al., 2016). We control for the skill composition of the workforce in two ways. First, we include controls for the share of workers in each skill group. Then, to account for the fact that workers in the same skill group might differ across unobserved dimensions, we also control for the average values of the individual fixed effects ($\hat{\alpha}_i$) in each quartile of the firm distribution of $\hat{\alpha}_i$. The average $\hat{\alpha}_i$ in the top quartile of the firm distribution has been found to correlate strongly with better managerial practices (Bender et al., 2018). Therefore, this additional set of controls also provides a way to proxy for differences in managerial practices across firms.

The results in column 3 are reassuring because the coefficient attached to coordination retains its sign and significance. The magnitude of the coefficient in this specification is such that a one-standard-deviation (95 hours per year) increase in hours coordination is associated with an increase equivalent to 0.6% of the average wage.[17]

Relative to other firm characteristics, the correlation between wages and coordination is greater than the association between wages and firm size or capital per employee and is of comparable magnitude to exporter status. As in other recent studies, we find no evidence of compensating differentials due to long hours (Card et al., 2016). Importantly, the sign and significance of the correlation between wages and coordination highlights the importance of measuring relative hours in a firm to capture dis-amenities from working time.

The correlation between the firm component of wages and coordination of hours remains significant within 1-, 2- or 3-digit sectors (columns 4 to 6 in Table 3). Based on our estimates, about half of the correlation between hours coordination and firm wages is explained by differences across sectors, with the other half explained by differences across firms within sectors. These findings establish that hours coordination is an important predictor of between-firm wage inequality and are in line with other recent studies that, using a structural approach, identify compensating differentials as an important determinant of wage inequality across firms (Sorkin, 2018).[18]

[17]This finding is obtained by multiplying the coefficient (0.076) by the standard deviation of the firm component of wages (0.26); this gives a 0.01404 log wage increase, which is 0.6% of the average log wage (2.26 $\approx$ 183 DKK).

[18]The correlation retains its sign and significance when we exclude from the analysis firms that bunch at 37

When we measure skills as the intersection of educational groups and occupational categories rather than using the AKM-based measure (section 4.3), we find almost identical results (Table D.36 in the online Appendix). Finally, considering part-time workers in the measure of hours coordination results in similar estimates (see Table D.10 in the online Appendix).

In online Appendix C.3, we show that the results are robust to an extensive set of additional controls. These include, for instance, the use of alternative measures of hours dispersion, controls of social skills intensity or innovation in a firm and time-specific wage trends.

4.4.1 Coordination of hours, wages and firm productivity

Existing studies find that the firm component of wages strongly correlates with productivity in a firm (e.g., Card et al., 2018). In our theoretical model, more productive firms select into coordination and pay wage premiums (Predictions 1 and 2). Consistent with this, conditional on measures of firm productivity, such as value added per employee, the coefficient on the standard deviation of hours decreases and becomes insignificant (Panel A in Figure 5)

To measure the importance of hours coordination in explaining the wage inequality across firms that is due to productivity, we use the *coordination share* described in Section 4.1. In line with the evidence provided in the previous paragraph, this measure rests on the assumption that coordination affects wages only through productivity. We estimate a coordination share of 15% across all firms and of 9.5% (6%) among firms in the same 1-digit (3-digit) industry (Panel B in Figure 5). This estimation suggests that coordination predicts a non-negligible share of the variation of firm wages that is linked to productivity differentials and that cannot be explained by other factors that are known to affect wages and productivity.

hours (average hours between 36.5 and 37.5) or when we consider earnings and coordination from normal hours only, thus excluding overtime (column 1 and 2 in online Appendix Table D.5). This indicates that the results are not affected substantially by institutional factors. In column 5 of Table D.5, we also exclude firms in industries with the top 10% highest shares of workers involved in shift work, for which our measure of coordination may be imprecise (see section 4.3). We find that the results are not driven by these firms.

5 Coordination, labor supply and tax rate changes

5.1 The 2010 Danish tax reform

We base the analysis presented in this section on the changes to the Danish personal tax schedule mandated by the 2010 tax reform. This reform led to a substantial decrease in the marginal tax rate on labor income faced by high-income earners, while it left the tax rate of low-income workers almost unchanged. To the extent that low- and high-income workers differ in desired work hours, the reform provides an ideal setting to test for spillovers and attenuating effects of coordination.

The Danish income tax system is based on different types of income that are aggregated in multiple ways to form different tax bases that are taxed at different rates. A detailed description of the tax system can be found in online Appendix B.4. Relevant to our analysis, prior to the 2010 reform, income was taxed using a three-bracket progressive tax schedule. The 2010 reform abolished the middle tax bracket and decreased tax rates in the bottom and top brackets by 2 and 7 percentage points, respectively, between 2008 and 2011. The reform also increased the income amount at which the top bracket becomes effective, which increased by approximately 9% in real terms between 2008 and 2011, leading to a substantial decrease in the marginal tax rate on labor income faced by workers in the middle and top tax brackets. For these workers, marginal tax rates declined by approximately 16% and 10%, respectively (Figure 6). The decrease was less pronounced in the bottom bracket, where the marginal tax rate decreased by approximately 4% (for further details, see online Appendix B.4).

Based on this, henceforth, by low-income workers, we mean workers who were either tax exempt or were in the bottom tax bracket in 2008 (left of the dashed line in Figure 7). Conversely, we define high-income workers as the workers who were in the middle or top tax bracket in 2008. From this group, however, we exclude workers who were in the top bracket in 2008 and who, based on their 2008 real income and the tax schedule in place after the reform, are predicted to be in the bottom tax bracket in 2011. We refer to these workers as the residual group. Workers in this group had incomes just above the lower limit of the top bracket in 2008 (dotted line in Figure 7). When the reform increased this limit (solid line in Figure 7) and abolished the middle bracket, these workers ended up (mechanically) in the bottom bracket after the reform. Based on this classification, approximately 34% of the workers in our sample are low income, 54% are high income, the remaining 12% are in the residual category.

Since workers in the residual group did not change their supply of hours as an effect of the reform and, consequently, did not have significant spillovers for low-income workers (online Appendix Table D.11), in what follows, we focus on on high- and low-income workers only.[19] This keeps the empirical framework as close as possible to the stylized model in which we consider only two groups of workers. In this regard, the high- and low-skilled workers of the stylized model are labelled as high- and low-income workers in this section to avoid confusion with the definition of skill groups used in section 4.

5.2 The tax data

We base the tax analysis on records from the Danish Tax Register, which collects detailed information on all the items that determine individual tax liabilities in Denmark. Marginal tax rates, however, are not directly observable. For this reason, we use the available tax records to simulate marginal tax rates for each worker using a simulator model of the Danish tax system. We do so by extending the tax simulator used in Kleven and Schultz (2014) to the years 2006–2011. In this simulator, marginal tax rates on labor income are obtained as the increase in tax liabilities due to a rise in labor income of 100 DKK. In particular, since the tax liability T() is a function of labor income (z_{LAB}) and other income components ($z_1, ...z_N$), the marginal tax rate on labor income is derived as follows $\tau = [T(z_{LAB} + 100, z_1, ...z_N) - T(z_L, z_1, ...z_N)]/100$.

In the empirical models that we use, we relate changes in labor supply to changes in marginal tax rates over 3-year intervals. Intervals of 3 years are commonly used in the taxation literature (e.g., Feldstein, 1995, Gruber and Saez, 2002, Kleven and Schultz, 2014). In the baseline specification, we focus on the 2008–2011 interval for two main reasons: first, to minimize the concerns related to the inter-temporal shift in earnings for tax avoidance purposes that

[19]We find no significant effects of the reform on hours worked by workers in the residual group. One possible reason for this is that workers in the residual group are close, in terms of income, to the top bracket and thus are unwilling to work more hours to avoid substantially higher taxes. Due to the absence of a direct effect, we also do not find significant spillovers from workers in the residual group to low-income workers (column 3 in Table D.11). For more details on the estimation of these effects, see Section C.4 in the online Appendix.

occurred between 2009 and 2010 (Kreiner et al., 2016) and, second, to reduce the possibility that the effects measured could capture lagged effects of a prior tax reform that occurred in 2004. However, as a robustness check, we also consider all the 3-years intervals between 2006 and 2011, but we exclude the years prior to 2006, as they would be too close to the 2004 reform.

