Coordination of Hours within the Firm

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Abstract

Hours constraints set by firms have been proposed as an important friction that regulates labor supply responses to tax changes. Yet, little evidence exists on the source of these constraints or the magnitude of their effects. In this paper we use new data on hours worked at the firm-level in Denmark to explore one mechanism that leads firms to constrain hours: the need for coordination of hours among coworkers. We 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 using changes to the personal income tax schedule in 2010, which affected high-wage earners differently. We find evidence of higher labor supply elasticity in firms with lower hours coordination. Furthermore, we find evidence of substantial spillover effects on hours worked by coworkers not directly affected by the reform. These findings have important implications for the evaluation of the efficiency costs of a tax reform.

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1 Introduction

The debate on the effects of taxation on the supply of labor is a long standing one in the fields of public and labor economics (Saez et al., 2012). Within this vast literature a number of recent studies find that labor market frictions are important to the interpretation of the labor supply effects of taxation and to the design of optimal tax policies (e.g. Kleven and Waseem, 2013). Among these frictions 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). However, due to the lack of information on hours at the firm level, to date little is known about the source of these constraints and the magnitude of their effects. In this paper we use new data on hours worked in Denmark to study one mechanism that may lead firms to constrain hours: the need for coordination of hours among coworkers.

Since most jobs involve some degree of cooperation, coworkers spend a great share of their working time interacting with each other (Delarue et al., 2008; Cross and Gray, 2013). One key aspect of cooperation within firms is that it necessitates some degree of coordination of hours. Specifically, a need for interaction may require that coworkers work a more similar number of hours, despite possibly different labour supply preferences. Such type of coordination ties together the supply of hours of coworkers who may face different tax rates and tax changes and, in doing so, it affects labour supply responses to taxation. In fact, on the one hand, it restricts the ability of workers to respond to changes in taxation that do not homogenously affect the workforce of a firm. On the other hand, it generates labor supply spillovers from the coworkers who are targeted by a tax reform to the others. These spillovers increase the efficiency costs of a tax reform and can lead to the estimation of attenuated labor supply elasticities.

To conceptualize the link between coordination of hours and labor supply elasticities we develop a framework where differently productive firms employ workers with heterogeneous desired work hours. In this framework, firms can choose whether to coordinate hours or not. Coordination enhances productivity but requires hours worked to be the same across heterogeneous coworkers. We derive three main predictions. (1) More productive firms coordinate hours and pay compensating wage differentials for imposing sub-optimal hours. (2) Coordination at-

tenuates the labor supply responses of workers targeted by a tax change. (3) In coordinated firms a tax change that affects one type of workers has spillovers on 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. In fact, 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. Additionally, the Danish data allow us to link number of hours worked to individual and firm characteristics. Furthermore, compared to other European countries, Denmark has a relatively flexible labor market where employers have considerable discretion in setting wages and hours (Botero et al., 2004; Hummels et al., 2014). In particular, there are two institutional features that allow for discretion in the provision of hours by salaried and hourly workers: overtime hours and the possibility to convert paid vacation in working time.

We measure coordination using the standard deviation of average hours worked across skill groups in a firm. In doing so we assume that workers in different skill groups have different labor supply preferences, and that a lower dispersion of hours implies a greater overlap of workers at the workplace. Therefore low dispersion is interpreted as high-coordination.[1] Validation exercises performed using alternative measures of coordination from O*NET, the Survey of Adult Skills, and the Danish Time Use Survey support this interpretation. A descriptive analysis based on our coordination measure reveals that more coordinated firms are more productive, employ better able workers, are less likely to employ part-time or hourly workers, require a more intense use of social skills (Deming, 2017), and are more likely to be in the service sector.

With our measure of coordination in hand, we first explore 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, we find a strong and positive association between the

[1]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 each other. Unfortunately data of this type do not exist on a such 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.

firm component of wages and coordination of hours across and within sectors. This correlation is robust to a number of firm characteristics that are known to affect wage inequality across firms.[2] In the same specification, exporter status has a similar predictive power while firm size is not as predictive as coordination.

After controlling for measures of firm productivity the correlation between wages and coordination is insignificant. In line with our framework, this suggests that only highly productive firms can afford to pay higher wages to achieve greater coordination. Specifically, we estimate that coordination can explain between 4% and 12% 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 differentials for greater coordination in more productive firms.

In the second part of the paper we analyze the effects of a tax reform which abolished the middle bracket of a 3-bracket progressive tax schedule and lowered the top tax rates. This resulted in a sizeable reduction of the marginal tax rates of workers who used to be in the top and middle tax bracket prior to the reform (henceforth high-skilled).

To identify the attenuating effects of coordination we estimate the elasticity of hours worked by high-skilled 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 wages (Gruber and Saez, 2002). In line with the model predictions, we find an elasticity close to zero and insignificant in high-coordination firms, and a negative and significant elasticity of -0.1 in low-coordination firms.

Next, we test the existence of labor supply spillovers estimating the elasticity of hours worked by low-skilled workers to the tax-driven change of average hours worked by high-skilled coworkers. We find an elasticity of 0.88 that implies an increase of 0.85 hours worked by low-skilled for each additional hour provided by high-skilled coworkers. Consistent with our framework we find a lower elasticity among workers in low-coordination firms. Importantly, the effects of coordination that we document do not reflect differences in unionization rates across firms or time invariant firm characteristics.

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

Our findings of attenuating and spillover effects have multiple implications. First, the elasticity of labor supply captures only a part of the efficiency costs associated with a tax change (Feldstein, 1999) since it neglects the indirect effects on untargeted coworkers. Including spillovers we estimate an increase of 15% in the marginal excess burden 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 (e.g. Eissa, 1995; Blundell et al., 1998). We estimate that in our setting the elasticity obtained using low-skilled as a control group would capture only 14% of the high-skilled response. More generally, our study suggests that hours coordination can be important for policy evaluation, and it should be taken into account in the analysis of policy interventions that affect the preferences over hours of one group of workers in a firm (e.g. old workers, parents).

This study relates to multiple strands of the literature. First, it complements the set of studies that analyze the effects of taxation when employers impose constraints on hours (Chetty et al., 2011; Best, 2014; Battisti et al., 2015). Some of these studies show aggregate evidence of bunching of workers who do not directly face tax schedule kinks that is consistent with our finding of labor supply spillovers. Using newly available data on hours and the quasi-experimental variation deriving 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.[3]

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 that can explain recent findings suggesting that compensating differentials

[3]Battisti et al. (2015) present evidence of reduced intertemporal elasticities from structural simulations of a policy that only affects a fraction of the firm workforce. This evidence is consistent with the attenuating effects of coordination on steady-state elasticities that we document. We complement their analysis being able to measure coordination using firm-level data on hours and using a real preference shock deriving from a tax reform. Our results also help to shed light on existing evidence 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 such difference may be linked to firm-level coordination. Hamermesh et al. (2008) documents synchronization of working schedules across US states. Our results indicate that coordination among coworkers is associated to co-movement of hours.

are an important source of wage inequality across firms (Sorkin, 2018; Lavetti and Schmutte, 2016).[4] 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; Hamermesh, 1999; Card et al., 2016; Goldin and Katz, 2016; Mas and Pallais, 2017).

Finally, our study complements the literature that highlights the positive correlation between social skills and wages (Heckman and Kautz, 2012; Deming, 2017). We document, in fact, that workers in highly coordinated firms make more intense use of social skills. Compensating differentials from coordination can therefore be viewed as a channel through which higher wages are associated with social skills.[5]

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 relation between coordination, wages and firm productivity. Section 5 quantifies the effects of coordination on the elasticity of labor supply. Finally, Section 6 concludes.

2 Conceptual framework

Underlying the standard labor supply model is the assumption that employers are indifferent to the hours supplied by their employees. Hours worked however vary across sectors and, most notably, across firms within a sector. Figure 1 shows the distribution of weekly hours worked across six major sectors in Denmark. The distribution is considerably more concentrated in the service sector than in agriculture, manufacturing or construction, even though the latter sectors are more unionized than services.

The variation in the hours worked between sectors, however, accounts only for a small part of the overall variation in hours. A decomposition of the variance of total annual hours worked

[4] Siow (1987) found higher wages in industry-occupations with less volatile hours. Our research complements these findings moving to 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.

[5] In this respect our empirical findings support the theoretical work that links synchronization of working schedules to the potential for better communication and cooperation (Lewis, 1969; Weiss, 1996).

in Denmark into between and within sector variability first, and then into cross and within firm variability shows that cross-firm variation explains more than 35% of the overall variance, whereas merely 4% of the overall variation occurs between 1-digit sectors (Figure 2).[6] This descriptive evidence suggests that employers may indeed affect their workers' supply of hours. Motivated by this evidence, in this section we propose a model where 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):

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

where $(Q_i)^{(\sigma-1)/\sigma} \equiv \int_{\omega\in\mathbf{\Omega}} q_i(\omega)^{(\sigma-1)/\sigma}\mathrm{d}\omega$ 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 utility of leisure function $v(\ell_i)$ is increasing and concave with $v'(\ell_i) > 0$ and $v''(\ell_i) < 0$.

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 on-line appendix A.1).

In contrast, workers employed in the coordinated labor market must work for a prescribed

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

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

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 respectively the number of groups and the number of workers. h_{it}, $\overline{h_{gt}}$ and $\overline{h_t}$ are respectively the worker hours, the average hours within each group and the average hours across all workers. The variance is decomposed in each year between 2003 and 2008. Figure 2 shows average shares across all years. To the extent that hours are measured with errors the within firms component of the variance may be overestimated which means that hours between firms may vary even more than our measure shows.

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 so 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. An implication is that, in equilibrium, a coordinated labor market can only co-exist with the non-coordinated labor market if workers are indifferent between employment in either market segment. 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 $P^{\sigma-1} \equiv \int_{\omega\in\mathbf{\Omega}} p(\omega)^{-(\sigma-1)}\,\mathrm{d}\omega$ is the (exponentiated) price index, and $\bar{\pi} \equiv \int_{\omega\in\mathbf{\Omega}} \pi(\omega)\mathrm{d}\omega/(N_H+N_L)$ 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 $\hat{h}$. To illustrate this, in Figure 3 we assume that $\hat{h} > h_i^*$. For the sake of clarity in the figure we ignore T and $\bar{\pi}$ and assume $t_i = 0$, $P = 1$. Figure 3 shows that the wage rate $\hat{\mathrm{w}}_{\mathrm{i}}$ that makes the worker indifferent between working h_i^* at the rate $\mathrm{w_i}^*$ and working $\hat{h}$ is greater than the equilibrium wage $\mathrm{w_i}^*$. Since this applies to any hours choice $\hat{h} \neq h_i^*$, condition (2) defines a function $\hat{\mathrm{w}}_i(\hat{h})$, that has $\mathrm{w_i}^*$ as parameter, and that we refer to as the *wage-hour function*.

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 a lower extra compensation to make 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 $\hat{\mathrm{w}}''(\hat{h}) > 0$ (on-line appendix A.2).[7] Therefore, the resulting wage-hour function is

[7] As we show in on-line appendix A.2 there are condition on the curvature of the leisure preferences or

U-shaped with minimum at the equilibrium wage w_i^* where hours $\hat{h} = h_i^*$.

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.[8]

2.3 Firms

There is a continuum of firms, each producing 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 with $G_H(\cdot,\cdot)$ the first derivative of $G(\cdot,\cdot)$ with respect to its argument $(n_H h_H)$, and with $G_L(\cdot,\cdot)$ 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 $\gamma = 1$ so that firms produce with productivity ϕ. In the coordinated labor market $\gamma = \hat{\gamma} > 1$ so 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 minimizes costs:

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

The first-order conditions imply that

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

economy-wide productivity that ensure $\hat{\mathrm{w}}''(\hat{h})$ to be positive.

[8] In presence of search frictions, coordinated firms would still pay higher wages compared to their non-coordinated peers as long as search costs do not exceed the utility losses from accepting standardized hours $\hat{h}$

[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.

As by convention, we assume $G_H(\cdot,\cdot) > G_L(\cdot,\cdot)$ so 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 $\hat{\mathrm{w}}_i(\hat{h})$ so that each type i worker is indifferent between employment in the coordinated or non-coordinated labor market. This results in the following cost minimization problem:

$$\begin{aligned}\hat{C}(\omega) \equiv \min_{n_H,n_L,h} \hat{\mathrm{w}}_{\mathrm{H}}\, n_H\, h + \hat{\mathrm{w}}_{\mathrm{L}}\, n_L\, h \qquad & \text{s.t.} \quad h\, G(n_H, n_L) \geq q^*(\omega)/(\hat{\gamma}\phi) \\ & \text{and} \quad U\left(h\frac{\hat{\mathrm{w}}_i}{P}(1-t_i) + \frac{T+\bar{\pi}}{P}, h\right) = U(Q^*_i, h^*_i) \\ & \text{for } i = H, L.\end{aligned}$$

From which the first-order condition that implicitly defines $\hat{h}$ is (see on-line 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 in 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 and h^*_H to satisfy (4). Second, (4) establishes that optimal hours are such that marginal costs of increasing hours in coordinated firms equal marginal benefits. To understand this let us consider the case in which high-skilled 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, it results in lower wage premiums paid to high-skilled 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. Thus it results 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 savings from marginally higher hours equal costs. Finally, (4) implies that $\hat{h}$ is set to be closer to the desired hours of the larger group of workers in the firm.[10]

[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 $\hat{h} < h^*_i$. This implies that $\hat{h}$ moves closer to h^*_i as $\hat{n}_i$ goes up.

Based on (4), both high and low-skilled workers in coordinated firms work suboptimal hours and therefore are compensated with wage premiums. It follows that:

Prediction 1 *Firms that coordinate work-time to 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 (on-line 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 respectively minimized marginal production costs in the uncoordinated and coordinated segment. Based on this, 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, the higher the fixed cost $\hat{F}$ of coordinating or the higher the marginal cost $\hat{\mu}$ of producing in the coordinated market, the more elevated the entry threshold would be. Conversely, a less competitive market with a high overall price level P and a larger aggregate economy with higher E facilitates 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:

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 $\hat{\gamma} > \hat{\mu}/\mu^*$, we indicate with $\hat{M}$ and M^* respectively the total mass of non-coordinated and coordinated firms in equilibrium. 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 of 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 on-line 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 respectively the second derivative of the utility function relative to consumption, the marginal utility of consumption and the marginal utility of leisure for high-skilled workers, 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 that is made 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, desired hours of high-skilled workers go up when t_H increases and so do the hours worked in the coordinated sector. Conversely the derivative is negative if the substitution effect prevails over the income effects. Based on this we can state:

Prediction 3 *(Spillovers) At firms that coordinate work-hours, changes in tax rates that only affect high-skilled have spillover effects on hours worked by low-skilled workers. Hours worked by high and low-skilled workers move together.*

[11] Here we consider the case of a generic additive 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 of t_H.

Hours worked by high-skilled in coordinated firms however, are less elastic to the tax change than high-skilled hours in uncoordinated firms. To visualize this in Figure 4 we plot the case, consistent with our empirical findings, in which high-skilled workers desire to work more hours than low-skilled, the tax rate on high-skilled workers goes down, and the income effect from the tax change prevails. In this case, as t_H goes down 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 go down as much as desired hours do ($\mid \hat{h}_1 - \hat{h}_0 \mid = \mid h^*_{1H} - h^*_{0H} \mid$), the benefits for coordinated firms to marginally increase hours would remain unchanged relative to the pre-tax change period. At the same time 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 convexity of the wage-hours function, a marginal increase in hours would imply a lower increment in wage premiums to low-skilled workers than prior to the tax change. As a result, marginal benefits would exceed marginal costs and hours would optimally move up. This implies that $\mid \hat{h}_1 - \hat{h}_0 \mid < \mid h^*_{1H} - h^*_{0H} \mid$ and therefore:

Prediction 4 *(Attenuation): High-skilled workers in coordinated firms are less responsive to tax rate changes compared to workers in uncoordinated firms.*

The model also implies that the magnitude of the spillovers on low-skilled workers is increasing in the relative share of high skilled-workers. This is shown graphically in Figure 4 where the dashed line corresponds to a lower α. In this case, as an effect of the tax change, the equilibrium moves from C to D implying a greater reduction in hours than in the case of a higher α.[12]

Finally, in this setting a tax change that moves coordinated hours has effects on wage rates in the coordinated segment. While our main analysis focuses on the hours worked, in on-line appendix A.5 we discuss the consequences of a tax change on wage rates.[13]

[12]The algebra behind prediction 4 remains difficult to treat even assuming specific functional forms for the utility function. Therefore, we only propose a graphical examination of this prediction.

[13]In the model of this section we do not explicitly consider unions. As long as unions' preferences reflect workers' preferences, including unions would not change the main predictions. Moreover in the empirical analysis we do not find sizeable differences in the magnitude of the effects between highly and lowly unionized firms.

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 used to be set at the industry level through collective bargaining, but over time the system has gone through a decentralization process that has made the negotiation much more firm-level based.

As an effect of this process and despite the fact that around 70% of the workers in the private sector are unionized, the wages of about 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 and 100% of the normal wage for each hour of overtime that exceeds the first 3 hours (on-line appendix B.1).

Regarding the working time regulation, sectoral agreements usually define the normal week to be composed of 37 hours on average and by not 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 about 60% of full-time workers in the private sector were estimated to be covered by this type of local regulation (Dansk-Arbejdsgiverforening, 2012). Similarly, an increasing number of employers have made use of local framework agreements that allow working time conditions to be negotiated between employers and employees at the individual level. In 2005 around one third of the private firms had signed an agreement of this type (Jørgensen, 2006).

Extra discretion in the choice of working hours comes from overtime work. Around 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 in working hours at the contractual wage (on-line appendix B.1). According

to a survey of Danish private firms 73% of the HR managers indicate to have 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 shows substantial variation of vacation time between firms, in particular among salaried workers (on-line 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 2).

3.2 The data

The empirical analysis is based on data from multiple sources (on-line 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) that collects annual data on the entire Danish population. Data on annual hours of regular and overtime work are extracted from *Lønstatistikken* (LON). These are reported by employers whose contributions to the employees' pensions are based on hours worked.[14] Unfortunately, not all workers in IDA can be matched to LON. For our study however, it is particularly important to observe hours of as many workers as possible within a firm. For this reason we only consider 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 that provide information on firm characteristics such as 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) that 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 period 2003-2011 when

[14]Employers' pension contributions discontinuously jump at certain hours levels and this may induce bouncing of reported hours. However, in the Danish setting these discontinuities only affect part-time employees (< 27 weekly hours) that are not included in the sample used for estimation (on-line appendix Table D.1).

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 year period, which are about 90% of the workers in the sample. We leave out part-timers for two main reasons: first, because they are more likely to work at unusual hours or fewer days in a week and this can be problematic for measuring coordination (Section 4.3). Second, because focusing on full-timers makes our results more easily comparable to other studies, especially those on wage inequality across firms.