5.3 The attenuating effects of coordination

We analyze the effect of the tax reform on the labor supply of high-income workers using the following empirical model:

$$log\left(\frac{h^H_{it+3}}{h^H_{it}}\right) = \beta_0 + \beta_1\, log\left(\frac{1-\tau^H_{it+3}}{1-\tau^H_{it}}\right) + \beta_3\, X_{ijt} + \upsilon_{ijt} \tag{10}$$

In this model, the dependent variable is the log change in hours worked by high-income workers between 2008 and 2011. We relate this variable to the individual variation in the marginal net-of-tax rate on labor income (1-τ) that occurred over the same period. We control for a number of individual (i) and firm (j) characteristics X_{ij} measured in 2008 (time t). The effect of the reform is captured by β_1, which measures the elasticity of hours worked to changes in the marginal net-of-tax rate.

To test whether the response of high-income workers in more coordinated firms is lower than that of similar workers in less coordinated firms, we estimate this model separately for workers employed in high- and low-coordination firms. In the presence of attenuating effects, the elasticity β_1 is expected to be smaller, in absolute terms, for workers in high-coordination firms.

In this specification, the labor supply elasticity is inclusive of the income effect. In online Appendix C.5, we attempt to separate the uncompensated elasticity of labor supply from the income elasticity. However, our study is based on a single tax change that primarily affected workers in the upper part of the income distribution. Therefore, unlike other existing studies, we have limited variation in tax rates across the income distribution that is needed to separately estimate the two effects in a precise way. Despite the noisy estimates, the results in online Appendix C.5 support our baseline findings.

5.4 The spillover effects of a tax change

In firms that coordinate hours worked, a tax rate change that targets one type of workers can affect hours worked by other workers in the same firm (Prediction 3). We test this prediction by relating the effects of a tax-driven change in hours worked by high-income workers to changes in the supply of hours by low-income coworkers. The equation to be estimated takes the following form:

$$log\left(\frac{h^L_{ijt+3}}{h^L_{ijt}}\right) = \alpha_0 + \alpha_1\, log\left(\frac{\overline{h^H_{jt+3}}}{\overline{h^H_{jt}}}\right) + \alpha_2\, log\left(\frac{1-\tau^L_{it+3}}{1-\tau^L_{it}}\right) + \alpha_3\, X_{ijt} + \epsilon_{ijt} \tag{11}$$

The dependent variable in this model is the log change in the number of hours worked by low-income worker i in firm j between 2008 and 2011. The regressor of key interest is

$$log\left(\frac{\overline{h^H_{jt+3}}}{\overline{h^H_{jt}}}\right) = log\left(\frac{H^{-1}_{jt+3}\sum_{h=1}^{H_{jt+3}} h_{hjt+3}}{H^{-1}_{jt}\sum_{h=1}^{H_{jt}} h_{hjt}}\right) \tag{12}$$

This term captures the log change in the average number of hours worked by high-income workers in firm j. We isolate the tax-related component of this change using the average variation in the marginal net-of-tax rate on labor income among high-income workers in firm j as an instrument for the change in hours. Section 5.5 describes this instrument in detail. Based on the theory, we expect α_1 to be positive and greater in magnitude in more coordinated firms.

The term $log\left(1-\tau^L_{it+3}/1-\tau^L_{it}\right)$ in equation (11) captures the changes in the marginal net-of-tax rate on labor income faced by low-income workers between 2008 and 2011. Since the reform lowered the marginal tax rate paid by low-income workers, this term controls for the direct effect of the reform on the supply of hours of low-income workers. Finally, X_{ijt} is a vector of firm and individual controls measured in 2008.

The empirical specifications that we have discussed thus far differ from the standard model in the taxable income literature (e.g., Gruber and Saez, 2002) along two important dimensions. First, we estimate the effect of tax changes on hours worked rather than on labor income. In our setting, in fact, a tax rate change can shift hours and wage rates in opposite directions, which makes it difficult to interpret the overall effect on labor income. Second, in equation (11), we augment the standard model with an additional term that captures the spillover effects of the tax change among coworkers. This is done to reflect a key feature of our framework whereby the hours worked by one type of worker depend on the hours worked by the other workers in the same firm. Section A.6 in the online Appendix describes how to adapt the standard economic model underlying the empirical specification used in the literature to the specific features of our setting.[20]

5.5 *Identification*

The identification of the effects of the reform from equations (10) and (11) needs to address multiple issues. First, due to the non-linearity of the tax schedule, the marginal tax rate in the post-reform period depends on post-reform income, which is endogenous to the supply of hours. This situation creates a correlation between $\Delta\, log\ (1-\tau_{it})$ and the error terms in our specifications. Second, changes in the supply of hours by high-income workers in equation (11) might be correlated with changes in the supply of hours worked by low-income coworkers in endogenous ways. This might be the case, for instance, if both types of workers experience the same unobserved local labor market shocks, local policy reforms or changes specific to a firm (e.g., firm organizational changes and changes to the technologies used in production).

To address the first set of concerns, following the literature (e.g., Gruber and Saez, 2002), we construct a set of instruments based on mechanical tax rate changes that are driven only by variations in the tax laws, which we denote by the subscript M. In practice, for each individual in the sample, we use a simulator of the Danish tax system to obtain marginal tax rates on labor income (τ_{Mit+3}) in the post-reform period (time $t+3$) based on income in the pre-reform period (time t) adjusted for inflation. We then construct the mechanical change in the marginal net-of-tax-rate on labor income of high-income workers as $log\left(1-\tau^{H}_{Mit+3}\right) - log\left(1-\tau^{H}_{it}\right)$, and we use it as an instrument for the observed change $\Delta\, log\ \left(1-\tau^{H}_{it}\right)$ in equation (10). Similarly, we use the mechanical change in the marginal net-of-tax rate of low-income workers $log\left(1-\tau^{L}_{Mit+3}\right) - log\left(1-\tau^{L}_{it}\right)$ as an instrument for the observed change $\Delta\, log\ \left(1-\tau^{L}_{it}\right)$ in equation (11).

By holding real income constant between t and $t+3$, these instruments exploit the variation in the marginal tax rates due to changes in the tax schedule only. While these instruments are

[20] As done in other studies (e.g. Gruber and Saez, 2002, Kleven and Schultz, 2014) we weight observations by labor income. The unweighed regressions, however, deliver almost identical results (see columns 7 and 8 of Table D.12 and column 4 of Table D.14 in the online Appendix).

exogenous to post-reform income, they still depend on pre-reform income, which is problematic if the latter correlates with the error term due, for instance, to mean reversion or long-term income trends (Slemrod, 1998, Saez et al., 2012). To address this issue, we follow the existing literature and estimate a set of additional regressions in which we control for pre-reform income in a flexible way. Overall, however, we find that our baseline results are not substantially affected by these controls, which may be because, unlike most other studies, we estimate separate regressions on rather homogeneous groups of workers (i.e., low-income and high-income). Furthermore, we study a relatively short time period, thus limiting the concerns related to long-term trends. Since our results are not too sensitive to the specific functional form used to control for pre-reform income, we present as baseline specifications those that maximize the power of the first-stage regression, as measured by the F-stat on the excluded instruments. Then, we present in the online Appendix all other specifications (Tables D.12 and D.13).

Turning to the identification of the spillover effects (α_1) from equation (11), we use simulated marginal tax rates to construct the mechanical change in the average marginal net-of-tax rate on labor income faced by high-income workers in each firm j:

$$log\left(\frac{\overline{1-\tau^H_{Mjt+3}}}{\overline{1-\tau^H_{Mjt}}}\right) = log\left[\frac{H^{-1}_{jt+3}\sum_{h=1}^{H_{jt+3}}(1-\tau_{Mhjt+3})}{H^{-1}_{jt}\sum_{h=1}^{H_{jt}}(1-\tau_{Mhjt})}\right] \tag{13}$$

We then use this term as an instrument for $log\left(\overline{h^H_{jt+3}}/\overline{h^H_{jt}}\right)$ in equation (11). This instrument isolates the component of the change in hours of high-income workers due to the tax reform from other confounding factors. Its validity relies on the assumption that the instrument affects hours worked by low-income workers only through changes in the average hours of high-income coworkers. This assumption may be violated if, for instance, the tax reform, while changing the supply of hours by high-income workers, also leads to the adoption of new technologies that require a different supply of hours by low-income workers. However, we fail to find significant effects of the reform on firm size, physical capital or the share of high- relative to low-income workers, which suggests that firm technologies are not affected by the reform (for details see the online Appendix C.6).

5.6 *Results*

5.6.1 Coordination and attenuating effects

Table 4 reports the elasticity of total hours worked by high-income workers to the net-of-tax rate estimated from equation (10). In columns 1 to 3, we estimate the regression on all high-income workers in the sample, while in columns 4 to 7, we differentiate between workers in high- and low-coordination firms. The base year in all the specifications is 2008. We measure the degree of coordination of each firm in the base year using the standard deviation of hours worked across skill groups, as described in Section 4.3. Highly coordinated firms are in the bottom half of the distribution of the standard deviation across firms, while low-coordination firms are in the top half. To attach each worker to the correct measure of coordination, we restrict the analysis to high-income workers who are at the same firm in 2008 and 2011.

The first column in Table 4 shows the OLS estimates, while all other columns are based on the IV model described in the previous section. In the absence of controls for pre-reform income, the elasticity from the IV model in column 2 is approximately -0.07. Likely due to mean reversion, the elasticity increases to -0.05 when we control for income in 2008 (column 3). Based on this estimate, the total hours of high-income workers decreased by approximately 0.8% or about 15 hours on a yearly basis as an effect of the reform.[21]

When we divide the sample between workers at firms with a high (column 4) versus low (column 5) degree of coordination, however, we find substantial differences between the two groups. In line with Prediction 4, we estimate a statistically significant elasticity of approximately -0.1 in low-coordination firms, while in high-coordination firms, the elasticity is insignificant and approximately -0.02. The two elasticities are statistically different at the 5% level. Therefore, based on these estimates, hours worked by high-income workers in firms with a high degree of coordination were not significantly affected by the reform, while high-income hours in low-coordination firms decreased by approximately 1.6%, or approximately 30 hours per year.[22]

[21] The result of -0.8% is obtained as the product of the the elasticity (-0.047) and the average log change in the net-of-tax rate between 2008 and 2011 (17%). The 0.8% decrease is then multiplied by the average number of hours worked in 2008 by the high-income workers in the estimation sample (i.e., 1924) to obtain the change in hours due to the reform.

[22] The average change in hours worked is derived as the product of the elasticities in low-coordination firms

The difference between the two elasticities widens as we move towards the extremes of the distribution of coordination. In fact, workers in the bottom 25% least coordinated firms are more responsive than the baseline. Conversely, workers in the top 25% most coordinated firms show elasticities that are insignificant and even closer to zero. This finding indicates that the attenuating effects increase with the degree of hours coordination in a firm.

One concern with these results is that the differential effects may be driven by unobserved characteristics of high- relative to low-coordination firms (e.g. different labor supply preferences of workers, different sectors/production technologies). To better investigate this possibility, in columns 1 and 2 of Table 5, we follow the workers from the baseline regressions back to 2006; then, we estimate our baseline models on all 3-year intervals between 2006 and 2011. These specifications allow us to control for unobserved characteristics specific to a firm using firm fixed effects. Moreover, having observations from multiple 3-year intervals also allows us to include fixed effects for each interval, which provide a way to control for confounding factors specific to a time period (e.g., macroeconomic shocks, other policy reforms). While these specifications have some advantages over the baseline one, they are more likely to capture lagged effects of the 2004 tax reform. Reassuringly, however, the elasticity in the two types of firms remains statistically different at 5% and of a similar magnitude as in the baseline.

One other concern is that the different elasticities may be driven by the interaction between the tax reform and other firm characteristics that correlate with coordination. For this reason, in columns 3 to 6 of Table 5, we present the results obtained while controlling for the interaction between changes in marginal tax rates and other firm characteristics, such as TFP and firm size, which strongly correlate with coordination (see Table 3). In these specifications workers in high- and low-coordination firms exhibit statistically different elasticities.[23]

When we base our measure of coordination on educational groups and occupational categories (section 4.3), rather than using the AKM-based measure of skills, we find similar results (columns 1 and 2 in the online Appendix Table D.37). Finally, considering part-time workers in the measure of hours coordination leads to similar results (online Appendix Table D.15).

(i.e., -0.097 for total hours and -0.061 for regular hours), the average net-of-tax rate change (17%) and the average number of hours worked by high-income workers in low-coordination firms (i.e., 1914 total hours).

[23] We obtain similar results when we control for other firm characteristics, such as the firm's exporter status or unionization rate. These results are available upon request.

5.6.2 Coordination and attenuating effects - discussion of the results

Several studies in the literature find an elasticity of hours across all firms that are close to zero (see Chetty, 2012). Our results document pronounced attenuating effects associated with coordination, which provide a mechanism to explain the low elasticities estimated in previous studies. While coordination attenuates behavioral responses, it also lowers the loss in tax revenues from high-income workers. Based on our results, we can conclude that if workers in high-coordination firms were to change their supply of hours as workers in low-coordination firms do, then the loss in tax revenues would be twice as large (see Appendix A.7 for details).

Interestingly, we find a negative elasticity of hours worked, which indicates that, in our setting and sample, the income effect prevailed. Findings of a negative elasticity of hours are not rare in the literature (e.g., Ashenfelter and Heckman, 1973, Ham, 1982). Since we focus on hours worked, however, our results are not directly comparable to those of the studies on the elasticity of taxable/labor income (e.g., Feldstein, 1995, Gruber and Saez, 2002, Kleven and Schultz, 2014). This is even more so in our framework in which hours worked and wage rates can move in opposite directions due to compensating wage differentials from coordination (see online Appendix A.5). Suggestive of this possibility, we find insignificant effects of the reform on labor income in our sample (column 1 of online Appendix Table D.16).

Relative to the recent literature on taxable income in Denmark, two other aspects make our results difficult to compare to those, for instance, of Kleven and Schultz (2014). First, we analyze a different tax reform; second, we base our analysis on the sample of workers for whom data on hours are available, while Kleven and Schultz (2014) base their analysis on the overall population of employees for which data on labor income are available. When we use data on all employees to estimate the elasticity of labor income associated with the 2010 tax reform, we obtain an estimate of 0.03 (column 2 in online Appendix Table D.16), which is in line with the 0.05 elasticity estimated in Kleven and Schultz (2014) for previous reforms. This finding is reassuring, as it rules out the possibility that our empirical model is misspecified, while suggesting that differences across estimating samples may be yet another factor contributing to the different findings.

5.6.3 Coordination and spillovers

Table 6 reports the estimated elasticity of low-income hours to the average hours of high-income coworkers obtained from equation (11). In these specifications, the base year is 2008, and we focus only on low-income workers who are at the same firm in 2008 and 2011. Column 1 reports the OLS estimates, while columns 2 to 11 show the IV estimates. In all specifications, we include the change of the marginal net-of-tax rate experienced by low-income workers to control for any direct effect of the reform on low-income hours.

In line with Prediction 3, we estimate positive and significant spillovers that are robust to controls for pre-reform income (columns 3 and 4). Specifically, in our preferred specification (column 3), we estimate an elasticity of regular hours of low-income workers to the average hours of high-income coworkers of 0.88, which implies an increase of 0.85 hours worked by low-income workers for each additional hour that high-income coworkers provide, on average. Based on this, we estimate that the regular hours of low-income coworkers decreased by approximately 8.5 hours (or 0.5%) on a yearly basis as an effect of the reform.[24]

The existence of spillovers has two main implications. First, it implies a change in tax revenues due to the change in labor supply from low-income workers. Specifically, in our setting, we estimate that tax revenues decreased by approximately 3.3% due to spillovers (see details in online Appendix A.7). Second, with spillovers, the use of untargeted workers as a control group to estimate the labor supply elasticity provides downward-biased estimates, which is yet another reason that may explain the low elasticity estimated in some existing studies (e.g., Eissa and Liebman, 1996; Kreiner et al., 2016). In our setting, using low-income workers as a control group in a difference-in-differences model would result in an elasticity of high-income hours of -0.01 (Appendix Table D.17). This captures only approximately 20% of the elasticity obtained from the instrumental variable approach of the previous section.