The final sample that we use includes more than 400,000 employees and around 8,300 firms. Table D.3 of the on-line appendix shows descriptive statistics on the entire population (column 1), on the sample of the population that can be linked to data on firms and hours (column 2), and on our final sample composed by firms where 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 estimating equation is as follows:

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

where $\widehat{\psi_{j(i,t)}}$ is the firm fixed effect from a firm-worker fixed effect model of the type described in Abowd, Kramatz and Margolis (1999) (henceforth AKM) that we discuss in Sections 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 coordination of hours and wages. For this reason in our empirical specifications we include in $\bar{Z}_j$ an extensive set of controls aimed at reducing these concerns. Among the controls we include detailed geographic and industry fixed effects, controls for the composition of the workforce of a firm both in terms of gender and ability, as well as other firm characteristics such as firm size or exporter status, 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 that 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 little evidence that exists on coordination of hours among coworkers, we see this analysis as an important first step towards the understanding of 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 seen 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 through coordination, we first estimate equation (7) omitting σ_j and including measures of firm productivity such as value added and total factor productivity (TFP). From this alternative specification of equation

(7) we obtain the partial R-squared associated with value added and TFP. This measures the share of the variance of $\widehat{\psi_{j(i,t)}}$ that is explained by productivity once we control for the variables in $\bar{Z}_j$. Then we measure the predictive power of hours coordination as the ratio of the partial R-squared associated to σ_j from equation (7) and the partial R-squared associated to valued added and TFP. From now on 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:

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

where $\mathrm{w_{ijt}}$ 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.[15] The variable of primary interest to us is the firm fixed effect $\psi_{j(i,t)}$ that 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. But, unlike in most other studies, we use hourly wages rather than annual or monthly earnings as a dependent variable to better fit the first model prediction 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. As in other studies, we focus on full-time workers only.

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

[15] Following Card et al. (2013), we include in X_{ijt} a set of interactions between year dummies and educational attainments as well as interaction terms between quadratic and cubic terms in age and educational attainments. In addition, we also control for firm characteristics that change over time such as value added, sales, capital per employee, exporter status and the share of hourly workers. These extra firm controls isolate the average wage premium paid by a firm from temporary fluctuations due to firm-level shocks. The results obtained when we only include individual characteristics are noisier but still in line with the baseline regression and are shown in the robustness section. We estimate this regression on all workers and firms for which data on hourly wages, individual and firm characteristics are available (column 2 in Table D.3 in the on-line appendix).

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 each other. 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, 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 respectively the number of workers in sjt and the number of skill groups in jt. 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 showing that desired hours increase with skills (on-line appendix Table D.4). 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 $\widehat{s_{ijt}}$. Given that this measure of skills is based on individual fixed effects and observable time varying characteristics, it might reflect more closely a worker's skills. In a setting where wages depend on hours however, $\widehat{s_{ijt}}$ might still reflect compensating wage differentials to the extent that those are not fully captured by the firm component of wages in equation (8). For this reason in on-line appendix D.3 we present the results of a parallel analysis in which we define skills at the intersection of 3 educational groups (i.e. primary, secondary and tertiary education) and

3 broad occupational categories (i.e. manager, middle manager and blue collar). The results obtained from these two alternative definitions of skills do not differ in a sensitive way.

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, in different days of the week or in different periods of the same year. For the latter case, since the great majority of the workers in our sample work for the entire year this is unlikely to play a major role.[16] Furthermore, by focusing on full-time workers in private firms we reduce concerns regarding whether they work different days of the week or at different times of the working day. In fact, descriptive evidence from time use survey data (TUS) indicates that around 70% of full-time workers in Denmark start working between 7am and 9am. Of the remaining 30% the great majority are employed in either manufacturing 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 the health-care sector is public and thus excluded from the sample. Similarly, around 60% of full-time workers in TUS do not work on weekends and those that do work are mostly concentrated in the health care sector (for more details see on-line appendix C.2).

While focusing on full-timers reduces the concerns mentioned above, this may come at the cost of ignoring some of the variation that is of interest to us. In particular firms at low degree of coordination may hire relatively more part-timers. This concern, however, is mitigated by the fact that our measure of coordination strongly correlates with the share of part-timers, so that, based on σ_{jt}, more coordinated firms also hire fewer part-timers (Section 4.3.2).

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 on 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

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

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 complementary (Bombardini et al., 2012). The descriptors are: *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?"; *Communication*: "How important is communicating with supervisors, peers, or subordinates to the performance of your current job?".

The measure of 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 5 we plot the standard deviation of hours versus the importance of the 3 descriptors across firm-year observations. A negative and statistically strong 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 on-line 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 with data from O*NET.

4.3.2 Coordination and firm characteristics

In this section we document new facts that emerge when we look at the correlations between our measures of coordination and a number of firm characteristics.

Table 1 shows the standardized coefficients obtained from a set of regressions of coordination on a number of firm characteristics. A few interesting facts emerge from the table. First, firms that coordinate are more profitable: they have higher value added per employee and total factor productivity. This evidence supports our theoretical framework in which more productive firms select into coordination. Along the same lines, firms that coordinate are more likely to be exporters and to employ a greater share of tertiary educated workers. Second, less coordinated firms employ relatively more hourly and part-time workers suggesting that greater flexibility

in these firms is achieved through the hiring of these workers. Third, lower coordination is associated with higher unionization rates. This suggests that low dispersion of hours is not systematically linked to institutional constraints imposed by unions.

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 (α_i) from an AKM model among the workers in the top quartile of the distribution of α_i in each firm. In Table 1 we look at the correlation between this measure of managerial ability and hours coordination and we find a strong positive association between the two. This 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 coordination of hours 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*).[17] Consistent with Deming (2017) we find that hours coordination is stronger in firms where the social skill intensity is greater.

If hours coordination is thought of as decreasing the costs of communication then greater coordination may lead to more problems being solved at the top of firm hierarchy, and thus to a decrease of wage inequality among blue collar workers and an increase in wage inequality among managers and between managers and blue collars (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, a greater 90th-10th ratio among top managers, and a greater ratio between the average wage of managers and blue collar workers.

The on-line appendix Table D.5 compares coordination in different sectors. Based on this, firms in the service industry coordinate more on average than those operating in the agriculture,

[17] Coordination in O*NET is defined as measuring the importance of "Adjusting actions in relation to others' actions", Negotiation as "Bringing others together and trying to reconcile differences", Persuasion as "Persuading others to change their minds or behavior" and Social Perceptiveness as "Actively looking for ways to help people".We match O*NET to the Danish registers based on occupation and we take the average importance of each one of these descriptors in a firm as a measure of social skill intensity in that firm.

manufacturing or construction sectors. 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 (on-line appendix C.2.2). However, most of the correlations discussed in this section hold within narrowly defined sectors suggesting that they are driven by differences across firms within sectors (see column 2 in Table 1).

4.4 Results

In this section we discuss the correlation between the firm component of wages and hours coordination. We start by estimating this correlation across all firms and checking for the importance of other confounding factors. Then we study how wages and coordination of hours 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 2 shows the standardized correlation between coordination and the firm component of wages excluding controls for other firm characteristics. In line with the model prediction, higher coordination in a firm is associated with higher relative wage premiums.

However, from the discussion of the previous section one may worry that this correlation may be driven by other firm characteristics. Thus in columns 2 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. In this last specification we also control for the share of female workers in the firm because females are more likely to sort in low paying firms or to bargain lower wages (Card et al., 2016). Finally, we control for the share of unionized workers as a way to capture rents from unions (Dickens, 1986), and the average number of hours worked to control for compensating differentials due to long hours.

In line with the literature, we find that firm size and export status are positively associated with wages, and that better paying firms employ fewer female workers. Importantly, as in other recent studies we find no evidence of compensating differentials due to long hours (Card et al., 2016). In contrast, we find that the magnitude, the sign and significance of the correlation between wages and coordination is unaffected by these controls. This result highlights the

importance of measuring relative hours in a firm to capture dis-amenities from working time.

In column 3 we add to the previous specification extra controls for the skill composition of the workforce in a firm. Recent studies in fact, show that the sorting of better able workers in 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 effect (α_i) in each quartile of the firm distribution of α_i. The average α_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 extra set of controls provides also a way to proxy for differences in managerial practices across firms. The findings from this specification are reassuring because the coefficient attached to coordination retains its sign and significance while the magnitude increases.

The correlation remains negative and of similar magnitude when we exclude from the analysis firms that bunch at 37 hours (average hours between 36.5 and 37.5) or when we consider earnings and coordination from normal hours only, thus excluding overtime (columns 4 and 5). This suggests that the results are not affected much by these other institutional factors.

From the results of the previous section, we know that coordination positively correlates with the intensity of social skills in a firm. These skills have been associated to higher wages (Deming, 2017). In light of this, one possible reason for the higher returns associated to social skills may be that they allow for a greater degree of hours coordination that requires compensating wage differentials. However, to the extent that the returns to social skills are associated to other factors such as, for instance, the low substitutability with new production technologies, it is important to check how much of the correlation between coordination of hours and wages can be linked to social skills. Thus in column 6 we add to the baseline specification the 4 measures of social skill intensity described in the previous section. We find that around 1/3 of the correlation estimated in column 3 can be associated to these skills, suggesting that most of the returns from coordination are not driven by social skills.

The strong correlation between the firm component of wages and coordination of hours

persists within 1, 2 or 3-digit sectors (columns 1 to 3 in Table 3) suggesting that coordination plays a non-negligible role in predicting wage inequality across firms within sectors.[18]

In most of the specifications the magnitude of the correlation between wages and coordination is greater than the association between wages and firm size or capital per employee, and of comparable magnitude as export status. From column 3 in Table 2, we infer that an increase of hours coordination by one standard deviation (95 yearly hours) is associated with an increase in firm-level wages equivalent to 0.5%.[19] These findings establish compensating differentials from hours coordination as 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).[20]

In on-line appendix C.3 we discuss a set of additional robustness checks to the results presented in this section including, for instance, a discussion of measurement errors in hours.

4.4.1 Coordination of hours, wages and firm productivity

Existing studies find that the firm component of wages strongly correlates to productivity in a firm (e.g. Card et al., 2018). In our stylized model more productive firms select into coordination and pay wage premiums. Consistent with this, conditional on measures of firm productivity, such as value added per employee, the coefficient on the standard deviation of hours goes down and becomes insignificant while value added per employee strongly and positively correlates with wage premiums (column 8 in Table 3).

To get a sense of 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

[18]The correlation within 2 or 3-digit industries is less precisely estimated. This is likely due to outliers. If coordination is measured through the median absolute deviation from the median hours in fact, the coefficients are negative and strongly significant (columns 4 to 6 in Table 3).

[19]The effect is obtained by multiplying the coefficient (0.07) by the standard deviation of the firm-component of wages (0.26) that gives a 0.0156 log wage change equivalent to 0.5% of the average wages.

[20]If we allow for mobility frictions, the wage differentials may also reflect rent sharing at better paying firms (Burdett and Mortensen, 1998). However, Lavetti and Schmutte (2016) have recently proposed an estimation procedure to identify compensating wage differentials using matched employer-employee data in the case of mobility under frictions. Following this procedure we obtain estimates of similar magnitude (on-line appendix Table D.6). This suggests that mobility frictions are unlikely to play a major role in our specific analysis.

that coordination only affects wages through productivity. We estimate a coordination share of 20% across all firms (column 3 in Table 2) and of 12% (4%) among firms in the same 1-digit (3-digit) industry (columns 1 and 3 in Table 3). This 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.

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 of 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 from coordination.

The Danish income tax system is based on different types of income that are aggregated in multiple ways to form different tax bases taxed at different rates. A detailed description of the tax system can be found in on-line appendix B.5. For what concerns our analysis, prior to the 2010 reform income was taxed using a three-bracket progressive tax schedule (Figure 6). As an effect of the 2010 reform the middle tax bracket was abolished while tax rates at the bottom and top bracket went down by respectively 2 and 7 percentage points between 2008 and 2011. The reform also increased the income amount at which the top bracket starts that went up by around 9% in real terms between 2008 and 2011. This led to a substantial decrease of the marginal tax rate on labor income faced by workers in the middle and top tax bracket. For them in fact, marginal tax rates went down respectively by around 16% and 10% (Figure 7). The decrease was less pronounced in the bottom bracket where the marginal tax rate went down by around 4% (more details in on-line appendix B.5).[21]

Based on this, from now on, we refer to low-skilled workers as the workers who were either

[21] The net-of-tax rate in the top, middle and bottom bracket went up respectively by 3%, 15% and 19%.

tax exempt or in the bottom tax bracket in 2008 (left of the dashed line in Figure 8). Conversely, we define high-skilled 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 the 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 8). When the reform increased this limit (solid line in Figure 8) and abolished the middle bracket, these workers ended up (mechanically) in the bottom bracket after the reform.

Relative to the high-skilled, workers in the residual group experienced a net-of-tax rate change about 3 times as large (Figure 9). As an effect of this, while for high-skilled workers the income effect prevails and hours go down as a consequence of the reform (Section 5.6.1), for workers in the residual group the substitution effect prevails and the estimated labor supply elasticity is positive but insignificant (on-line appendix C.4). In on-line appendix C.4 we argue that the insignificant effects may be due to the fact that these workers are close, in terms of income, to the top bracket and thus unwilling to work more hours to avoid substantially higher taxes.

Since the supply of hours in the residual group is unchanged by the reform and in order to keep the empirical framework as close as possible to the stylized model, in the baseline specification we only study the spillovers from high to low-skilled workers. However, we then show that including the residual group does not affect the conclusions of the baseline analysis. Based on this classification, around 34% of the workers in our sample are low-skilled, 54% are high-skilled, the remaining 12% are in the residual category (Figure 9).

5.2 The Tax Data

We base the tax analysis on records from the Danish Tax Register that 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 of labor income by 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 of labor supply to changes in marginal tax rates over 3-years 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 interval 2008-2011 for two main reasons: first to minimize the concerns related to the inter-temporal shift of earnings for tax avoidance purposes that happened between 2009 and 2010 (Kreiner et al., 2016), and second to reduces 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 the years 2006 to 2008, 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-skilled 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-skilled workers between 2008 and 2011. We relate this to the individual variation of 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 that measures the elasticity of hours worked to changes of the marginal net-of-tax rate.

To test whether the response of high-skilled workers in more coordinated firms is lower than that of similar workers in less coordinated firms, we estimate this model separately on workers employed in high versus low-coordination firms. In 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 on-line appendix C.5 we make an attempt to separate the uncompensated elasticity of labor supply from the income elasticity. However, our study is based on a single tax change that mostly affected workers in the upper part of the income distribution. Therefore, unlike in 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 on-line 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-skilled workers to changes in the supply of hours of low-skilled coworkers. The estimating equation 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-skilled 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-skilled workers in firm j. We isolate the tax related component of this change using the average variation of the marginal net-of-tax rate on labor income among high-skilled in firm j as an instrument for the change in hours. Section 5.5 describes this instrument in details. 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 of the marginal net-of-tax rate on labor income faced by low-skilled between 2008 and 2011. Since the reform lowered the marginal tax rate paid by low-skilled, this term controls for the direct effect of

the reform on the supply of hours of low-skilled workers. Finally, X_{ijt} is a vector of firm and individual controls measured in 2008.

The empirical specifications that we have so far discussed 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 move hours and wage rates in opposite directions making it difficult to interpret the overall effect on labor income. Second, in equation (11) we augment the standard model with one extra term that captures the spillover effects of the tax change among coworkers. This is done to reflect a key feature of our framework where hours worked by one type of workers depend on the hours worked by the other workers in the same firm. Section A.6 in the on-line appendix describes how to adapt the standard economic model underlying the empirical specification used in the literature to the specific features of our setting.

5.5 Identification

The identification of the effects of the reform from equation (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 that is endogenous to the supply of hours. This creates a correlation between $\Delta\, log\ (1-\tau_{it})$ and the error terms in our specifications. Second, changes of the supply of hours by high-skilled workers in equation (11) might be correlated to changes of the supply of hours worked of low-skilled 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, 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 of the tax laws. 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 of the marginal net-of-tax-rate on labor income of

high-skilled workers as $log\left(1-\tau^H_{Mit+3}\right)-log\left(1-\tau^H_{it}\right)$ and we use this as an instrument for the observed change $\Delta\, log\,\left(1-\tau^H_{it}\right)$ in equation (10). Similarly, we use the mechanical change of the marginal net-of-tax rate of low-skilled 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 of the marginal tax rates due to changes of the tax schedule only. To give a sense of the identifying variation, Figure 9 plots the average mechanical change of the marginal net-of-tax rates among high and low-skilled workers between 2008 and 2011. Due to the nature of the reform, the change is more pronounced for high-skilled (18%) than for low-skilled (2%).

While these instruments are 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 deal with this, we follow the existing literature and we perform 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 affected in a noticeable way by these controls. This may be due to the fact that, unlike in most other studies, we estimate separate regressions on rather homogeneous groups of workers (i.e. low-skilled and high-skilled). Furthermore, we study a relatively short time period thus limiting the concerns related to long term trends.

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

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

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 the high-skilled due to the tax reform from other confounding factors. Its validity hinges on the assumption that the instrument affects hours worked by low-skilled workers only through changes in the average hours of high-skilled coworkers. This assumption may be violated if, for instance, the tax reform, while changing

the supply of hours of high-skilled workers, led also to the adoption of new technologies that required a different supply of hours by low-skilled workers. However, we fail to find significant effects of the reform on firm size, physical capital and the share of high relative to low-skilled workers, suggesting that firm technologies were not affected by the reform (on-line appendix C.6).

Finally, one general concern of the instruments that we use is that they might capture other unobserved changes that occurred between t and $t+3$ thus confounding the estimated effect of the tax reform (e.g. other policy reforms or macroeconomic shocks). For this reason we present additional specifications in which 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 adding base-year fixed effects. These specifications also allow to control for unobserved characteristics specific to all coworkers using firm fixed-effects. While these models have some advantage over the baseline, they result in weaker first stages (Section 5.6.2) and are more likely to capture lagged effects of the 2004 tax reform.

5.6 Results

5.6.1 Coordination and attenuating effects

Table 4 shows the elasticity of hours worked by high-skilled workers to the net-of-tax rate estimated from equation (10). In columns 1 to 3 we estimate the regression on all high-skilled workers in the sample while in columns 4 to 7 we differentiate between workers in high versus 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 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 workers to the right measure of coordination we restrict the analysis to high-skilled 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 absence of controls for pre-reform income, the elasticity from the IV model in column 2 is around -0.07. Probably due to mean reversion,

the elasticity goes up to -0.05 when we control for income in 2008 (column 3). Based on this estimate, total hours of high-skilled went down by around 0.8% or about 15 hours on a yearly basis as an effect of the reform.[22]

When we break the sample between workers at firms with high (column 4) versus low (column 5) degree of coordination however, we find substantial differences between the two groups. In line with the model predictions, we estimate a statistically significant elasticity of around -0.1 in low-coordination while in high-coordination firms the elasticity is insignificant and of about -0.02. The two elasticities are statistically different at the 5% level. Therefore based on these estimates, hours worked by high-skilled workers in firms with high degree of coordination were not significantly affected by the reform, while high-skilled hours in low-coordination firms went down by around 1.6%, that is about 30 hours per year.[23]

The difference between the two elasticities widens as we move towards the extremes of the distribution of coordination. In fact, workers in the top 25% most coordinated firms show even lower elasticities than in the baseline. Conversely, workers in the bottom 25% least coordinated firms are more responsive than the baseline (columns 6 and 7). This indicates that the attenuating effects increase with the degree of hours coordination in a firm.

The differential effects in the two types of firms are not driven by other observable firm characteristics, firm fixed effects or by unobserved factors that occurred between 2008 and 2011. In fact, the results hold conditional on firm and base-year fixed effects (columns 1 to 4 in Table 5), and they are robust to the interaction between changes in marginal tax rates due to the reform and other base-year firm characteristics such as size, export status, share of unionized workers or productivity (columns 5 to 10 in Table 5).