We would expect the spillovers to be stronger in firms with a higher degree of coordination. Based on the results from the previous section, however, in firms with a high degree of coordi-

[24] An increase in high-income hours by 1 is equivalent to a 0.053% increase, causing an increase of 0.043% of low-income hours (0.053%*0.88) that, at the average hours worked by low-income workers (1,812), is equivalent to 0.85 hours. The reform caused a decrease of approximately 10 regular hours worked by high-income workers (elasticity of -0.03, see Table D.27), thus implying a change of 8.5 regular hours worked by low-income workers.

nation, the attenuating effects are also strong, preventing high-income workers from changing their hours and, therefore, from affecting the hours of low-income coworkers. We then expect spillovers to be stronger in the middle of the distribution of coordination, where the attenuating effects are mild, but the need for coordination is still strong enough to generate spillovers. In line with this, when we decompose the spillovers of column 3 along the distribution of coordination, we find that they are driven by firms in between the first quartile and the median of the distribution (column 7).

If we include overtime hours, the elasticity of low-income to high-income hours is higher, which suggests even stronger spillovers from overtime (column 11). However, the point estimate from this specification might be inflated by the low power of the instrument (F-stat of approximately 4).

Our results complement those of other studies that find aggregate evidence of excess mass in the distribution of taxable income at kinks in the tax schedule (bunching) among a minority of workers who do not face these kinks (Chetty et al., 2011, Best, 2014). However, we provide firm-level evidence that suggests that coordination is a mechanism through which changes in preferences over hours spill over to other coworkers. In doing so, we also document a much more pervasive phenomenon than that linked to aggregate bunching. In fact, when excluding taxpayers close to the major kinks in the Danish tax schedule, the spillovers remain significant and of similar magnitude (column 3 of Table D.14 in the Appendix).

To check whether the spillovers may be explained by unobserved characteristics of all workers in a firm or by other events specific of the 2008–2011 time interval, in the online Appendix Table D.14, we estimate the baseline model on all 3-year intervals between 2006 and 2011. In these specifications, we then include firm and time-interval fixed effects. While these specifications result in a weaker first stage (i.e., lower F-stats), the spillovers remain significant and of a similar magnitude (columns 1 and 2).

In the online Appendix, we also present the results obtained under two alternative definitions of hours coordination. First, we include hours of part-time workers in the measure of coordination (Appendix Table D.15); second, we base our measure of coordination on educational groups and occupational categories (section 4.3) rather than using the AKM-based measure of skills (columns 3 and 4 in Table D.37). In both cases, we obtain results similar to the baseline.

In online Appendixes C.4 and C.5, we present a set of additional robustness checks that include flexible controls for pre-reform income, the estimation of attenuating and spillover effects based on an alternative database on hours worked (*E-indkomst*) and the use of alternative measures of hours dispersion in a firm.

5.6.4 Spillovers and peer effects

Spillovers across coworkers may occur through peer effects rather than hours coordination. The existing studies, however, find significant peer effects among coworkers with similar skills (Mas and Moretti, 2009; Bandiera et al., 2010). On the contrary, we study spillovers across workers with different levels of income who are less likely to be peers, which would therefore suggest that peer effects may be of secondary importance in our setting.

To better investigate the importance of peer effects, we estimate the spillovers separately for workers in occupations characterized by more repetitive tasks and workers in less-repetitive occupations. In fact, workers performing more standardized tasks can more easily observe and judge one another's work and may therefore face stronger peer pressure (Cornelissen et al., 2017). We select the most repetitive occupations using the classification proposed by Cornelissen et al. (2017), which also includes occupations such as agricultural helpers or cashiers, for which peer effects are known to be strong (Mas and Moretti, 2009; Bandiera et al., 2010). We find significant spillovers only among workers in less-repetitive occupations, which confirms that peer pressure is unlikely to explain the spillovers in our setting (online Appendix Table D.18).[25]

[25] One alternative explanations of the spillovers is the existence of complementarities in leisure time among coworkers. Unfortunately, the data at hand do not allow us to properly investigate this hypothesis. However, time use data indicate that Danish workers spend, on average, only 2.5% of their leisure time with non-family members, which suggests that leisure complementarities are likely to be small. In line with this interpretation, Georges-Kot et al. (2017) find small leisure complementarities among coworkers in France.

6 Coordination of hours within skill groups

Due to the specific features of the tax reform that we analyze, in this study, we focus on coordination of hours among workers with different skills or income levels. However, hours coordination among similarly skilled workers is an equally interesting and potentially important aspect to study. In fact, when we decompose the overall variance of hours worked in a within- and between- skill groups component, we find that a substantial part (i.e., 65%) of the variation of hours is within skill groups.[26] At the firm level, we find that the standard deviation of hours across skill groups positively and strongly correlates with the standard deviation of hours within skill groups (Table 2), which indicates that these two dimensions of hours coordination move together. Finally, we find that the average standard deviation of hours within skill groups is negatively and significantly correlated with the firm component of wages, which would suggest that coordination within skills may play a role in explaining firm wage inequality (online Appendix Table D.19). For reasons similar to those discussed in the case of coordination between skill groups, coordination within skill groups may also distort the effects of policy interventions that differently affect workers with similar skills, thus leaving space for potentially interesting future research.

7 Conclusions

This paper explores how the coordination of hours affects the firm component of wages. Our findings indicate that coordination is strongly correlated with wage differentials across firms. Future work might investigate how coordination is associated with other dimensions that are linked to firm wage inequality, such as the gender gap (Card et al., 2016).

We also find attenuated responses to tax changes in high-coordination firms and spillovers on the supply of hours by coworkers not targeted by the tax reform. These findings stress the importance for future research and policy evaluations to take spillovers into account when assessing the effects of a tax reform.

[26] The share of variation within skills may be inflated by measurement error in hours and therefore should be interpreted with caution.

Finally, the implications of our results go beyond tax reforms and apply to any policy intervention that affects the preferences over hours of one group of workers in a firm. For instance, policies that target the supply of hours of older workers or workers with children might indirectly affect other coworkers. The analysis of hours coordination in these different settings may also provide a way to study the distortive effects of coordination among workers with similar skills.

Supplementary material

An online Appendix for this article can be found at `https://drive.google.com/file/d/0ByvVLbcKzrtAbVAwVEJWUVJtQTg/view`