When we separate the sample between salaried and hourly workers (on-line appendix Table D.7) we find evidence suggesting that different responses between high and low coordination firms are driven by changes in overtime hours of salaried workers (columns 1 and 2), while we fail to find sizeable differences in normal hours of salaried workers (columns 3 and 4), or in

[22] -0.5% is obtained as the product of the the elasticity (-0.047) and the average log change of the net-of-tax rate between 2008 and 2011 (17%). -0.8% is then multiplied by the average number of hours worked in 2008 by the high-skilled workers in the estimating sample (i.e. 1924) to obtain the change in hours due to the reform.

[23] The average change in hours worked is derived as the product of the elasticities in low-coordination firms (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-skilled workers in low-coordination firms (i.e. 1914 total hours).

total hours of hourly workers (columns 5 and 6).

Therefore, in agreement with the existing literature, we find an average elasticity of hours across all firms close to zero (Pencavel, 1986, Triest, 1990, Chetty, 2012). However, we document pronounced attenuating effects associated to coordination that provide a mechanism to explain the low elasticity of previous studies. Other studies that focus on labor income (rather than hours) find small and positive elasticities in Denmark (Kleven and Schultz, 2014). However, these studies consider the entire population while we focus on full-time workers in private firms for whom data on hours are available. Using a comparable sample to analyze the effects on labor income we find results that are in line with other studies (on-line appendix C.4).

While coordination attenuates behavioral responses, it also lowers the dead-weight burden of taxation on high-skilled. 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 marginal excess burden would be twice as large.[24]

5.6.2 Coordination and spillovers

Table 6 shows the estimated elasticity of low-skilled hours to the average hours of high-skilled coworkers obtained from equation (11). In these specifications the base year is 2008 and we focus only on low-skilled workers who are at the same firm in 2008 and 2011. Column 1 shows the OLS estimates, while columns 2 to 7 show the IV estimates. In the first 5 columns we estimate the effects on regular hours while in the last two we examine the effects on total hours.

In line with our theory, we estimate positive and significant spillovers that are robust to controls of pre-reform income (columns 3 and 4). Specifically, in our favourite specification (column 3) we estimated an elasticity of regular hours of low-skilled workers to the average hours of high-skilled coworkers of 0.88. This implies an increase of 0.85 hours worked by low-skilled workers for each additional hour that high-skilled coworkers provide on average. Based on this, we estimate that regular hours of low-skilled coworkers went down by around 8.5 hours (or 0.5%) on a yearly basis as an effect of the reform.[25]

[24]The marginal excess burden (MEB) is defined as the ratio between the change in tax revenues due to behavioral responses to the tax reform and the total change in tax revenues (see also on-line appendix A.6.1).

[25]An increase of high-skilled hours by 1 is equivalent to a 0.053% increase. This causes an increase of 0.043% of low-skilled hours (0.053%*0.88) that, at the average hours worked by low skilled (1,812), is equivalent to 0.85

When we consider overtime hours the elasticity of low-skilled to high-skilled hours is higher suggesting even stronger spillovers from overtime (column 6). However, the point estimate from this specification might be inflated by the low power of the instrument (F-stat of about 4).

The existence of spillovers has two main implications. First, it implies extra tax efficiency costs. Specifically, taking spillovers into account we estimate an increase in the marginal excess burden from the tax reform of around 15% (on-line appendix A.6.1). Second, with spillovers the use of untargeted workers as a control group to estimate the labor supply elasticity provides downwards biased estimates. This is yet another reason that may explain the low elasticity estimated by some of the existing studies (e.g. Eissa, 1995; Eissa and Hoynes, 2004; Blundell et al., 1998; Kreiner et al., 2016). In our setting using low skilled workers as a control group in a difference in difference model would results into an elasticity of high skilled that captures only 14% of the elasticity obtained in the previous section (on-line appendix Table D.8).

Our framework implies stronger spillovers in firms at high degree of coordination. Ideally we would compare high and low-coordination firms. Based on the results from the previous section, however, hours worked by high-skilled in high-coordination firms were not affected by the reform. As a result, we lack the identifying variation to estimate the spillovers in these firms. Thus in column 4 and 7 of Table 6 we restrict the analysis to low-skilled workers in firms at low degree of coordination where hours of high-skilled coworkers are more elastic. Among these workers we find lower elasticities of regular and total hours than across all workers which suggests weaker spillovers in low-coordination firms. Finally, when we break the sample in temporary versus salaried workers we only find spillovers among hourly workers (Table D.9).

The significance and magnitude of the spillovers that we find is robust to the inclusion of firm and base-year fixed effects capturing unobserved characteristics of a firm, or of the time period over which the reform occurred (columns 1 and 2 in on-line appendix Table D.10). The coefficient capturing the spillovers is of greater magnitude, but less precisely estimated, when we condition on the effects of being in a firm with a share of unionized workers above the median (column 3 in Table D.10). This suggests that spillovers are not driven by differences in unionization.

hours. The reform caused a decrease of about 10 regular hours worked by high-skilled (elasticity of -0.03, see Table D.23) thus implying a change of 8.5 regular hours worked by low-skilled workers.

The spillovers from high-skilled workers remain of similar magnitude and significance when we control for the average change in hours among coworkers in the residual group. In fact, consistent with the fact that hours in the residual group are unaffected by the reform, we do not find significant spillovers from this group on low-skilled coworkers (column 4 of Table D.10).

While other mechanisms may explain the spillovers, hours coordination better fits our evidence and setting. For instance, spillovers might as well result from peer effects. In that case however, low-skilled would not need to be compensated for a change in high-skilled hours so we would expect to find no effects on low-skilled wages. However, using hourly wages as a dependent variable in equation (11) we estimate wage effects that, despite being noisy, are of a sizeable magnitude (Table D.11 in the on-line appendix). This would suggest that peer effects are of secondary importance in our setting and may be due to the fact that we analyze spillovers among coworkers in different skills groups while recent studies in Denmark find significant peer effects only among coworkers with similar skills (Fadlon and Nielsen, 2017). One other possible channel for the spillovers may be the existence of complementarities in leisure time among coworkers. However, based on Danish time use data, workers in Denmark spend on average only 2.5% of their leisure time with people outside of their family, which would suggest that such complementarities are of second order. In line with this Georges-Kot et al. (2017) find weak leisure complementaries among coworkers in France.

Our results complement those of other studies that find aggregate evidence of excess mass in the distribution of taxable income at kinks of the tax schedule (bunching) among a minority of workers who do not face these kinks (Chetty et al., 2011, Best, 2014). However, differently from the literature, we use new data on hours and the variation deriving from an actual tax rate change to bring new firm-level evidence that propose coordination as a mechanism through which changes in preferences over hours spillover to other coworkers. In doing so we also document a much wider phenomenon than the one linked to aggregate bunching. In fact, excluding taxpayers close to the major kinks of the Danish tax schedule, the spillovers remain significant and of similar magnitude (column 5 of Table D.10 in the on-line appendix).

In the on-line Appendix C.4 and C.5 we present a set of additional results and robustness checks that include flexible controls of pre-reform income, the estimation of attenuating

and spillover effects based on an alternative database on hours worked, the use of alternative measures of coordination and the estimation of specifications that separate the uncompensated elasticity from the income elasticity.

6 Conclusions

This paper explores how the coordination of hours affects the firm-component of wages. Our findings indicate that coordination strongly correlates with wage differentials across firms. Moving forward, future work might investigate how coordination is associated to other dimensions that are linked to firm wage inequality such as, for instance, 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 of coworkers not targeted by a tax reform. These suggest that the labor supply elasticity of the workers directly targeted by a tax reform captures only a part of the efficiency costs of a tax change. Therefore, future research and policy evaluations should take these effects into account when assessing the excess burden associated to a tax reform.

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 might indirectly affect the supply of hours of younger coworkers. Similarly, policies that directly affect workers with children may have spillovers on other coworkers. It would be interesting to evaluate, in these other settings, the effects of coordination of hours among workers with similar skills and incomes.

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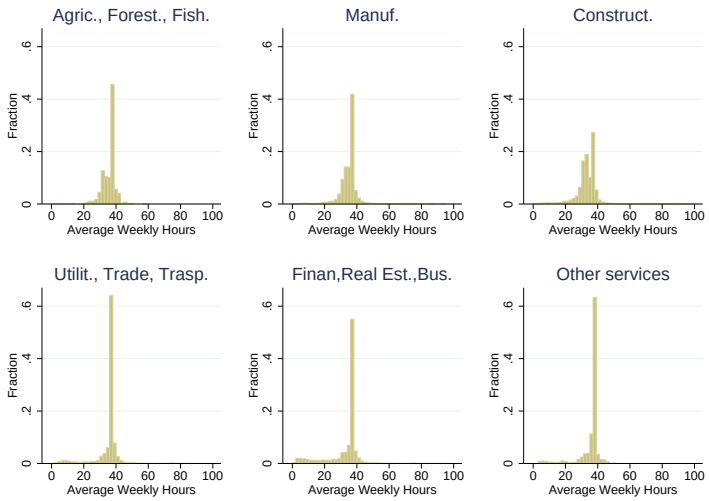
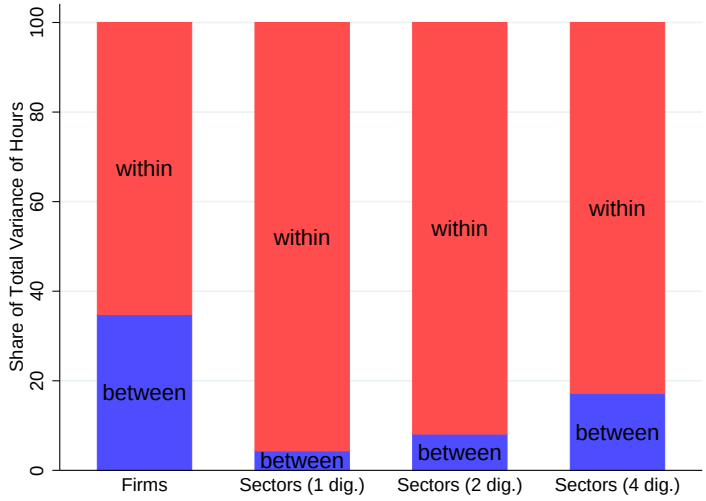
Figures and Tables

Figure 1: The distribution of hours across sectors in Denmark



Notes: The figure shows histograms of weekly total (regular and overtime) hours worked in the six major sectors in Denmark over the years 2003-2011. Weekly hours are obtained dividing annualized hours by 52. Observations are grouped in bins of 2 hours. Figures are based on a total of 875,078 individual-year observations that include fulltime and part-time workers in firms where hours are available on least 95% of the workforce. From the top left to the bottom right we have the following sectors: Agriculture, forestry, fishing, mining and quarrying; Manufacturing; Construction; Utilities, trade and transport; Financial, insurance, real estate and other businesses; Other services.

Figure 2: Variance of hours decomposition: between and within component



Notes: The figure shows the decomposition of the variance of hours worked in between and within components (footnote 6). We consider total annualized hours (including overtime) of fulltime workers. The figure is based on the 787,683 individual-year observations in our final sample (Table D.3). The first bar shows the decomposition in between and within firm components. The second, third and fourth bar show respectively the within-between decomposition for 1, 2 and 4-digit sector. Industries are defined using the classification NACE rev. 2.

Figure 3: Wage rates and hours worked

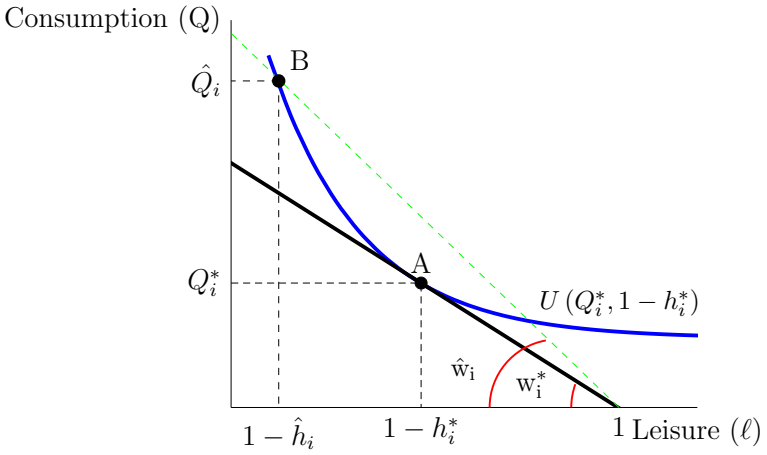
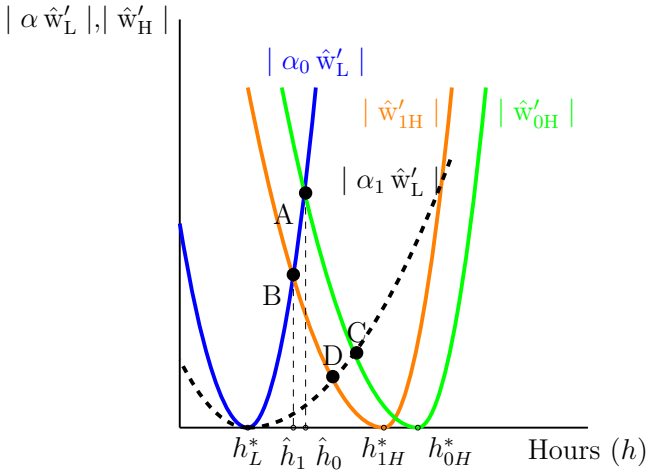
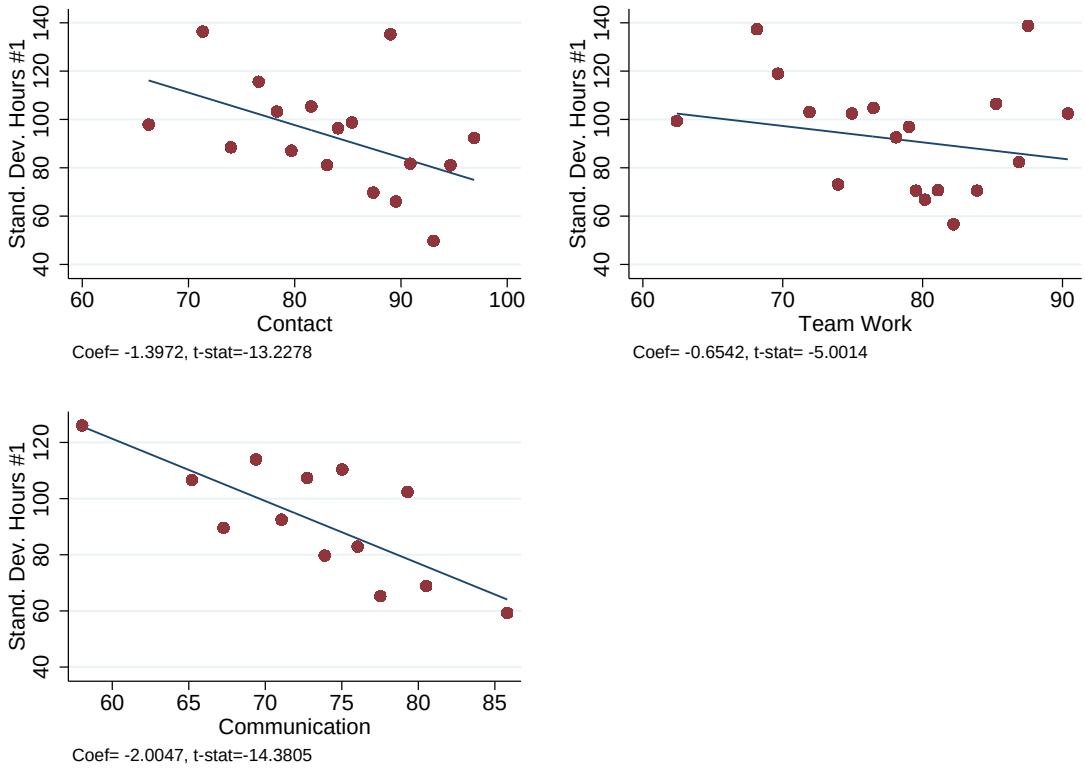


Figure 4: The effects of a tax rate change on wages



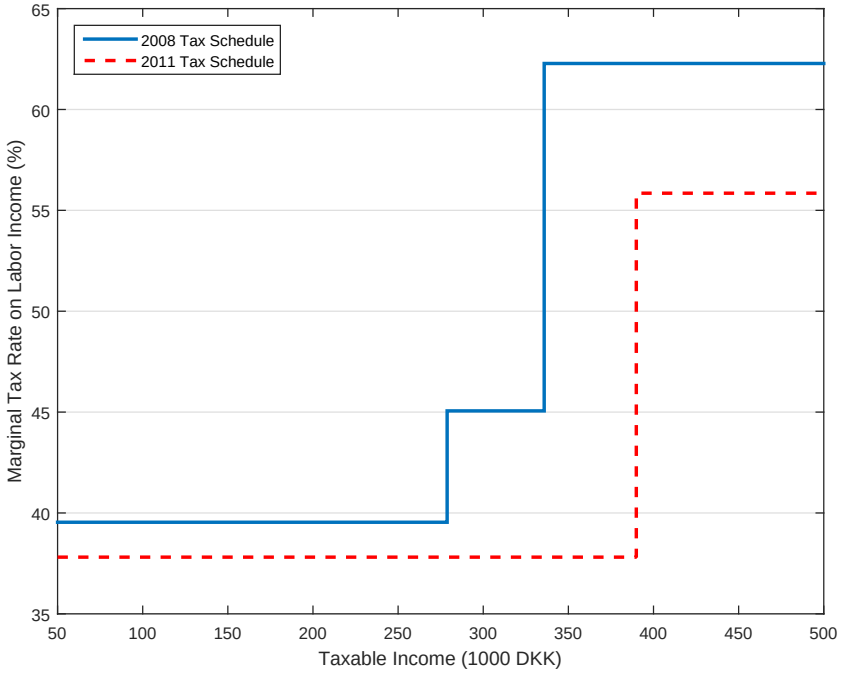
Notes: The figure shows on the y-axis the absolute value of the first derivative of the wage hours function in coordinated firms for high-skilled ($\hat{w}'_H$) and low-skilled workers ($\hat{w}'_L$). $\alpha = \hat{n}_L \div \hat{n}_H$ is the ratio between the number of low and high-skilled workers 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 point A to B represent the change in optimal hours and wage rates in coordinated firms when the tax rate goes down and the income effect prevails so that desired hours of high-skilled move down from h^*_{0H} to h^*_{1H}. The shift from C to D represents the change in wages and hours in coordinated firms obtained from the same change in desired hours of high-skilled from h^*_{0H} to h^*_{1H} assuming a lower α ($\alpha_1 < \alpha_0$).