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Tables and figures

Table 1: Descriptive statistics

	IDA Sample		IDA -Firmstat-LON sample		Final sample	
	(1)	(1)	(2)	(2)	(3)	(3)
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Workers Characteristics						
Mean Age	39.82	12.87	41.11	11.09	42.05	10.91
Fraction < 30 years old	0.27	0.44	0.19	0.39	0.16	0.37
Fraction > 50 years old	0.27	0.44	0.25	0.43	0.27	0.45
Fraction Males	0.50	0.50	0.66	0.47	0.70	0.46
Fraction Unionized	0.70	0.46	0.73	0.44	0.77	0.15
Fraction Hourly	0.17	0.37	0.24	0.42	0.28	0.45
Fraction Primary Educ.	0.33	0.47	0.28	0.45	0.29	0.45
Fraction Secondary Educ.	0.40	0.49	0.52	0.50	0.51	0.50
Fraction Tertiary Educ.	0.27	0.43	0.20	0.39	0.20	0.39
Hourly wage (in DKK)			187.07	141.14	183.65	124.37
Annual Labor Income (in 1000 DKK)	267.00	448.30	357.93	288.35	349.36	248.68
Total Annual Hours			1907.99	213.01	1896.19	197.24
Overtime Annual Hours			27.82	95.55	27.62	87.60
Workers by sector (% of total)						
Agriculture, forestry and fishing, mining and quarrying	2.52		0.37	6.05	0.16	4.00
Manufacturing	26.60		32.48	46.83	35.73	47.92
Construction	10.35		8.67	28.15	9.43	29.23
Electricity, gas, steam and air conditioning supply,						
Trade and transport	30.14		43.46	49.57	40.82	49.15
Financial and insurance, Real estate, Other business	22.95		14.82	35.53	13.71	34.39
Other services	7.44		0.2	4.46	0.15	3.92
Firms Characteristics						
Hours Coordination					94.65	91.73
Mean Firm Size			51.42	328.24	43.37	302.3649
Mean Capital per employee (1000 DKK)			423.49	7339.72	963.66	43505.13
Mean Value Added per employee (1000 DKK)			436.30	3040.25	504.30	1773.43
Mean Revenues per employee (1000 DKK)			1687.35	6511.18	2132.89	8693.84
Exporters (%)			39.40	48.86	39.96	48.98
Number of observations	22,379,298		4,466,676		787,683	
Number of individuals	3,518,236		1,205,301		400,653	
Number of firms	266,196		25,249		8,369	

Notes: The table shows the mean and the standard deviations for a set of variables for 3 groups of employees. In all 3 groups, we consider only workers who are between 15 and 65 years of age in the years 2003-2011. The "IDA Sample" refers to the entire Danish population. The "IDA-Firmstat-LON" sample refers to the sample of workers in IDA that can be matched to Firmstat and LON samples. The "Final sample" is composed of all the workers from IDA-Firmstat-LON who are employed in firms in which information on hours is available for at least 95% of the workforce. Data on employment by industry for the entire population are from Statistikbanken (Statistics Denmark), which does not provide standard errors around mean values. Blue-collar workers and top managers are defined on the basis of the level of occupation extracted from the IDA variable "PSTILL". Annual and hourly earnings, value added, capital and sales are expressed in Danish Kroner (DKK) and deflated using the CPI index with 2000 as the base year (8 DKK $\simeq$ 1 USD in 2000).

Table 2: Coordination and firm characteristics

	Stand. Dev. Of Hours across skill groups within firms			Obs.
	(1)	(2)	(3)	
Value Added per employee	-0.038***	-0.014*	-0.014**	17806
	(0.008)	(0.007)	(0.007)	
TFP	-0.133***	-0.071***	-0.068***	16213
	(0.008)	(0.011)	(0.012)	
Firm size	-0.032***	-0.044***	-0.094***	17806
	(0.007)	(0.012)	(0.022)	
Exporter status	-0.162***	-0.037***	-0.023***	17806
	(0.007)	(0.011)	(0.011)	
Share of tertiary educ. workers	-0.181***	-0.081***	-0.079***	17806
	(0.007)	(0.011)	(0.012)	
Fraction of hourly workers	0.337***	0.267***	0.260***	17806
	(0.007)	(0.015)	(0.015)	
Fraction of part-timer workers	0.221***	0.120***	0.128***	17806
	(0.008)	(0.014)	(0.013)	
Fraction of female workers	-0.034***	0.064**	0.058**	17806
	(0.008)	(0.012)	(0.013)	
Mean managerial ability	-0.180***	-0.043**	-0.033**	16423
	(0.008)	(0.013)	(0.013)	
Adjust actions to others	-0.161***	-0.083***	-0.085***	13439
	(0.009)	(0.012)	(0.013)	
Negotiation	-0.310***	-0.174***	-0.171***	13439
	(0.009)	(0.014)	(0.015)	
Persuasion	-0.313***	-0.179***	-0.179***	13439
	(0.009)	(0.014)	(0.015)	
Social perceptiveness	-0.289***	-0.132***	-0.136***	13439
	(0.009)	(0.014)	(0.015)	
Blue collar workers: 90th/10th wage ratio	0.121***	0.066***	0.074***	15776
	(0.008)	(0.013)	(0.013)	
Top managers: 90th/10th wage ratio	-0.079***	-0.043***	-0.034***	12546
	(0.008)	(0.009)	(0.008)	
Std. Dev. hours within skill groups	0.572***	0.522***	0.522***	16462
	(0.006)	(0.019)	(0.019)	
Mean dependent variable	90.66	90.66	90.66	
Std. dependent variable	95.74	95.74	95.74	
2 digits Sector F.E.	NO	YES	NO	
3 digits Sector F.E.	NO	NO	YES	

Notes: The table shows standardized coefficients from regressions of the standard deviation of hours across skill groups within firms from Section 4.3 on firm characteristics and a constant. Each cell in the table corresponds to a different regression. In columns 2 and 3, we add industry fixed effects to the baseline regressions. To do so, we use the Danish industry classification DB07, which corresponds to NACE rev.2. Regressions are based on firm-year observations from the firms in our final sample (Table 1) for the years 2003–2011. TFP (total factor productivity) is obtained following Ackerberg et al. (2015) (online Appendix B.3). Managerial ability is measured as the average individual fixed effect ($\hat{\alpha_i}$) from an AKM model among the workers in the top quartile of the distribution of $\hat{\alpha_i}$ in each firm. To avoid confusion, we label the O*NET descriptor “Coordination” as “Adjust Actions to Others”. To identify production workers and managers, we use the primary employment variable (“PSTILL”), which defines the job function of the most important employment at the end of November of each year. Standard errors in parentheses are clustered at the firm level. * p<0.10, ** p<0.05, *** p<0.01.

Table 3: Coordination and wage premiums

	(1) Firm Mean Wage	(2) Firm f.e.	(3) Firm f.e.	(4) Firm f.e.	(5) Firm f.e.	(6) Firm f.e.
Std dev. hours btw skill groups	-0.140***	-0.076***	-0.054***	-0.045***	-0.028**	-0.028**
	(0.021)	(0.015)	(0.016)	(0.012)	(0.012)	(0.013)
Firm size			0.011	0.011	0.007	0.018***
			(0.008)	(0.007)	(0.005)	(0.007)
Exporter status			0.045***	0.045***	0.022*	0.014
			(0.015)	(0.016)	(0.013)	(0.013)
Union. rate			0.023	0.030*	0.031	0.033*
			(0.017)	(0.016)	(0.019)	(0.018)
Female share			-0.136***	-0.173***	-0.117***	-0.108***
			(0.034)	(0.033)	(0.024)	(0.025)
Average hours			0.129	0.062	-0.036	-0.048
			(0.084)	(0.094)	(0.089)	(0.088)
log(Cap./empl)			0.023*	0.025**	0.029***	0.036***
			(0.012)	(0.012)	(0.010)	(0.010)
Region F.E.	NO	NO	YES	YES	YES	YES
Additional Controls	NO	NO	YES	YES	YES	YES
1 digit Sector F.E.	NO	NO	NO	YES	NO	NO
2 digits Sector F.E.	NO	NO	NO	NO	YES	NO
3 digits Sector F.E.	NO	NO	NO	NO	NO	YES
Mean Dependent Variable	0.013	0.456	0.456	0.456	0.456	0.456
Mean Std Dev. btw skill gr.	94.643	94.643	94.643	94.643	94.643	94.643
Part. R-sq SD Hours	0.024	0.008	0.004	0.003	0.001	0.001
Part. R-sq VA and Sales	0.135	0.025	0.027	0.027	0.015	0.013
Coordination Share	0.175	0.319	0.146	0.095	0.054	0.061
R-sq	0.024	0.008	0.284	0.291	0.322	0.330
N	7464	7464	7464	7464	7464	7464

Notes: In this table, we report the results of estimating equation (7). All regressions report standardized coefficients. In column (1), the dependent variable is the firm's mean wage. In columns (2)-(6), the dependent variable is the firm fixed effect from the AKM model (8). The variable "Std dev. hours btw skill groups" in the table refers to our measure of hours coordination that is the standard deviation of the average total (regular and overtime) hours worked across skill groups within a firm (Section 4.3). Skill groups are defined as deciles of the distribution of $\hat{\alpha_i} + \hat{\beta}\, X_{ijt}$ from the AKM model (8). The exporter dummy is defined as the modal exporter status (i.e., zero for not exporting, one for exporting) between 2003 and 2011. "Region f.e." refers to the following region dummies: Capital Region of Denmark; Central Denmark Region; North Denmark Region; Region Zealand; Region of Southern Denmark. "Additional Controls" refers to a vector of controls for the share of workers in each skill group, a vector containing the average value of the individual fixed effects $\hat{\alpha_i}$ in each quartile of the distribution of $\hat{\alpha_i}$ within a firm and average hours squared. "Coordination Share" is derived as the ratio of "Part. R-sq SD Hours" and "Part. R-sq VA and TFP" (Section 4.1). "Part. R-sq VA and TFP" is from Table D.9. Value added and TFP are obtained as described in Appendix B.3. Standard errors are clustered at the 2-digit industry level. *, ** and *** indicate significance at the 10, 5 and 1 percent levels.

Table 4: The elasticity of hours of high-income workers

	(1)	(2)	(3)	(4) High Coordination	(5) Low Coordination	(6) High Coordination	(7) Low Coordination
Dependent Variable:	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$
$\Delta log\,(1-\tau^H)$	-0.067***	-0.069***	-0.047***	-0.017	-0.097***	0.003	-0.147***
	(0.008)	(0.018)	(0.014)	(0.016)	(0.025)	(0.018)	(0.055)
Log base-year income			-0.008***	-0.002	-0.023***	-0.001	-0.038*
			(0.003)	(0.003)	(0.006)	(0.003)	(0.022)
IV	NO	YES	YES	YES	YES	YES	YES
Overtime Hours	YES	YES	YES	YES	YES	YES	YES
Mean Hours	1924.47	1924.47	1924.47	1928.33	1914.91	1917.40	1870.33
P-value $High = Low$				0.01		0.01	
F-stat Excl. Inst.		1355.19	754.51	1293.74	192.94	566.19	133.53
P-value Excl. Inst.		0.00	0.00	0.00	0.00	0.00	0.00
N Firms	1167	1167	1167	584	583	293	291
N	26488	26488	26488	18875	7613	8307	2371

Notes: This table reports the results from estimating equation (10). It shows the elasticity of high-income hours to the net-of-tax rate (1-τ^H). In columns 4 and 5, we distinguish between high- and low-coordination firms based on whether the firm is in the bottom or top half of the distribution of the standard deviation of hours across skill groups in 2008, respectively (Section 4.3). In columns 6 and 7, we define high-coordination firms as being in the bottom 25% of the distribution of the standard deviation of hours across skill groups in 2008 and low-coordination firms as firms in the top 25% of the standard deviation of hours across skill groups in 2008. The specifications in columns 2 to 7 use mechanical changes in the net-of-tax rate on labor income as an instrument for observed changes in 1-τ^H (Section 5.5). First-stage regressions are in Table D.30. "P-value High=Low" refers to the p-value of the null hypothesis that the coefficient attached to $\Delta log\,(1-\tau^H)$ in low- and high-coordination firms is equal. Each regression contains the following controls measured in the base year: work experience, work experience squared, sex, age, number of children, marital status, education, local unemployment (municipality), region fixed effects, firm size, exporter status, and share of high- and low-income workers in the firm (the residual group is omitted). We estimate this regression the 3-year change between 2008 and 2011. Observations are weighted by labor income. Standard errors in parentheses are clustered at the firm level.* p<0.10, ** p<0.05, *** p<0.01.

Table 5: Elasticity of high-income hours: additional specifications

	(1) High Coordination	(2) Low Coordination	(3) High Coordination	(4) Low Coordination	(5) High Coordination	(6) Low Coordination
Dependent Variable:	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$
$\Delta log\,(1-\tau^H)$	-0.027	-0.077***	-0.008	-0.105***	0.008	-0.075**
	(0.017)	(0.026)	(0.016)	(0.039)	(0.027)	(0.036)
$\Delta log\,(1-\tau^H)\times$ Size			-0.009	0.013		
			(0.015)	(0.164)		
$\Delta log\,(1-\tau^H)\times$ High TFP					-0.040	-0.059
					(0.038)	(0.073)
Firm F.E.	YES	YES	NO	NO	NO	NO
Base-year F.E.	YES	YES	NO	NO	NO	NO
P-value High=Low	0.02		0.02		0.02	
F-stat Excl. Inst.	1543.64	356.55	1043.54; 7163.93	291.56; 612.12	972.19; 2257.20	150.78; 941.42
P-value Excl. Inst.	0.00	0.00	0.00; 0.00	0.00; 0.00	0.00; 0.00	0.00; 0.00
N Firms	786	679	584	583	584	583
N	26441	10317	18849	7639	18849	7639

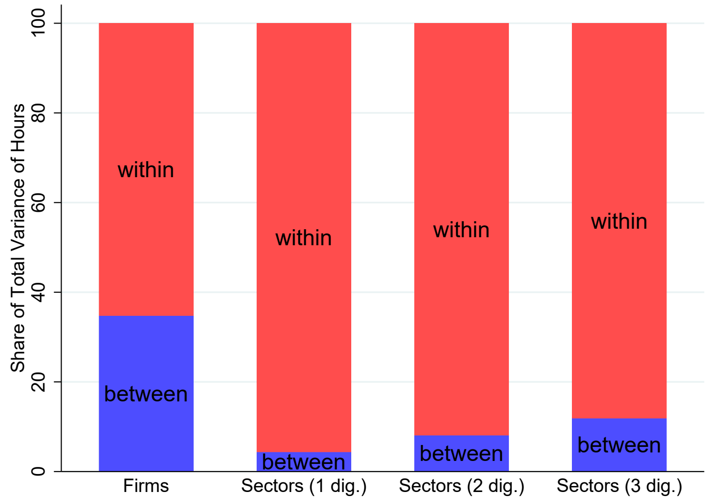
Notes: This table reports the results from estimating equation (10) while controlling for additional variables and fixed effects. The main variable of interest is the elasticity of high-income total hours (regular and overtime) to the net-of-tax rate (1-τ^H) reported in the first row. In columns 1 and 2, we consider all 3-year changes in the 2006–2011 period. In columns 3 to 6, we consider the 3-year change between 2008 and 2011 only. The term "Time interval F.E." refers to a set of fixed effects for each 3-year interval in between 2006 and 2011. We distinguish between high- and low-coordination firms based on whether the firm is in the bottom or top half of the distribution of the standard deviation of hours across skill groups in 2008, respectively. "P-value High=Low" refers to the p-value of the null hypothesis that the coefficient attached to $\Delta log\,(1-\tau^H)$ in low- and high-coordination firms is equal. The dummy variables "High TFP" (columns 5 and 6) take a value of 1 if the firm had TFP above the median in 2008, respectively. All specifications use mechanical changes in the net-of-tax rate on labor income as an instrument for observed changes in 1-τ^H (Section 5.5). First-stage regressions are in Table D.31. Each regression contains the following controls measured in the base year: log base-year labor income, work experience, work experience squared, sex, age, number of children, marital status, education, local unemployment (municipality), region fixed effects, firm size, exporter status, and share of high- and low-income workers in the firm (the residual group is omitted). Observations are weighted by labor income. Standard errors in parentheses are clustered at the firm level. * p<0.10, ** p<0.05, *** p<0.01.