Figure 5: Validation: Standard Deviation of Hours vs Coordination in O*NET



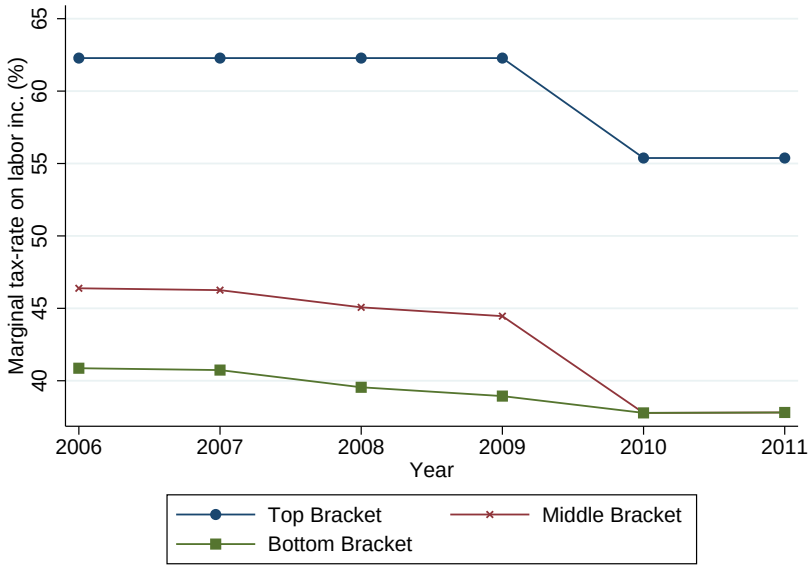
Notes: The figure shows on the y-axis the standard deviation of hours across skill groups within firms (Section 4.3) and on the x-axis 3 measures of firm-level coordination based on O*Net: Contact, Team Work and Communication. These variables are measured on a scale of importance from 0 to 100. For each 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 each one containing the same number of firms. We plot mean values within each bin. At the bottom of each graph we show 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 6: The Danish Tax Schedule



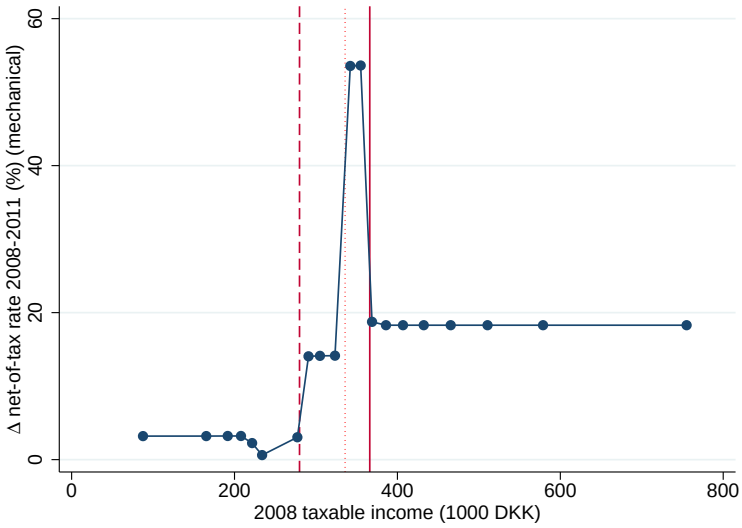
Notes: The figure plots the marginal tax rate on labor income over taxable income in 1000 DKK (5 DKK $\simeq$ 1 USD). Taxable income is in nominal terms. The solid line plots the tax schedule prior to the tax reform (2008). The dashed line plots the tax schedule after the tax reform (2011). The figure is based on Table D.22. Marginal tax rates on labor income in the bottom and middle bracket are obtained as: 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: 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.22. Marginal tax rates on labor income in the bottom and middle bracket are obtained as: 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 8: 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 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 within beans median values. The dashed line delimits the bottom tax bracket in 2008 (279,800 DKK). The dotted line is the low boundary of the top tax bracket in 2008 (335,800 DKK, see Table D.22). The solid line is the low boundary of the top tax bracket in 2011 expressed in 2008 DKK (nominal 389,900 DKK discounted by 1.06 CPI, see Table D.22).

Figure 9: Average (mechanical) marginal net-of-tax rate change across groups

Notes: This figure plots the share of workers in each skill group and the average mechanical change in marginal net-of-tax rates on labor income between 2008 and 2011 in each group. Mechanical marginal tax rates in 2011 are based on 2008 income adjusted by inflation. Low-skilled are defined as tax exempt or in the bottom tax bracket in 2008. Workers in the residual group were in the top tax bracket in 2008 and,based on their 2008 income adjusted by inflation, are predicted to be in the bottom tax bracket in 2011. High-skilled are all workers who are neither in the residual group nor low-skilled.

Table 1: Coordination and Firm Characteristics

	Stand. Dev. Of Total Hours (deciles of skills distr.)		**Obs.**
	(1)	(2)	
V.A. /employee	-0.038***	-0.013**	17807
	(0.008)	(0.006)	
TFP	-0.133***	-0.080***	16212
	(0.008)	(0.012)	
Firm size	-0.032***	-0.095***	17807
	(0.007)	(0.021)	
Share of tertiary educ.	-0.178***	-0.080***	17807
	(0.007)	(0.013)	
Number of plants	-0.032***	-0.085***	17807
	(0.007)	(0.017)	
Exporter status	-0.141***	-0.005	17807
	(0.007)	(0.009)	
Fraction of hourly work.	0.337***	0.257***	17807
	(0.007)	(0.016)	
Fraction of Unionized work.	0.084***	0.017	17807
	(0.008)	(0.012)	
Fraction of Part-Time work	0.225***	0.120***	17807
	(0.008)	(0.014)	
Mean Managerial Ability	-0.069***	-0.019*	16420
	(0.008)	(0.012)	
Negotiation	-0.310***	-0.146***	13441
	(0.009)	(0.016)	
Persuasion	-0.313***	-0.153***	13441
	(0.009)	(0.016)	
Social Perceptiveness	-0.289***	-0.116***	13441
	(0.009)	(0.015)	
Adjust Actions to others	-0.160***	-0.077***	13441
	(0.009)	(0.013)	
Av. Wage Mangers/Av. Wage Production workers	-0.068***	-0.012	13706
	(0.008)	(0.013)	
Production workerers: 90th/10th wage ratio	0.122***	0.081***	15772
	(0.008)	(0.013)	
Middle managers: 90th/10th wage ratio	-0.044***	-0.012	13632
	(0.008)	(0.008)	
Top managers: 90th/10th wage ratio	-0.078***	-0.035***	12541
	(0.008)	(0.009)	
5 digits industry f.e.	NO	YES	

*Notes: The table shows standardized coefficients from a regression of the standard deviation of hours across skill groups (Section 4.3) on each firm characteristic and a constant. Each cell in the table corresponds to a different regression. In column 2 we add 5-digit industry fixed effects to the baseline classification. We use the Danish industry classification DB07 that for the first 4-digit corresponds to NACE rev.2. Regressions are based on firm-year observations from the firms in our final sample (Table D.3) over the years 2003-2011. (Cap/empl) stands for physical capital over number of full-time equivalent employees. TFP (Total Factor Productivity) is obtained following Ackerberg et al. (2015) (on-line appendix B.4). Managerial ability is measured as the average individual fixed effect (α_i) from an AKM model among the workers in the top quartile of the distribution of α_i in each firm. To avoid confusion we label the O*NET descriptor "Coordination" as "Adjust Actions to Others". Standard errors in parentheses are clustered at the firm level. * p<0.10, ** p<0.05, *** p<0.01.*

Table 2: Coordination and wage premiums

	(1) Firm f.e.	(2) Firm f.e.	(3) Firm f.e.	(4) Firm f.e.	(5) Firm f.e.	(6) Firm f.e.
Stand. Dev.	-0.075***	-0.053***	-0.066***	-0.090***		-0.041**
	(0.016)	(0.016)	(0.018)	(0.018)		(0.015)
Stand. Dev. Normal Hours					-0.070***	
					(0.016)	
Firm size		0.014*	0.010	0.033***	0.010	0.011
		(0.007)	(0.007)	(0.010)	(0.007)	(0.007)
Exporter status		0.061***	0.059***	0.054**	0.059***	0.049***
		(0.015)	(0.016)	(0.021)	(0.016)	(0.013)
Union. Rate		-0.002	0.031	0.035	0.030	0.062**
		(0.027)	(0.024)	(0.031)	(0.024)	(0.027)
Female Share		-0.055	-0.109**	-0.126***	-0.106**	-0.086***
		(0.045)	(0.043)	(0.041)	(0.043)	(0.022)
Average Hours		0.004	0.004	0.015	0.004	-0.041
		(0.025)	(0.026)	(0.024)	(0.025)	(0.028)
log(Cap/empl)		0.039***	0.024*	0.049***	0.024*	0.032***
		(0.012)	(0.013)	(0.014)	(0.013)	(0.012)
Negotiation						0.348***
						(0.105)
Persuasion						-0.259***
						(0.093)
Social Perceptiveness						0.008
						(0.036)
Adjust Actions to others						0.017
						(0.017)
Region F.E.	NO	YES	YES	YES	YES	YES
Compos. cntr	NO	NO	YES	YES	YES	YES
Ability Measures	NO	NO	YES	YES	YES	YES
Av. Hours b/w 36.5 and 37.5	YES	YES	YES	NO	YES	YES
Part. R-sq SD Hours	0.008	0.003	0.006	0.008	0.007	0.002
Part. R-sq VA and TFP	0.022	0.010	0.032	0.038	0.032	0.020
Coordination Share	0.349	0.321	0.200	0.196	0.233	0.097
R-sq	0.008	0.033	0.106	0.126	0.108	0.135
N	7312	7312	7312	4415	7299	6089

*Notes: In this table we show the results of estimating equation (7). The dependent variable is the firm fixed effect from the AKM model (8). "Stand. Dev." 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). The "Stand. Dev. Normal hours" is the standard deviation of the average regular hours worked across skill groups within a firm. Skill groups are defined as deciles of the distribution of $\alpha_i + \beta X_{ijt}$ from the AKM model (8). All regressions show standardized coefficients. The exporter dummy is defined as the modal exporter status between 2003 and 2011. (Cap/empl) stands for physical capital over number of full-time equivalent employees. "Compos. cntr" refers to a vector of controls for the share of workers in each skill group. "Ability Measures" indicate a vector containing the average value of the individual fixed effects α_i in each quartile of the distribution of α_i within a firm. The dependent variable (firm f.e.) in column (5) is based on wage rates from regular hours only. To avoid confusion we label the O*NET descriptor "Coordination" as "Adjust Actions to Others". 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.19. Standard errors are clustered at the 2-digit industry level. *, ** and *** are 10, 5 and 1 percent significance levels.*

Table 3: Coordination and wage differentials within sectors

	(1) Firm f.e.	(2) Firm f.e.	(3) Firm f.e.	(4) Firm f.e.	(5) Firm f.e.	(6) Firm f.e.	(7) Firm f.e.	(8) Firm f.e.
Stand. Dev.	-0.060***	-0.031*	-0.028*				-0.064***	-0.018
	(0.018)	(0.016)	(0.016)				(0.019)	(0.017)
Median Abs. Dev.				-0.075***	-0.045***	-0.040**		
				(0.014)	(0.014)	(0.015)		
Firm size	0.009	0.006	0.017*	0.010	0.006	0.018*	0.011	0.010*
	(0.006)	(0.005)	(0.009)	(0.007)	(0.005)	(0.009)	(0.008)	(0.005)
Exporter status	0.065***	0.030**	0.021	0.062***	0.029**	0.020	0.063***	0.032**
	(0.018)	(0.013)	(0.013)	(0.018)	(0.013)	(0.013)	(0.015)	(0.014)
Union. Rate	0.040	0.039	0.039	0.042	0.040	0.040	0.032	0.051**
	(0.025)	(0.029)	(0.030)	(0.025)	(0.029)	(0.030)	(0.024)	(0.022)
Female Share	-0.140***	-0.069**	-0.057*	-0.140***	-0.069**	-0.057*	-0.113***	-0.120***
	(0.040)	(0.027)	(0.029)	(0.038)	(0.026)	(0.028)	(0.042)	(0.034)
Average Hours	-0.006	-0.033	-0.039*	-0.018	-0.038*	-0.043**	0.001	-0.034
	(0.022)	(0.023)	(0.023)	(0.021)	(0.021)	(0.021)	(0.026)	(0.022)
log(Cap/empl)	0.028**	0.031***	0.035***	0.028**	0.030***	0.035***	0.022*	-0.089***
	(0.013)	(0.010)	(0.010)	(0.013)	(0.010)	(0.010)	(0.013)	(0.023)
log(VA/empl)								0.381***
								(0.070)
1 digit Sector f.e.	YES	NO	NO	YES	NO	NO	NO	NO
2 digits Sector f.e.	NO	YES	NO	NO	YES	NO	YES	YES
3 digits Sector f.e.	NO	NO	YES	NO	NO	YES	YES	YES
Part. R-sq SD Hours	0.004	0.001	0.001	0.006	0.002	0.001	0.009	
Part. R-sq VA and TFP	0.033	0.016	0.014	0.033	0.016	0.014		
Coordination Share	0.113	0.049	0.042	0.181	0.113	0.095		
R-sq	0.113	0.155	0.162	0.115	0.156	0.162	0.112	0.104
N	7306	7306	7306	7306	7306	7306	7060	7060

*Notes: In this table we show the results of estimating equation (7). The dependent variable is the firm fixed effect from the AKM model (8). "Stand. Dev." 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). The "Median Abs. Dev." is the the median absolute deviation of median hours across skill groups within a firm. Skill groups are defined as deciles of the distribution of $\alpha_i + \beta X_{ijt}$ from the AKM model (8). All regressions show standardized coefficients. The exporter dummy is defined as the modal exporter status between 2003 and 2011. (Cap/empl) stands for physical capital over number of full-time equivalent employees. "Compos. cntr" refers to a vector of controls for the share of workers in each skill group. "Ability Measures" indicate a vector containing the average value of the individual fixed effects α_i in each quartile of the distribution of α_i within a firm. In column (8) TFP is used as an instrument for valued added per employee (log(V.A./empl)). TFP is obtained as in Ackerberg et al. (2015) (on-line appendix B.4). 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.20. Standard errors are clustered at the 2-digit industry level. *, ** and *** are 10, 5 and 1 percent significance levels.*

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

	(1)	(2)	(3)	(4) High Coord.	(5) Low Coord.	(6) High Coord. Top 25%	(7) Low Coord. Bottom 25%
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
Region F.E.	YES	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
Pvalue $High = Low$				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-skilled hours to the net-of-tax rate (1-τ^H). In columns 4 to 7 we distinguish between high and low-coordination firms. In column 4 and 5 high-coordination firms are in the bottom half of the distribution of the standard deviation of hours across skill groups in 2008, and conversely low-coordination firms are in the top half. In columns 6 and 7 we only consider respectively firms in the bottom 25% and top 25% of the distribution of the standard deviation of hours across skill groups in 2008. Specifications in columns 2 to 7 use mechanical changes of the net-of-tax rate on labor income as an instrument for observed changes of 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: work experience, work experience squared, sex, age, number of children, marital status, education, local unemployment (municipality), region fixed effects, firm size, exporter status, share of high and low-skilled workers in the firm (the residual group is omitted). "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. We only consider high-skilled workers who are at the same firm between 2008 and 2011, and in firms that employ at least 1 low-skilled worker. We estimate this regression on 3 years changes 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-skilled hours: additional specifications

	(1) High Coord.	(2) Low Coord.	(3) High Coord.	(4) Low Coord.	(5) High Coord.	(6) Low Coord.	(7) High Coord.	(8) Low Coord.	(9) High Coord.	(10) Low Coord.
Dependent Variable	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$	$\Delta log\, h^H$
$\Delta log\,(1-\tau^H)$	-0.027	-0.075***	-0.010	-0.099**	0.045	-0.121**	-0.041	-0.125**	0.006	-0.073**
	(0.017)	(0.026)	(0.016)	(0.039)	(0.043)	(0.059)	(0.032)	(0.052)	(0.027)	(0.036)
$\Delta log\,(1-\tau^H)\times$ Size			-0.000	0.000						
			(0.000)	(0.000)						
$\Delta log\,(1-\tau^H)\times$ Export					-0.073	0.041				
					(0.048)	(0.083)				
$\Delta log\,(1-\tau^H)\times$ High Union Share							0.038	0.044		
							(0.040)	(0.072)		
$\Delta log\,(1-\tau^H)\times$ High TFP									-0.040	-0.052
									(0.038)	(0.072)
Firm F.E.	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO
Base-year F.E.	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO
N Firms	785	675	584	583	584	583	584	583	584	583
N	26497	10267	18875	7613	18875	7613	18875	7613	18875	7613

*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-skilled total hours (regular and overtime) to the net-of-tax rate (1-τ^H) reported in the first row. We distinguish between high and low-coordination firms based on whether the firm in respectively in the bottom or top half of the distribution of the standard deviation of hours across skill groups in 2008. The dummy variables "High Union Share" (columns 9 and 10) and "High TFP" (columns 7 and 8) take value 1 if the firm had respectively a share of unionized workers and TFP above the median in 2008. "Size" (columns 3 and 4) and "Export Status" (columns 5 and 6) are measured in 2008. All specifications use mechanical changes of the net-of-tax rate on labor income as an instrument for observed changes of 1-τ^H (Section 5.5). First Stage Regressions are in Table D.32 and D.33. 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, high unionization rate dummy, high TFP dummy, share of high and low-skilled workers in the firm (the residual group is omitted). We only consider high-skilled workers who are at the same firm between 2008 and 2011, and in firms that employ at least 1 low-skilled worker. In columns 1 and 2 we consider 3 years changes over the period 2006-2011. In columns 3 to 10 we consider 3 years changes 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 6: The spillover effects on hours worked by low-skilled

	(1)	(2)	(3)	(4)	(5) Low Coord.	(6)	(7) Low Coord.
Dependent Variable	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$	$\Delta log\, h^L$
$\Delta log\, \overline{h^H_{normal}}$	0.540***	0.899***	0.878***	0.894**	0.624**		
	(0.112)	(0.304)	(0.301)	(0.373)	(0.297)		
$\Delta log\, \overline{h^H_{total}}$						1.375**	0.706**
						(0.612)	(0.345)
$\Delta log\,(1-\tau^L)$	-0.005	0.023	0.051	0.053	-0.060	0.056	-0.053
	(0.009)	(0.088)	(0.114)	(0.126)	(0.115)	(0.138)	(0.115)
IV	NO	YES	YES	YES	YES	YES	YES
Region F.E.	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
Log Mean Inc. High Sk.	NO	NO	NO	YES	NO	NO	NO
Overtime Hours	NO	NO	NO	NO	NO	YES	YES
F-stat Excl. Inst.		13.09, 160.40	15.45,76.76	4.66, 55.84	11.90, 48.55	4.43, 76.72	8.39, 50.92
P-value Excl. Inst.		0.00, 0.00	0.00, 0.00	0.03,0.00	0.00, 0.00	0.04, 0.00	0.00, 0.00
Mean Hours Low Sk.	1812.51	1812.51	1812.51	1812.51	1742.05	1828.87	1760.74
Mean Hours High Sk.	1875.00	1875.00	1875.00	1875.00	1846.56	1905.60	1879.90
N Firms	968	968	968	968	484	968	484
N	10091	10091	10091	10091	4100	10091	4100

Notes: This table reports the results from estimating equation (11). It shows the elasticity of low-skilled hours to the average hours worked by high-skilled coworkers. We consider both regular (normal) hours (columns 1 to 5) and total (regular and overtime) hours (columns 6 and 7). Specifications in columns 2 to 7 use mechanical changes of the average net-of-tax rate among high-skilled in a firm as an instrument for the average change in hours, and the mechanical change of the net-of-tax rate of low-skilled as an instrument for observed changes of 1-τ^L (Section 5.5). First Stage results are in Table D.34. Low-coordination firms (columns 5 and 7) are defined as being in the top half of the distribution of the standard deviation of hours across skill groups in 2008. 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, share of high and low-skilled workers in the firm (the residual group is omitted). "Splines" refer to a flexible piecewise linear functional form with 5 components. We only consider low-skilled workers who are at the same firm between 2008 and 2011. We estimate this regression on 3 years changes 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.*