Table 6: The spillover effects on hours worked by the low-income

	(1)	(2)	(3)	(4)	(5) High Coordination Above Median	(6) Low Coordination Below Median	(7) Low Coordination 25th to 50th pctile	(8) Low Coordination 0 to 25th pctile	(9) Low Coordination 12.5 to 25th pctile	(10) Low Coordination 0 to 12.5 pctile	(11)
Dependent Variable:	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$
$\Delta log\, \overline{h^H}$	0.540***	0.899***	0.878***	0.894**	1.195	0.608**	0.903**	0.668	2.345	0.224	
	(0.112)	(0.304)	(0.301)	(0.373)	(1.384)	(0.308)	(0.399)	(0.590)	(2.460)	(0.674)	
$\Delta log\, \overline{h}^H_{total}$											1.372**
											(0.596)
$\Delta log\, (1-\tau^L)$	-0.005	0.023	0.051	0.053	0.089	-0.050	0.399	-0.550**	-0.493	-0.818	0.031
	(0.009)	(0.088)	(0.114)	(0.126)	(0.156)	(0.186)	(0.253)	(0.252)	(0.407)	(0.698)	(0.141)
IV	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Splines of log t-1 Inc. and Δlog inc. t-1-t	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES
Log Mean Inc. High Sk.	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO
Overtime Hours	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES
F-stat Excl. Inst.		13.06, 160.40	15.45,76.76	4.66, 55.84	2.68, 43.12	7.83, 41.38	8.15, 22.12	1.80, 27.92	1.43, 17.35	1.77, 7.81	4.24, 76.57
P-value Excl. Inst.		0.00, 0.00	0.00, 0.00	0.03,0.00	0.10, 0.00	0.01, 0.00	0.00, 0.00	0.18, 0.00	0.23, 0.00	0.19, 0.01	0.04, 0.00
Mean Hours Low Sk.	1812.51	1812.51	1812.51	1812.51	1859.74	1742.53	1742.49	1743.20	1741.42	1746.34	1831.38
Mean Hours High Sk.	1875.00	1875.00	1875.00	1875.00	1893.86	1847.05	1840.27	1862.51	1828.08	1915.17	1910.07
N Firms	968	968	968	968	486	482	254	229	127	103	968
N	10091	10091	10091	10091	6025	4066	2845	1229	745	485	10091

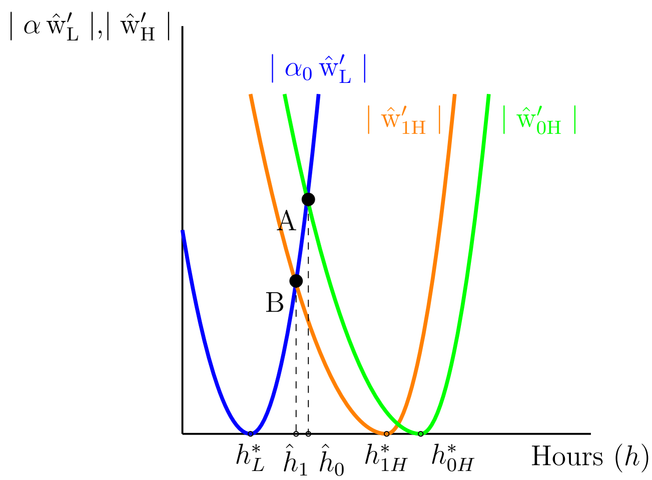
Notes: This table reports the results from estimating equation (11). It shows the elasticity of low-income hours to the average hours worked by high-income coworkers. Specifications in columns 2 to 11 use mechanical changes in the average net-of-tax rate among high-skilled workers in a firm as an instrument for the average change in hours and the mechanical change in the net-of-tax rate of low-income workers as an instrument for observed changes in 1-τ^L (Section 5.5). First-stage results are in Table D.32 and D.33. Low-coordination firms (columns 6-10) are defined as being in the top half of the distribution of the standard deviation of hours across skill groups in 2008. High-coordination firms (column 5) are defined as being in the bottom half of the distribution of the standard deviation of hours across skill groups in 2008. In order to be consistent with the previous tables, we use the distribution of coordination across all firms considered in Table 4. Each regression contains the following controls measured in the base year (2008): work experience, work experience squared, sex, age, number of children, marital status, education, local unemployment (municipality), region fixed effects, firm size, exporter status, and share of high- and low-income workers in the firm (the residual group is omitted). "Splines" refer to a flexible piecewise linear functional form with 5 components. We consider only low-income workers who are at the same firm between 2008 and 2011. We estimate these regressions on the time interval between 2008 and 2011. Observations are weighted by labor income. Standard errors in parentheses are clustered at the firm level.* p<0.10, ** p<0.05, *** p<0.01.

Figure 1: Variance of hours decomposition: between and within component



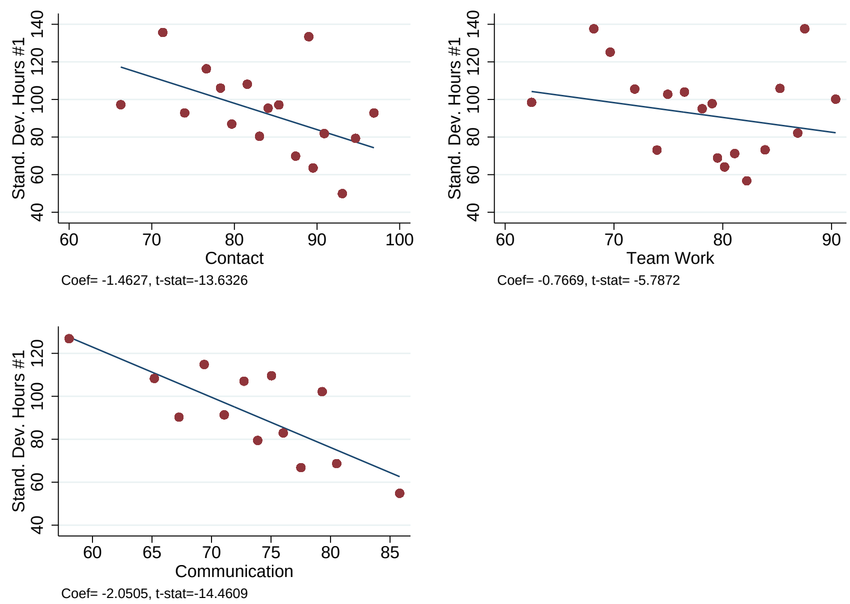
Notes: The figure depicts the decomposition of the variance in hours worked into between and within components (footnote 6). We consider the total annualized hours (including overtime) of full-time workers. The figure is based on the 787,683 individual-year observations in our final sample (Table 1). The first bar shows the decomposition into between- and within-firm components. The second, third and fourth bars show the within-between decomposition for 1-, 2- and 4-digit sectors, respectively. Industries are defined using the classification NACE rev. 2.

Figure 2: The effects of a tax rate decrease on wages



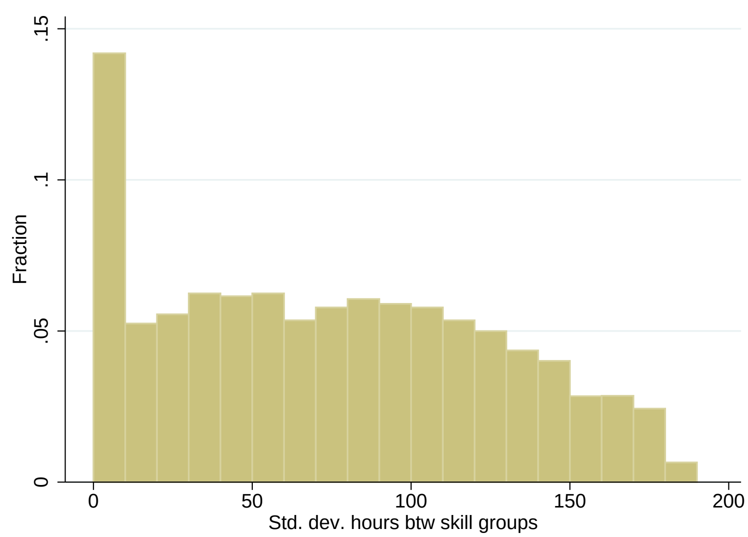
Notes: The figure shows on the y-axis the absolute value of the first derivative of the wage hours function in coordinated firms for high-income ($\hat{w}'_H$) and low-income workers ($\hat{w}'_L$). $\alpha = \hat{n}_L \div \hat{n}_H$ is the ratio between the number of low- and high-income workers in coordinated firms. At the optimum, $\hat{w}'_H + \alpha\hat{w}'_L = 0$. Therefore, we plot the absolute value of $\hat{w}'_H$ and $\hat{w}'_L$ to have them on the same quadrant. The shift from points A to B represents the change in optimal hours and wage rates in coordinated firms when the tax rate decreases and the income effect prevails, such that the desired hours of high-skilled workers shift down from h^*_{0H} to h^*_{1H}.

Figure 3: Validation: standard deviation of hours vs. coordination in O*NET



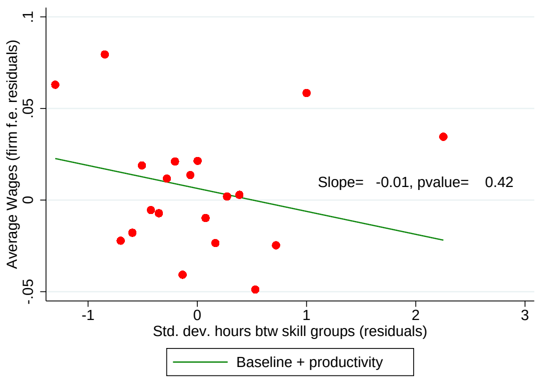
Notes: The figure shows the standard deviation of hours across skill groups within firms (Section 4.3) on the y-axis and 3 measures of firm-level coordination based on O*NET – contact, team work and communication – on the x-axis. These variables are measured on a scale of importance from 0 to 100. For each firm, we take the median importance of contact, team work and communication across workers. We break ties in median scores using the average. Firms are grouped into 20 bins, with each one containing the same number of firms. We plot mean values within each bin. At the bottom of each graph, we report the coefficient and the associated t-stat from a regression of the y on the x variable. We map the ISCO-88 classification of the Danish registers to the SOC classification in O*NET using the cross-walk provided by the National Crosswalk Center.

Figure 4: Distribution of hours coordination

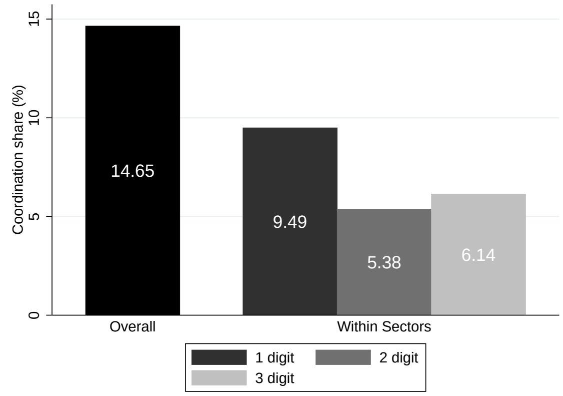


Notes: This figure presents the distribution of our measure of hours coordination – the standard deviation of the average total (regular and overtime) hours worked across skill groups within a firm (Section 4.3). Skill groups are defined as deciles of the distribution of $\hat{\alpha_i} + \hat{\beta} X_{ijt}$ from the AKM model (8). For each firm, we plot the average value of the standard deviation of hours across skill groups in the 2003-2001 period. Each bin in the histogram is ten hours long. To comply with the Danish micro-data usage regulation, we do not show the top 5% of the distribution because it would result in a number of observations below the allowed limit in some bins.

Figure 5: Coordination, productivity and firm wages



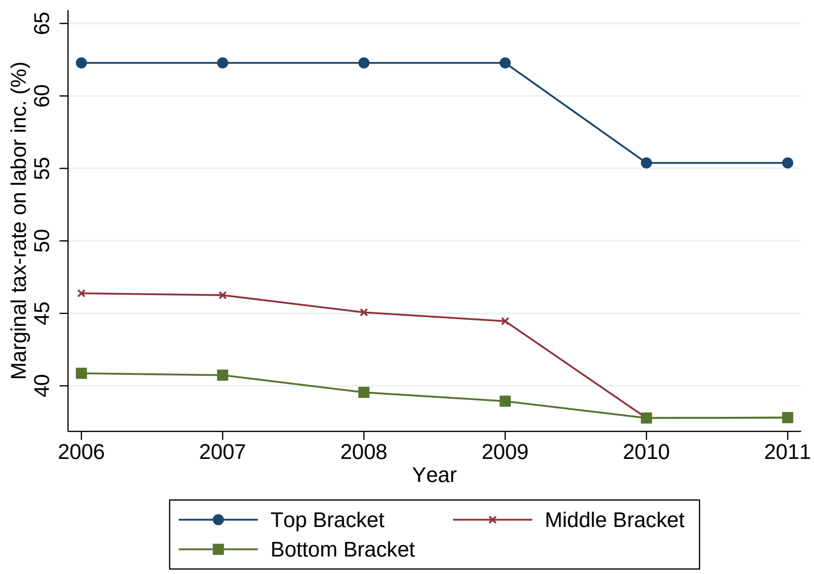
(a) Coordination, firm wages and productivity



(b) Coordination share

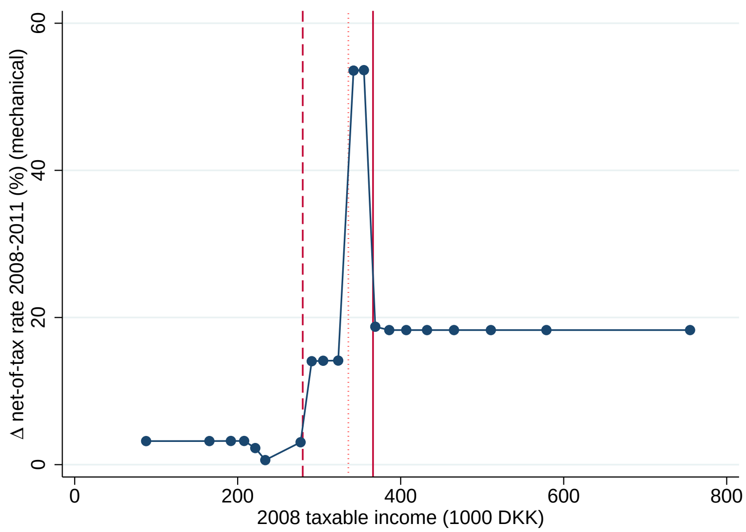
Notes: Panel A plots the residual firm component of wages and the residual standard deviation of hours between skill groups once we control for all other firm characteristics included in column 7 of the online Appendix Table D.5. The line results from a linear regression of the y-variable on the x-variable. The term "Slope" refers to the slope of the line, and "p-value" refers to the p-value of the slope. Firms are grouped into 20 bins, with each one containing the same number of firms. Firm productivity is measured as value added per employee, which is instrumented using total factor productivity to reduce the measurement error derived from using value added as a measure of firm productivity. The full regression behind Panel A is shown in column 7 of the online Appendix Table D.5. Panel B shows the "coordination share" (see details in section 4.1). The regressions behind Panel B are presented in columns 3 to 6 of Table 3.

Figure 6: The evolution of the marginal tax rate on labor income



Notes: The figure shows the evolution of the marginal tax rate on labor income between 2006 and 2011. The figure is based on Table D.26. Marginal tax rates on labor income in the bottom and middle brackets are obtained as follows: statutory marginal tax rate * (1 - labor market contribution) + labor market contribution - EITC; in the top bracket, they are obtained as marginal tax ceiling*(1 - labor market contribution) + labor market contribution.

Figure 7: Mechanical marginal net-of-tax rate change across taxable income



Notes: This figure plots the mechanical change in marginal net-of-tax rates on labor income between 2008 and 2011 over 2008 taxable income for each individual who is in our sample in both 2008 and 2011. Taxable income is expressed in 1000 DKK (5 DKK $\simeq$ 1 USD). Mechanical marginal tax rates in 2011 are based on 2008 income adjusted by inflation. Each bin contains the same number of workers. The graph plots the median value in each bin. The dashed line delimits the bottom tax bracket in 2008 (279,800 DKK). The dotted line is the lower boundary of the top tax bracket in 2008 (335,800 DKK; see Table D.26). The solid line is the lower boundary of the top tax bracket in 2011 expressed in 2008 DKK (nominal 389,900 DKK discounted by 1.06 CPI; see Table D.26).